

# **Final Statement of Reasons for Rulemaking Including Summary of Comments and Agency Responses**

**Public Hearing to Consider the Proposed Heavy-Duty Engine and Vehicle  
Omnibus Regulation and Associated Amendments:**

**Amendments to the Exhaust Emissions Standards and Test Procedures  
for 2024 and Subsequent Model Year Heavy-Duty Engines and Vehicles,  
Heavy-Duty On-Board Diagnostic System Requirements,  
Heavy-Duty In-Use Testing Program,  
Emissions Warranty Period and Useful Life Requirements,  
Emissions Warranty Information and Reporting Requirements, and  
Corrective Action Procedures,  
In-Use Emissions Data Reporting Requirements, and  
Phase 2 Heavy-Duty Greenhouse Gas Regulations,  
and Powertrain Test Procedures**



Public Hearing Date: August 27, 2020  
Agenda Item No.: 20-8-2

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## List of Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
%	Percent
°C	Degrees Celsius
°F	Degrees Fahrenheit
2016 State SIP Strategy	Revised Proposed 2016 State Strategy for the State Implementation Plan or 2016 State Strategy for the State Implementation Plan
15-Day Notice Amendments	Second Notice of Public Availability of Modified Text and Availability of Additional Documents
30-Day Notice Amendments	Notice of Public Availability of Modified Text and Availability of Additional Documents
1B-MAW or B-MAW	Single Bin 300 Second Moving Average Window
3B-MAW	Three-Bin Moving Average Window
AAPC	American Automotive Policy Council
ABT	Averaging, Banking, and Trading
ACEEE	American Council for an Energy Efficient Economy
ACT	Advanced Clean Trucks
AECD	Auxiliary Emission Control Device
AESI	Advanced Engine Systems Institute
AESS	Automatic Engine Shutdown System
AFS	Agility Fuel Solutions
ALA	American Lung Association
Allison	Allison Transmission, Inc.
Amendments or Proposed Amendments	Associated Amendments of the Heavy-Duty Engine and Vehicle Omnibus Regulation
AQMD	Air Quality Management District
ASTM	American Society for Testing and Materials
ATA	American Trucking Associations
AUL	Applicable Useful Life
BAAQMD	Bay Area Air Quality Management District
BAE	BAE Systems
bhp	Brake Horsepower
BREATHELA	BREATHE California of Los Angeles County
CAA	Clean Air Act
CA-ABT	California-Averaging, Banking, and Trading
CAEJ	Center for Community Action and Environmental Justice
California Transit	California Transit Association
CARB or Board	California Air Resources Board
CCA	Coalition for Clean Air

<b>Acronym/ Abbreviation</b>	<b>Definition</b>
CCR	California Code of Regulations
CDA	Cylinder Deactivation
CEERT	Center for Energy Efficiency and Renewable Technologies
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CNG	Compressed Natural Gas
CNGVC	California Natural Gas Vehicle Coalition
CO	Carbon Monoxide
CO2	Carbon Dioxide
C-R	Concentration-Response
CTA	California Trucking Association
CTI	Cleaner Trucks Initiative
CTTA	California Tow Truck Association
Cummins	Cummins Inc.
DAAAC	Diesel Aftertreatment Accelerated Aging Cycle
DEF	Diesel Exhaust Fluid
DeSOx	Desulfation
DF	Deterioration factor
Diesel Test Procedures	California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles
DMV	Department of Motor Vehicles
DOC	Diesel Oxidation Catalyst
DOF	Department of Finance
DPF	Diesel Particulate Filter
DTNA	Daimler Trucks North America
EA	Environmental Analysis
ECF	Transient Cycle Conversion Factor
ECM	Engine Control Module
ECU	Engine Control Unit
EDF	Environmental Defense Fund
EGR	Exhaust Gas Recirculation
EIR	Environmental Impact Report
EMA	Truck and Engine Manufacturers Association
EMFAC	Emission FACTors Inventory Model
ERC	Emissions Related Component
EU	European Union
EWIR	Emissions Warranty Information and Reporting
FCL	Family Certification Level
FEL	Family Emission Limit

<b>Acronym/ Abbreviation</b>	<b>Definition</b>
FIR	Field Information Report
Ford	Ford Motor Company
FSOR	Final Statement of Reasons
FTP	Federal Test Procedure
FUL	Full Useful Life
g/bhp-hr	Grams Per Brake Horsepower-Hour
g/hr	Grams Per Hour
g/kW-hr	Grams Per Kilowatt-Hour
GCVW	Gross Combined Vehicle Weight
GEM	Greenhouse Gas Emissions Model
GHG	Greenhouse Gas
GVWR	Gross Vehicle Weight Rating
H&SC	Health and Safety Code
HC	Hydrocarbons
HD	Heavy-Duty
HD I/M	Heavy-Duty Vehicle Inspection and Maintenance
HDDE	Heavy-Duty Diesel Engine
HDIUC	Heavy-Duty In-Use Compliance
HDIUT	Heavy-Duty In-Use Testing
HDO	Heavy-Duty Otto-Cycle
HDOH	Heavy-Duty On-Highway
HD-ZEP	Heavy-Duty Zero-Emission Powertrain
HHD	Heavy Heavy-Duty
HHDD	Heavy Heavy-Duty Diesel
hp	Horsepower
HPD	High Power Density
HVIP	Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project
Hz	Hertz
ICCT	International Council on Clean Transportation
ICT	Innovative Clean Transit
IHC	International Hydrail Conferences
IPT	Incidence-Per-Ton
IRAF	Infrequent Regeneration Adjustment Factors
ISOR or Staff Report	The Staff Report: Initial Statement of Reasons for Rulemaking
ITR	Innovative Technology Regulation
IUL	Intermediate Useful Life
IUT	In-Use Testing
JVS	Jacobs Vehicle Systems
kW	Kilowatt

<b>Acronym/ Abbreviation</b>	<b>Definition</b>
L	Liter
LACETBC	Los Angeles County Electric Truck and Bus Coalition
lb or lbs	Pound or Pounds
lb*ft	Pound Force Foot (torque)
LCFS	Low Carbon Fuel Standard
LCJA	Leadership Counsel for Justice and Accountability
LEV	Low-Emission Vehicle
LHD	Light Heavy-Duty
LHDD	Light Heavy-Duty Diesel
LLC	Low Load Cycle
LNC	Low NOx Coalition
LO	Light Off
MAW	Moving Average Window
MDE	Medium-Duty Engine
MECA	Manufacturers of Emission Controls Association
MEMA	Motor & Equipment Manufacturers Association
MHD	Medium Heavy-Duty
MHDD	Medium Heavy-Duty Diesel
MIL	Malfunction Indicator Light
MIT	MIT Plasma Science and Fusion Center
mph	Miles Per Hour
MST	Monterey-Salinas Transit
MY	Model Year
MYUL	Model Year Useful Life
N <sub>2</sub> O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
Navistar	Navistar, Inc.
NBB	National Biodiesel Board
NERA	National Economic Research Associates
NESCAUM	Northeast States for Coordinated Air Use Management
NG	Natural Gas
NH <sub>3</sub>	Ammonia
NH <sub>4</sub> NO <sub>3</sub>	Ammonium Nitrate
NHTSA	National Highway Traffic Safety Administration
NMHC	Non-Methane Hydrocarbons
NO	Nitrogen Monoxide
NO <sub>2</sub>	Nitrogen Dioxide
NO <sub>x</sub>	Oxides of Nitrogen
NPGA	National Propane Gas Association

<b>Acronym/ Abbreviation</b>	<b>Definition</b>
NPRM	Notice of Proposed Rulemaking
NRDC	Natural Resources Defense Council
NREL	National Renewable Energy Laboratory
NTE	Not-to-Exceed
NVH	Noise, Vibration, and Harshness
OBD	On-Board Diagnostic
OEM	Original Equipment Manufacturer
OLNS	Optional Low NOx Standards
Omnibus Regulation or Regulation	Heavy-Duty Engine and Vehicle Omnibus Regulation
ORVR	Onboard Refueling Vapor Recovery
Otto-Cycle Test Procedures	California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Otto-Cycle Engines and Vehicles
PEMS	Portable Emissions Measurement System
PM	Particulate Matter
PM2.5	Fine Particulate Matter
PNA	Passive NOx Adsorber
ppb	Parts Per Billion
ppm	Parts Per Million
QRF	Quantitative Risk Factors
R&D	Research and Development
RDE	Real Driving Emissions
REAL	Real Emissions Assessment Logging
REMI	Regional Economic Models, Inc.
RESS	Rechargeable Energy Storage System
RMC or RMC-SET	Ramped Modal Cycle Version of the Supplemental Emission Test
RMS	Root-Mean-Squared
RNG	Renewable Natural Gas
rpm	Revolutions Per Minute
R-R	Relative Risk
RRC	Resource Recovery Coalition
SAFE	Safer Affordable Fuel-Efficient
SCAB / SoCAB	South Coast Air Basin
SCAQMD	South Coast Air Quality Management District
SCR	Selective Catalytic Reduction
SCRF	Selective Catalytic Reduction Coated on Filter
SET	Supplemental Emission Test
SI	Spark-Ignited
SIP	State Implementation Plan

<b>Acronym/ Abbreviation</b>	<b>Definition</b>
SJVAPCD	San Joaquin Valley Air Pollution Control District
SoCalGas	Southern California Gas Company
SOS	Sum-Over-Sum
SRIA	Standardized Regulatory Impact Assessment
SRT	Sacramento Regional Transit
Std	Standard
SwRI	Southwest Research Institute
TCO	Total Cost of Ownership
TDAC	Truck Dealers Alliance of California
tpd	Tons Per Day
U.S.	United States
U.S. EPA or EPA	United States Environmental Protection Agency
UCS	Union of Concerned Scientists
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compounds
Volvo	Volvo Group North America
WSPA	Western States Petroleum Association
WVU	West Virginia University
YSTA	Yuba-Sutter Transit Authority
ZEB	Zero-Emission Bus
ZEP	Zero-Emission Powertrain
ZET	Zero-Emission Truck
ZEV	Zero-Emission Vehicle

# **Final Statement of Reasons for Rulemaking, Including Summary of Comments and Agency Response**

## **Public Hearing to Consider the Proposed Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments:**

Proposed Amendments to the Exhaust Emissions Standards and Test Procedures  
for 2024 and Subsequent Model Year Heavy-Duty Engines and Vehicles,  
Heavy-Duty On-Board Diagnostic System Requirements,  
Heavy-Duty In-Use Testing Program,  
Emissions Warranty Period and Useful Life Requirements,  
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Corrective Action Procedures,  
In-Use Emissions Data Reporting Requirements, and  
Phase 2 Heavy-Duty Greenhouse Gas Regulations,  
and Powertrain Test Procedures

Public Hearing Date: August 27, 2020  
Agenda Item No.: 20-8-2

### **I. General**

The Staff Report: Initial Statement of Reasons for Rulemaking (Staff Report or ISOR), entitled “Public Hearing to Consider the Proposed Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments: Proposed Amendments to the Exhaust Emissions Standards and Test Procedures for 2024 and Subsequent Model Year Heavy-Duty Engines and Vehicles, Heavy-Duty On-Board Diagnostic System Requirements, Heavy-Duty In-Use Testing Program, Emissions Warranty Period and Useful Life Requirements, Emissions Warranty Information and Reporting Requirements, and Corrective Action Procedures, In-Use Emissions Data Reporting Requirements, and Phase 2 Heavy-Duty Greenhouse Gas Regulations, and Powertrain Test Procedures,” released June 23, 2020, and subsequently updated and released with errata on July 10, 2020, is incorporated by reference herein. The Staff Report contains descriptions of the rationale for the Associated Amendments (Proposed Amendments or Amendments) for the Heavy-Duty (HD) Engine and Vehicle

Omnibus Regulation (Omnibus Regulation or Regulation), including Appendices A through I, which provide regulatory language and in-depth analyses in support of the rulemaking. On June 23, 2020, all references relied upon and identified in the Staff Report were made available to the public, and the Staff Report was released for a 60-day public comment period.

On August 27, 2020, the California Air Resources Board (CARB or Board) conducted a public hearing to consider the Proposed Amendments. The Board received 58 written comments during the 60-day comment period leading up to the hearing and 12 written comments during the hearing, and heard oral testimony from 56 stakeholders at the hearing. At the conclusion of the hearing, the Board approved Resolution 20-23 for adoption of the proposed regulation, and in accordance with Government Code section 11346.8, the Board directed the Executive Officer to adopt the proposed amendments after making any appropriate conforming modifications, as well as any additional supporting documents and information, available to the public for a period of at least 15 days. The Board further directed the Executive Officer to consider such written comments as may be submitted during this period, to make such modifications as may be appropriate in light of the comments received, and to present the regulations to the Board for further consideration if warranted.

In particular, the Board approved CARB staff's proposal to adopt more stringent low oxides of nitrogen (NOx) and particulate matter (PM) exhaust emission standards. These standards were demonstrated to be technically feasible by data generated from the Southwest Research Institute (SwRI) Low NOx Demonstration Program, as well as modeling, testing, and research by engine manufacturers, manufacturers of emission controls, component suppliers, and non-governmental organizations. The Board also approved the new Low Load Cycle (LLC).

Additionally, the Board approved CARB staff's proposal to adopt the California Heavy-Duty In-Use Compliance (HDIUC) Program and amend the manufacturer-run Heavy-Duty In-Use Testing (HDIUT) Program. The Amendments revise procedures to better represent HD vehicle operations in real-world conditions, establish clearer criteria for engine family pass/fail determination, and require on-board diagnostic (OBD) data during testing to verify the condition of the test vehicle and sensors.

The Board also approved CARB staff's proposal to extend the criteria pollutant emissions warranty and useful life period requirements for HD vehicles and engines, as well as to amend the scheduled maintenance interval provisions. The lengthened warranty requirements would help minimize the occurrences of tampering and help ensure emission controls are well-maintained and repaired when needed. The lengthened useful life period requirements would help provide for more durable emission control systems that comply with applicable emission standards throughout a greater portion of HD engine and vehicle service lives, resulting in greater overall emission reductions than from the standards alone. The amended scheduled maintenance interval provisions would ensure the effectiveness of the lengthened emissions defects warranty for the intended periods so that their associated emission reductions would be achieved.

The Board approved CARB staff's proposal to lengthen the durability requirements and establish a new standardized methodology for demonstrating durability of HD diesel engines. These Amendments would ensure that future engine and aftertreatment system designs are capable of meeting emission standards over their useful life periods, and that the durability program can more accurately predict the actual emissions of engines and vehicles. Annual reporting of in-use emission data from a segment of the on-road HD vehicles originally sold in California would also be required to verify the performance of future engine and aftertreatment systems if a manufacturer chooses an optional durability demonstration procedure that allows for emissions aftertreatment accelerated aging.

The Board approved amendments to the existing averaging, banking, and trading (ABT) program to avoid potential credit accounting discrepancies between California and federal ABT programs resulting from the differences in proposed emission standards, certification test procedures, and useful life periods. These amendments would also provide flexibility to the engine manufacturers in producing on road HD engines for the California market. The Board also approved an allowance for HD zero-emission vehicles (ZEV) to generate NOx credits in order to incentivize the development, production, and sales of HD ZEVs in the California market from the 2022 model year (MY) until the 2026 MY.

Furthermore, the Board approved amendments to the powertrain certification test procedures for HD hybrid vehicles to provide manufacturers a voluntary option to certify hybrid powertrains to criteria pollutant emission standards. These amendments would align with federal procedures for powertrain testing. They would be based on the United States Environmental Protection Agency (U.S. EPA) Phase 2 Greenhouse Gas (GHG) technical amendments for powertrain testing.

The Board approved amendments to the existing Emissions Warranty Information and Reporting (EWIR) and Corrective Action Procedures to improve the effectiveness of the existing program. This would help identify and correct emission control component problems more expeditiously to prevent or reduce the excess emissions associated with such defective components. The Amendments would also require additional information for warranty reporting and tools to verify the accuracy of those warranty reports. They would base the need for corrective action solely on warranty failure rates and prevent the use of components that are known to have failure rates that exceed corrective action thresholds in future MYs.

The Board also approved some minor clarifications and corrections related to the Phase 2 GHG standards, diesel auxiliary power unit requirements, OBD system requirements, and medium-duty engine (MDE) and medium-duty vehicle requirements. These amendments are needed to better align with federal requirements, to clarify existing requirements, to conform with proposed emission standards, and to correct inadvertent ambiguities.

In addition to the minor clarifications and corrections needed for the California Phase 2 GHG Regulation, the Board approved updates to the environmental performance label specifications to clarify and improve the implementation of the original label specification requirements. The Board also approved modifications to certain trailer requirements of the California Phase 2 GHG Regulation, including providing compliance flexibility to exempt

specific trailer configurations if it is determined that technology is not available for trailers subject to the Phase 2 requirements.

The text of the proposed modifications to the originally proposed Regulation, certification and test procedures, and other supporting documents were made available for a 30-day public comment period through a “Notice of Public Availability of Modified Text and Availability of Additional Documents,” (30-Day Notice Amendments).<sup>1</sup> The 30-Day Notice Amendments, modified regulatory language, and additional supporting documents were posted on May 5, 2021, on CARB’s website, accessible to stakeholders and interested parties.<sup>2</sup> The comment period commenced on May 5, 2021 and ended on June 4, 2021, with a total of 20 comment letters received during this time. All modifications to the regulatory language are clearly indicated in the Notice of Public Availability of Modified Text.

A second notice for additional proposed modifications was made available for a 15-day public comment period through a “Second Notice of Public Availability of Modified Text and Availability of Additional Documents,” (15-Day Notice Amendments).<sup>3</sup> The 15-Day Notice Amendments, modified regulatory language, and additional supporting documents were posted on June 18, 2021, on CARB’s website, accessible to stakeholders and interested parties.<sup>4</sup> The comment period commenced on June 18, 2021 and ended on July 6, 2021, with a total of 12 comment letters received during this time. All modifications to the regulatory language are clearly indicated in the Second Notice of Public Availability of Modified Text.

On the same date that the 30-Day and 15-Day Notice Amendments and all attachments were posted on CARB’s website, the posted documents were also electronically distributed to other parties identified, per section 44(a), title 1, California Code of Regulations (CCR), in accordance with Government Code section 11340.85, including all persons having testified at the August 27, 2020, public hearing, all persons having submitted comments at the public hearing, all persons who submitted comments during the rulemaking comment period(s), and all organizations and individuals subscribed to the following CARB electronic distribution listings: Advanced Clean Trucks – “actruck,” Innovative Clean Transit – “bus-act,” CA Phase 2 GHG for New Heavy-Duty Engines and Vehicles – “caphase2ghg,” On-Road Certification Program – “cert,” Heavy-Duty Low NOx – “hdlownox,” Heavy-Duty Hybrid Electric Vehicle Certification Procedures – “hybridtruck,” Mobile Source Program Mailouts and Manufacturers Advisory Correspondence (MACs) – “ms-mailings,” On-Board Diagnostics Program – “obdprog,” Optional Reduced NOx Emission Standards for Heavy-Duty Engines – “optionnox,” Phase 1 GHG Standards for New Heavy-Duty Engines and Vehicles – “phase1ghg,” School Bus Idling ATCM – “sbidling,” School Buses –

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<sup>1</sup> California Air Resources Board. Notice of Public Availability of Modified Text and Availability of Additional Documents. Posted on May 5, 2021. Available online at:

<https://ww3.arb.ca.gov/regact/2020/hdomnibuslownox/30daynotice.pdf>

<sup>2</sup> <https://ww2.arb.ca.gov/rulemaking/2020/hdomnibuslownox>

<sup>3</sup> California Air Resources Board. Second Notice of Public Availability of Modified Text and Availability of Additional Documents. Posted on June 18, 2021. Available online at:

<https://ww3.arb.ca.gov/board/15day/hdomnibuslownox/2nd15daynotice.pdf>

<sup>4</sup> CARB Heavy-Duty Omnibus Regulation: <https://ww2.arb.ca.gov/rulemaking/2020/hdomnibuslownox>

“school\_buses,” State Implementation Plan – “sip,” Sustainable Freight Transport Initiative – “sfti,” and Truck Idling Reduction – “truck-idling.”

This Final Statement of Reasons (FSOR) updates the Staff Report by identifying and providing the rationale for the modifications made to the originally proposed regulatory text, including non-substantive modifications, as well as changes directed by the Board at the August 27, 2020, hearing and text circulated for public comment during the 30-day and 15-day comment periods. The FSOR also contains a summary of the comments received by CARB on the Proposed Amendments during the formal rulemaking process and CARB’s responses to those comments.

## **A. Mandates and Fiscal Impacts to Local Governments and School Districts**

The Board has determined that this regulatory action will result in a mandate to local government agencies who purchase 2024 and subsequent MY HD vehicles greater than 14,000 pounds gross vehicle weight rating (GVWR). However, the Board finds that the costs associated with this mandate are not reimbursable pursuant to Part 7 (commencing with section 17500), division 4, title 2 of the Government Code, because this action neither compels local agencies to provide new governmental functions (i.e., it does not require such agencies to provide additional services to the public), nor imposes requirements that apply only on local agencies or school districts.<sup>5</sup> Instead, this regulatory action does not require local agencies to provide new governmental functions, and only imposes requirements that apply to all individuals and entities that elect to purchase the categories of the new medium- and HD vehicles and engines at issue in this action. This action also does not compel local agencies to increase the actual level or quality of services that they already provide the public.<sup>6</sup> For the foregoing reasons, any costs incurred by local agencies to comply with this regulatory action are not reimbursable.<sup>7</sup>

The additional costs and savings associated with this regulatory action will apply generally to all entities that purchase affected engines and vehicles, private businesses, individual owners, and state agencies, as well as local agencies.

Local government agencies would be expected to pay a higher purchase price for new HD vehicles with engines that comply with the Omnibus Regulation. However, they would also obtain the benefit of repair cost savings from the lengthened warranties as well as additional local tax revenue generated from sales taxes on new Omnibus Regulation complying vehicles. CARB estimates the local government HD vehicle population to be about 10.7 percent of the state total, per CARB’s Emission Factors Model (EMFAC)2017 and Department of Motor Vehicles (DMV) registration data, thus local government would bear about 10.7 percent of the net cost of the Proposed Amendments. Since the Board Hearing, CARB staff has conducted additional cost and benefits analysis to include the recently adopted Advanced Clean Trucks (ACT) Regulation and the 30-Day and 15-Day Notice Amendments. The estimated fiscal impact to local governments due to the Omnibus Regulation relative to baseline conditions in the current (2020/2021) fiscal year

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<sup>5</sup> County of Los Angeles v. State of California (1987) 43 Cal.3d 46, 56

<sup>6</sup> San Diego Unified School Dist. v. Commission on State Mandates (2004) 33 Cal.4th 859, 877.

<sup>7</sup> County of Los Angeles v. State of California, 43 Cal.3d. 46, 58.

is zero. In the 2021 to 2022 fiscal year, the Omnibus Regulation is expected to increase local tax revenue by \$6,000 and to have a net fiscal impact of \$5,600 in cost to local government. In the 2022 to 2023 fiscal year, the Omnibus Regulation is expected to increase local tax revenue by \$245,000 and to have a net fiscal impact of \$230,000 in cost to local government. In the 2023 to 2024 fiscal year, the Omnibus Regulation is expected to increase local tax revenue by \$321,000 and to have a net fiscal impact of \$300,000 in cost to local government. The lifetime compliance would cost local governments approximately \$256 million over the lifetime of the Regulation. Local governments would receive an additional approximately \$132 million in local tax revenue over the lifetime of the Regulation.

**B. Consideration of Alternatives**

Since the Board Hearing, CARB staff has conducted additional cost and benefits analyses to include the recently adopted ACT Regulation and the 30-Day and 15-Day Notice Amendments that are incorporated in this FSOR. A summary of the outcomes of the Proposed Amendments and the alternative scenarios including the updated cost and benefits analysis is provided in Table I.B.1. The alternative scenarios shown in Table I.B.1 are defined and discussed further below. The Proposed Amendments would provide significant emission reductions of 225,763 tons of NOx. They would result in monetized health benefits of \$23.4 billion, and cost \$2.39 billion over the time period from 2022 through 2050 at a cost-effectiveness of \$4.51 per pound of NOx.

**Table I.B.1. Proposed Amendments and Alternatives  
Comparison of Costs and Emission Benefits for 2022 through 2050**

<b>Scenario</b>	<b>Costs</b>	<b>NOx Emission Benefits (tons)</b>	<b>Cost-Effectiveness \$/lb NOx</b>
<b>Proposed Amendments</b>	\$2.39 billion	225,763	\$4.51
<b>Alternative 1</b>	\$2.60 billion	259,949	\$4.31
<b>Alternative 2</b>	\$535 million	267,824	\$1.00

Alternative 1 (Accelerated Timeline) would move the revised NOx standards for the federal test procedure (FTP), ramped modal cycle version of the supplemental emission test (RMC-SET), Clean Idle, PM standards, and new LLC, as well as initial implementation of new in-use procedures with the moving average window (MAW) two years earlier than the Proposed Amendments, from 2024 to 2022 MY engines. The amendments to the standards on the FTP, RMC-SET, and LLC and the in-use amendments in 2027 would also be accelerated to 2024. Similar to the Proposed Amendments, under Alternative 1, HD vehicle and bus purchasers would realize savings due to the proposed warranty, EWIR amendments, and transit exemption.

The total cost of Alternative 1 was assessed using the same modeled baseline conditions used for the Proposed Amendments. As indicated in Table I.B.1, the overall cost of Alternative 1 was estimated to be approximately \$2.60 billion over the 29 years of the analysis period (2022 through 2050). Thus, the cost of this alternative was estimated to be

\$207 million more than the Proposed Amendments, an 8.7 percent increase in cost for the period of analysis.

Although Alternative 1 would achieve greater NO<sub>x</sub> reductions sooner, the accelerated timeline of Alternative 1 may not provide manufacturers sufficient lead time to develop engines capable of complying with the newly established NO<sub>x</sub> standards, especially the 0.02 g NO<sub>x</sub>/bhp-hr standard applicable to 2027 model year engines. Without sufficient time for engine manufacturers to conduct research, development, and durability testing, products would likely not be able to meet the stringent criteria. Manufacturers have identified that five to six years of lead time would be required for full product development from proof of concept to production product. The Proposed Amendments would provide manufacturers with necessary lead time for engineering development for the changes required in 2024 and the more significant changes needed in 2027 (i.e., cylinder deactivation (CDA) and light-off selective catalytic reduction (SCR)). Because Alternative 1 does not likely provide the necessary lead time for engineering development and product feasibility, it was rejected.

Alternative 2 is a voluntary national program. Under Alternative 2, engine manufacturers would voluntarily certify to a national FTP and RMC-SET NO<sub>x</sub> standard that would be less stringent than the Proposed Amendments standard but that are more stringent than the current requirements. If the voluntary national program envisioned in Alternative 2 were successfully implemented, California would benefit from cleaner federally certified HD vehicles operating in California; over half the total HD vehicle miles traveled in California are accumulated by federally certified HD vehicles. Alternative 2 would not revise today's warranty and useful life periods or the EWIR program. Alternative 2 is modeled to have about 18.7 percent greater health benefits than the Proposed Amendments. However, because it is not clear whether all, or indeed any engine manufacturers would follow through with utilizing this Alternative, these modeled benefits are arguably speculative. For the purpose of analyzing Alternative 2, full participation and compliance was assumed.

The total costs of Alternative 2 were assessed using the same modeled baseline conditions used for the Proposed Amendments. The overall cost of Alternative 2 is approximately \$535 million over the 29 years of the analysis period, 2022 through 2050. Thus, the cost of this alternative was estimated to be \$1.85 billion less than the Proposed Amendments, which represents a 77.6 percent decrease in cost for the period of analysis.

From 2022 through 2050 calendar years, our modeling indicated Alternative 2 could achieve about nineteen percent greater emission benefits than the Proposed Amendments. It is important to note, however, that comparing the modeled benefits of Alternative 2 to those of the Proposed Amendments is misleading because of the doubts regarding enforceability and hence whether Alternative 2 would achieve any benefits at all. Although Alternative 2 could be more cost-effective than the Proposed Amendments and could achieve more benefits if it were fully implemented, it was rejected for several reasons. First, and most importantly, it is not clear how widely Alternative 2's proposal for a voluntary national standard would be adopted; nor is it clear how the proposal could be enforced by California. If CARB pursued a voluntary agreement with manufacturers in lieu of enforceable regulations and then some or all manufacturers chose not to honor the agreement, California could be left with no emission benefits. Furthermore, CARB staff believes there is an advantage to the Proposed

Amendments pushing manufacturers to deploy technically feasible, cost-effective technology with dramatically lower NOx emissions than today's HD engines as quickly as possible. The success of California's standards in 2024 and beyond will set a model for U.S. EPA to follow and make it more likely that federally certified vehicles of the future are lower emitting. Accordingly, Alternative 2 was rejected.

## **II. Modifications Made to the Original Proposal**

### **A. Modifications Approved at the Board Hearing and Provided for in the First 30-Day Comment Period**

Subsequent to the August 27, 2020, Board Hearing, modifications to the original proposal were made in order to address comments received during the 60-day public comment period. CARB staff released the 30-Day Notice Amendments that presented modifications to the regulatory and test procedures text pursuant to the Board's direction provided in Resolution 20-23. These modifications were explained in the "Notice of Public Availability of Modified Text" that was issued for a 30-Day public comment period that began on May 5, 2021, and ended on June 4, 2021. CARB staff made modifications to the previously Proposed Amendments in sections 1956.8, 1961.2, 1968.2, 1971.1, 1971.5, 2035, 2036, 2112, 2139.5, 2140, 2141, 2145, 2166.1, 2168, 2169, 2169.1, 2169.7, and 2169.8 of title 13, CCR, and section 95663 of title 17, CCR. CARB staff also made changes to the text of the modified regulatory language for the test procedures incorporated in the regulations by reference. Listed below are the most significant modifications. For further detail see Notice of Public Availability of Modified text and Availability of Additional Documents, posted on May 5, 2021, available online at:

<https://ww3.arb.ca.gov/regact/2020/hdomnibuslownox/30daynotice.pdf>

- Limited exemption for 2024 through 2026 MY HD engines rated at or above 525 horsepower maximum power;
- Revisions to the cycle-validation criteria for operation over the LLC for alternative-fueled engines;
- Additional options to the mileage and service accumulation procedures for durability demonstration;
- Modifications to the California averaging, banking, and trading (CA-ABT) program;
- Modifications to the HDIUT program;
- Modifications to the EWIR and scheduled maintenance requirements;
- Modifications to the OBD requirements for 2022 to 2023 MY gasoline-fueled HD engines;
- Modifications to correct the tractor sub-category in the GHG test procedures;
- Other definitions and clarifications of various elements in the Regulation, and
- Cost scenarios for optional elements in the Omnibus Regulation such as the optional 50-state-directed engine emission standards program, optional low NOx standards, and optional powertrain certification procedures in the ISOR for informational purposes.
- Modifications to remove the optional 50-state-directed engine emission standards, and

- A process to allow qualifying transit agencies to request compliance flexibility or assistance in complying with the Proposed Amendments.

## **B. Second 15-Day Notice Amendments**

CARB staff released additional modifications that were explained in the “Second Notice of Public Availability of Modified Text” that was issued for a 15-day public comment period that began on June 18, 2021, and ended on July 6, 2021. CARB staff made modifications to the previously Proposed Amendments in sections 1956.8, 2112, and to the text of the modified regulatory language for the test procedures incorporated in the regulations by reference. These modifications are intended to provide additional flexibilities for a set of engines for which market availability may be limited in early years. The flexibilities ensure continued availability, while providing mechanisms to avoid any air pollution impacts, primarily by channeling further compensatory investments towards ZEVs. For further detail see Second Notice of Public Availability of Modified Text and Availability of Additional Documents, posted on June 18, 2021, available online at:

<https://ww3.arb.ca.gov/board/15day/hdomnibuslownox/2nd15daynotice.pdf>

## **C. Non-Substantial Modifications**

Subsequent to the 30-day and 15-day public comment periods mentioned above, CARB staff identified the following additional non-substantive changes to the Regulation:

13 CCR Section 1956.8(a)(2)(C)3.b.iii.2: Added a period “.” at the end of the section to fix a typographical error.

13 CCR Section 1956.8(a)(2)(C)3.b.iii.3.B: Added the words “and approved” to improve readability.

13 CCR Section 1956.8(j)(24): A typographical error to a CFR reference in the definition for urban bus was corrected from “40 CFR 86.092-21” to “40 CFR 86.091-2”. The reference 40 CFR 86.092-21 is nonexistent, and staff’s intention was to reference 40 CFR 86.091-2.

“California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles” (Diesel Test Procedures) Section 11.B.5.3.5.2(c)(3)(ii): Added the words “and approved” to improve readability.

Diesel Test Procedures Section 11.B.5.3.4.2.d: The word “Exececutive” was replaced with “Executive” to correct a spelling error.

Diesel Test Procedures Section 11.B.7.1: The MY applicability of “2023” was replaced with “2021” for consistency with 13 CCR 1956.8(a)(2)(A) and the table of emissions standards in section 11.B.7.1.

Diesel Test Procedures Section 11.B.7.2: The MY applicability (“2022 through 2026”) in the title for the table of optional low NOx standards was replaced with “2022 and Subsequent” to make it consistent with the introductory statement as well as the table itself and also with the optional low NOx standards in 13 CCR 1956.8(a)(2)(A) and (a)(2)(E).”

Diesel Test Procedures Section 15.B.3.(j): Added a “-“ in the first sentence between the words “set” and “Zero-emission” to improve readability.

Diesel Test Procedures Section 86.1370.6.6: Deleted the word “of” in the definition for “e\_(*sos a, idle*)” to correct a grammatical error.

Diesel Test Procedures Section 86.1920.3.3: The word “guildlines” was replaced with “guidelines” to correct a spelling error.

Diesel Test Procedures Section 1065.680.B.1: The word “manufactuers” was replaced with “manufacturers” to correct a spelling error.

Appendix I to Part 86 – Urban Dynamometer Schedules. Subsection B: The merged cell in the first row of the table for the LLC Engine Dynamometer Schedule is removed and the phrase “Engine Testing” in the title header is kept outside the table. This modification is non-substantive, and it is done to improve accessibility and readability of the regulatory document.

The above described modifications constitute non-substantial changes to the regulatory text because they more accurately reflect the numbering of a section and correct spelling and grammatical errors, but do not materially alter the requirements or conditions of the proposed rulemaking action.

### **III. Documents Incorporated by Reference**

The Regulation and the incorporated test procedures and label specifications, adopted by the Executive Officer, incorporate by reference the following documents:

- “California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles,” adopted December 12, 2002, as last amended on September 9, 2021, incorporated by reference in 13 CCR 1956.8 and 2139.
- “California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Otto-Cycle Engines and Vehicles,” adopted December 27, 2000, as last amended on September 9, 2021, incorporated by reference in 13 CCR 1956.8 and 2139.
- “California 2015 and Subsequent Model Criteria Pollutant Exhaust Emission Standards and Test Procedures and 2017 and Subsequent Model Greenhouse Gas Exhaust Emission Standards and Test Procedures for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles,” adopted March 22, 2012, as last amended on September 9, 2021, incorporated by reference in 13 CCR 1961.2.
- “California Environmental Performance Label Specifications for 2021 and Subsequent Model Year Medium-Duty Vehicles, Except Medium-Duty Passenger Vehicles,” adopted December 19, 2018, as last amended on September 9, 2021, incorporated by reference in 13 CCR 1965.
- “California Exhaust Emission Standards and Test Procedures for New 2011 and Later Tier 4 Off-Road Compression-Ignition Engines, Part I-D,” adopted October 20, 2005, as last amended on September 9, 2021, incorporated by reference in 13 CCR 2423.

- “California Greenhouse Gas Exhaust Emission Standards and Test Procedures for 2014 and Subsequent Model Heavy-Duty Vehicles,” adopted October 21, 2014, as last amended on September 9, 2021, incorporated by reference in 17 CCR 95663.

CARB documents are readily available from CARB upon request and were made available in the context of this rulemaking in the manner specified in Government Code section 11346.5(b). The amended test procedures and label specifications are available online at CARB’s website at <https://ww2.arb.ca.gov/rulemaking/2020/hdomnibuslownox>.

These documents were incorporated by reference because it would be cumbersome, unduly expensive, and otherwise impractical to publish them in the CCR. In addition, some of the documents are copyrighted, and cannot be reprinted or distributed without violating the licensing agreements. The documents are lengthy and highly technical test methods and engineering documents that would add unnecessary additional volume to the Regulation. Distribution to all recipients of the CCR is not needed because the interested audience for these documents is limited to the technical staff at a portion of reporting facilities, most of whom are already familiar with these methods and documents. Also, the incorporated documents were made available by CARB upon request during the rulemaking action and will continue to be available in the future from CARB’s website at <https://ww2.arb.ca.gov/rulemaking/2020/hdomnibuslownox>. The documents are also available from college and public libraries, or may be purchased directly from the publishers.

## IV. Summary of Comments and Agency Response

### A. Comments Received Before and at the Board Hearing

Written comments were received during the 60-day comment period in response to the August 27, 2020, public hearing notice, as well as submitted during the Board Hearing. These are shown in Table IV.A.1, identifying the date in which the written comments were submitted, commenter name, and affiliation. In addition, oral comments were presented at the Board Hearing, as shown in Table IV.A.2; these are listed by commenter name and affiliation in the order that the oral comments were presented at the Board Hearing.

**Table IV.A.1. Written Comments Received  
During the 60-Day Comment Period and at the Board Hearing**

<b>Commenter</b>	<b>Affiliation</b>
Sharp, Christopher (July 7, 2020)	SwRI
Molina, Samuel (August 6, 2020)	Mi Familia Vota
Soleki, Mary (August 11, 2020)	World Energy Paramount
Pingle, Ray (August 12, 2020)	Sierra Club California
Pickett, Jeffrey (August 12, 2020)	Global Blue Oceans International, LLC
Bromberg, Leslie (August 12, 2020)	MIT Plasma Science and Fusion Center (MIT)
French, Timothy (August 13, 2020, August 21, 2020)	Truck & Engine Manufacturers Association (EMA)

<b>Commenter</b>	<b>Affiliation</b>
Thunberg, Bill (August 14, 2020)	International Hydrail Conferences (IHC)
Mandel, Jed (August 14, 2020, August 27, 2020)	EMA
Ernest, Steven (August 18, 2020)	Jacobs Vehicle Systems (JVS)
Sword, Mike (August 18, 2020)	Clark County Department of Environment and Sustainability
Ellingwood, John (August 18, 2020)	Private citizen
Kenny, Ryan (August 19, 2020)	Low NOx Coalition (LNC) <sup>8</sup>
Piening, Quinn (August 19, 2020)	California Tow Truck Association (CTTA)
Butler, Kimberly (August 20, 2020)	Maricopa County Air Quality Department
Carlson, Steve (August 20, 2020)	Tula Technology, Inc.
Barrett, William (August 20, 2020)	American Lung Association, California (ALA) <sup>9</sup>
Dhillon, Raj (August 20, 2020)	BREATHE California of Los Angeles County (BREATHELA)
Fromm, Laurence (August 21, 2020)	Achates Power, Inc.
Nastri, Wayne (August 23, 2020)	South Coast Air Quality Management District (SCAQMD)
Garland, Lesley (August 24, 2020)	National Propane Gas Association (NPGA)
Vega, Francisco (August 24, 2020)	Washoe County Health District
Brezny, Rasto (August 24, 2020)	Manufacturers of Emission Controls Association (MECA)
Kruger, Nancy (August 24, 2020)	National Association of Clean Air Agencies (NACAA)
Holmes, Laurie (August 24, 2020)	Motor & Equipment Manufacturers Association (MEMA)
Dragoni, Danilo (August 24, 2020)	Nevada Department of Conservation and Natural Resources
Boudreaux, Rebecca (August 24, 2020)	Oberon Fuels
Lawson, Thomas (August 24, 2020)	California Natural Gas Vehicle Coalition (CNGVC)
Remillard, Ashley (August 24, 2020)	Agility Fuel Solutions (AFS)

<sup>8</sup> The 20 signatories to this comment letter include Western Propane Gas Association, USA Renewable Energy, LLC, South San Francisco Scavenger Company, Inc., Clean Energy, Southern California Gas Company, Mustang Renewable Power Ventures, California Compost Coalition, CleanFleets.Net, Trillium, NGVAmerica, E.J. Harrison & Sons, Inc., Bioenergy Association of California, Interior Removal Specialists, Inc., California Waste Haulers Coalition, American Refuse, Gladstein Neandross & Associates, Agility Fuel Solutions, Inland Empire Disposal Association, Calgren Dairy Fuels, LLC, and Tule Trash Company. Thus, the responses to the comments of LNC are responsive to the aforementioned signatories as well.

<sup>9</sup> In addition to ALA, the signatories to this comment letter include Alliance of Nurses for Healthy Environments, American Academy of Pediatrics – California Chapter, American College of Physicians, California Chapter, BREATHE California of Los Angeles County, California Medical Association, California Society for Respiratory Care, Center for Climate Change and Health, Public Health Institute, Central California Asthma Collaborative, Climate Health Now, Coalition for Clean Air, Emphysema Foundation of America, Family Allergy Asthma Clinic (Fresno), Maternal and Child Health Access (Los Angeles), San Francisco Bay Physicians for Social Responsibility, Regional Asthma Management and Prevention, Riverside County Medical Association, St. John’s Well Child and Family Center (Los Angeles). Thus, the responses to the comments of ALA are responsive to the aforementioned signatories as well.

<b>Commenter</b>	<b>Affiliation</b>
Miller, Paul (August 24, 2020)	Northeast States for Coordinated Air Use Management (NESCAUM)
Allen, Lisa (August 24, 2020)	BAE Systems (BAE)
Waters, Sean (August 25, 2020)	Daimler Trucks North America (DTNA) <sup>10</sup>
Yeager, Jackie (August 25, 2020)	Cummins Inc. (Cummins)
Boyd, Susan (August 25, 2020)	Mojave Desert Land Trust
Fenton, Dawn (August 25, 2020)	Volvo Group North America (Volvo) <sup>11</sup>
Agelidis, Yasmine (August 25, 2020)	Earthjustice <sup>12</sup>
Hales, Heidi (August 25, 2020)	Vermont Department of Environmental Conservation
Gelb, Jacqueline (August 25, 2020)	Navistar, Inc. (Navistar) <sup>13</sup>
Pardo, Veronica (August 25, 2020)	Resource Recovery Coalition (RRC)
Chance, Barbara (August 25, 2020)	Allison Transmission, Inc. (Allison)
Portillo, Patricio (August 25, 2020)	Natural Resources Defense Council (NRDC)
Tunnell, Mike (August 25, 2020)	American Trucking Associations (ATA) California Trucking Association (CTA)
Pimentel, Michael (August 25, 2020)	California Transit Association (California Transit)
Coutsos, Nicholas (August 25, 2020)	American Automotive Policy Council (AAPC)
Barrett, William (August 25, 2020)	ALA
Posada, Francisco (August 25, 2020)	International Council on Clean Transportation (ICCT)
Quinn, Patrick (August 25, 2020)	Advanced Engine Systems Institute (AESI)
McAlinden, Kenneth (August 25, 2020, August 27, 2020)	Ford Motor Company (Ford)
Cooke, Dave (August 25, 2020)	Union of Concerned Scientists (UCS)
Sheikh, Samir (August 25, 2020)	San Joaquin Valley Air Pollution Control District (SJVAPCD)
Johnson, John H. (August 25, 2020)	Michigan Technological University
Schwartz, Andy (August 25, 2020)	Tesla
Geller, Michael (August 25, 2020)	MECA
Truck Dealers Alliance of California (August 25, 2020)	Truck Dealers Alliance of California (TDAC)
Mersky, Avi (August 26, 2020)	American Council for an Energy Efficient Economy (ACEEE)

<sup>10</sup> The comment from DTNA, a member of EMA, supports and incorporates by reference the comments made by EMA as its own. Thus, the responses to the comments of EMA are responsive to the comment from DTNA as well.

<sup>11</sup> Volvo, a member of EMA, indicated that it fully supports the comments made by EMA, in addition to providing separate Volvo comments. Thus, the responses to the comments of EMA are responsive to the comment from Volvo as well.

<sup>12</sup> Along with Earthjustice, the signatories of this comment letter include CAEJ, Coalition For A Safe Environment, East Yard Communities for Environmental Justice, Leadership Counsel for Justice and Accountability, Los Angeles County Electric Bus & Truck Coalition, San Pedro & Peninsula Homeowners Coalition, and Sierra Club California. Thus, the responses to the comments of Earthjustice are responsive to the aforementioned signatories as well.

<sup>13</sup> Navistar, a member of EMA, stated that it fully supports the comments made by EMA. Thus, the responses to the comments of EMA are responsive to the comments from Navistar as well.

<b>Commenter</b>	<b>Affiliation</b>
Portillo, Patricio (August 26, 2020)	NRDC
Fenwick, Scott (August 27, 2020)	National Biodiesel Board (NBB)
Sinnamon, Hilary (August 27, 2020)	Environmental Defense Fund (EDF)
Feeley, Eric (August 27, 2020)	Oregon Department of Environmental Quality
Aburn, George (August 27, 2020)	Maryland Department of Environment
Roberts, Tiffany (August 27, 2020)	Western States Petroleum Association (WSPA)
Lew, Shoshana (August 27, 2020)	Colorado Department of Transportation
Hamilton, Kevin (August 27, 2020)	Central California Asthma Collaborative

**Table IV.A.2. Oral Comments Presented at the Board Hearing<sup>14</sup>**

<b>Commenter</b>	<b>Affiliation</b>
White, Erik	Placer County Air Pollution Control District
Flint, Steve	New York State Environmental Conservation
Hanna, Peg	New Jersey Department of Environmental Protection
Babbidge, Tracy	Connecticut Department of Energy and Environmental Protection
Cooper, Caroline	NESCAUM
Crawford, Kelly	District of Columbia Department of Energy and Environment
Aburn, Tad	Maryland Department of the Environment
Good, Gail	Wisconsin Department of Natural Resources
Taylor, Kathy	Washington Department of Ecology
Feeley, Eric	Oregon Department of Environmental Quality
Vega, Francisco	Washoe County Air Quality Management Division
Le, Tung	California Air Pollution Control Officers Association
Brezny, Rasto	MECA
Brown, Kevin	MECA
Geller, Mike	MECA
Mandel, Jed	EMA
Jakpor, Karen	ALA
Alexander, Meredith	CALSTART
Dietzkamei, Janet	Private citizen
Boyd, Susy	Mojave Desert Land Trust
Agelidis, Yasmine	Earthjustice, Los Angeles County Electric Truck and Bus Coalition (LACETBC)
Holmes, Laurie	MEMA
Torres, Ivette	Center for Community Action and Environmental Justice (CAEJ)
Pimentel, Michael	CTA
Fenton, Dawn	Volvo
Black, Paul	BREATHE LA
Nastri, Wayne	SCAQMD

<sup>14</sup> The oral comments table is in the order that the oral comments were presented at the Board Hearing.

<b>Commenter</b>	<b>Affiliation</b>
Cooke, David	UCS
Tuitavuki, Norman	Monterey-Salinas Transit (MST)
France, Chet	EDF
Tunnell, Mike	ATA
Schwartz, Andy	Tesla
Mersky, Avi	ACEEE
Au, Katrina	AFS
Maggay, Kevin	Southern California Gas Company (SoCalGas)
Marquez, Jesse	Private citizen
Azamian, Shayda	Leadership Counsel for Justice and Accountability (LCJA)
Magavern, Bill	Coalition for Clean Air (CCA)
Shimoda, Chris	CTA
Granholt, Ben	WPGA
Shears, John	Center for Energy Efficiency and Renewable Technologies (CEERT)
Sheikh, Samir	SJVAPCD
Kenny, Ryan	Clean Energy
Portillo, Patricio	NRDC
Lawson, Thomas	CNGVC
Roberts, Tiffany	WSPA
Breen, Damian	Bay Area Air Quality Management District (BAAQMD)
Borja, Jofil	Sacramento Regional Transit (SRT)
Loera, Paola	ALA
Martin, Keith	Yuba-Sutter Transit Authority (YSTA)
Campbell, Todd	Clean Energy
Kennedy, Melina	Cummins
Barrett, Will	ALA
Ernest, Steven	JVS
Shade, Ben	AVL Test Systems
Edgar, Sean	Clean Fleets

Of the comments listed in Tables IV.A.1 and IV.A.2, the following comments were wholly in support of the Proposed Amendments, as shown in Table IV.A.3. If a comment was partially in support of the Proposed Amendments but also suggested changes to the Proposed Amendments, it is not included in Table IV.A.3 but is instead responded to in the agency responses later in this document.

**Table IV.A.3. Comments Wholly in Support of the Proposed Amendments**

<b>Affiliation</b>
Mi Familia Vota
Sierra Club California
Clark County Department of Environment and Sustainability
Maricopa County Air Quality Department
Tula Technology, Inc.

<b>Affiliation</b>
Achates Power, Inc.
Washoe County Health District
Nevada Department of Conservation and Natural Resources
Oberon Fuels
Mojave Desert Land Trust
Vermont Department of Environmental Conservation
ICCT
Michigan Technological University
Oregon Department of Environmental Quality
Maryland Department of Environment
Colorado Department of Transportation
Central California Asthma Collaborative
Placer County Air Pollution Control District
New York State Environmental Conservation
New Jersey Department of Environmental Protection
Connecticut Department of Energy and Environmental Protection
District of Columbia Department of Energy and Environment
Wisconsin Department of Natural Resources
Washington Department of Ecology
Washoe County Air Quality Management Division
California Air Pollution Control Officers Association
CALSTART
Janet Dietzkamei (CAEJ)
Jesse Marquez
AVL Test Systems

Several comments from Table IV.A.1 described advanced technologies, fuels, and research that support the technological feasibility of the proposed action. These comments are from World Energy Paramount, Global Blue Oceans International, LLC, Tula Technology, Inc., Achates Power, Inc., Oberon Fuels, ICCT, and Michigan Technological University. In addition, another comment, SwRI, from Table IV.A.1 was submitted in full support of the technological feasibility of the proposed action, as referenced in the ISOR. Furthermore, one comment from Table IV.A.1, John Ellingwood, did not pertain to the proposed action.

The following is a summary of each objection or recommendation regarding the proposed action, together with an agency response providing an explanation of how the proposed action has been changed to accommodate the objection or recommendation or the reasons for making no change. The comments have been grouped by topic wherever possible. Comments not involving objections or recommendations specifically directed towards the rulemaking or to the procedures followed by CARB in this rulemaking are not summarized below.

**(a) Comments Related to NOx and PM Standards for 2024 and Subsequent MY HD Engines**

**(a)i. New 2024 Through 2026 MY NOx and PM Emission Standards for HD Engines**

- (a)i.1. Comment: [I]f CARB proceeds down its current path, Heavy Heavy-Duty Diesel (HHDD) and Medium Heavy-Duty Diesel (MHDD) vehicle manufacturers likely will face the prospect of not being able to produce CARB-compliant products as of 2024, and may be forced to exit the California HD vehicle market. The net result could be that the proposed 2024 MY standards – which in effect will provide manufacturers with only two full years of lead time – will cause the HHDD and MHDD engine and vehicle markets largely to dry up in California in the 2024-2026 time period, meaning that CARB will have adopted regulations to compel the production of [heavy-duty on-highway] HDOH products that few, if any, manufacturers will be able to build, and that few, if any, fleet operators will be willing or able to buy. (EMA, Daimler, Navistar, Volvo)

Agency Response: No change to the Proposed Amendments was made in response to this comment. CARB staff disagrees with the above comment that alludes to the prospect of engine manufacturers exiting the California market because there is not enough lead time to produce HD engines that meet CARB's 2024 MY standards. As discussed extensively in the ISOR, CARB staff believes that the proposed 2024 MY standards are feasible without significant changes to the current engine and aftertreatment system architecture with thermal management strategies and improved aftertreatment systems, including advanced catalyst substrates and heated dosing. Advanced catalyst substrates would include current generation high cell density and increased porosity substrates. The high cell density and increased porosity provide increased surface area to allow sufficient contact area between the exhaust gas and the active catalytic materials and the thin substrate walls reduce the catalyst thermal mass allowing rapid warm-up. Heated dosing together with advances in low temperature catalyst performance enable urea dosing at low exhaust gas temperatures (130°C - 180°C) during low load duty cycles with minimal deposit formation.<sup>15</sup> <sup>16</sup> For example, the SwRI Stage 1 program aftertreatment screening process demonstrated 0.04 g/bhp-hr NOx on the FTP using a 2014 model conventional SCR system and heated dosing. Furthermore, manufacturers were made aware of the level of stringency early on through workgroup meetings, workshops, and CARB-industry meetings held during calendar years 2018 through 2020. Specifically, during those meetings, engine manufacturers

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<sup>15</sup> Faurecia. Reducing fuel consumption and NOx emissions for commercial vehicles with Heated Doser. YouTube Video. September 21, 2020. ([https://www.youtube.com/watch?v=aemU\\_uw\\_B80](https://www.youtube.com/watch?v=aemU_uw_B80) - accessed 9/1/2021)

<sup>16</sup> Technology Feasibility for Model Year 2024 Heavy-Duty Diesel Vehicles in Meeting Lower NOx Standards, Manufacturers of Emission Controls Association (MECA), June 2019. [http://www.meca.org/resources/MECA\\_MY\\_2024\\_HD\\_Low\\_NOx\\_Report\\_061019.pdf](http://www.meca.org/resources/MECA_MY_2024_HD_Low_NOx_Report_061019.pdf)

informed CARB staff that they were settling on engine design/ development plans to meet the 2024 MY Phase 2 GHG requirements and that they needed information on the stringency of the NOx standards for MY 2024 so that they can plan ahead and implement technology changes needed to comply with both the NOx and Phase 2 GHG standards for MY 2024. On April 18 2019, in response to the manufacturers' need for lead time, CARB staff released a feasibility assessment titled "*Staff White Paper: California Air Resources Board Staff Current Assessment of the Technical Feasibility of Lower NOx Standards and Associated Test Procedures for 2022 and Subsequent Model Year Medium-Duty and Heavy-Duty Diesel Engines*", which discussed anticipated emission standards and other Omnibus program elements.<sup>17</sup> CARB staff's Proposed Amendments are consistent with the white paper and hence manufacturers have had more than adequate lead time for MY 2024.

In addition, in response to manufacturers' continued concerns on lead time, CARB provided a number of flexibilities that would enable them to develop and certify engines in time for MY 2024. These flexibilities included options that reduce the time needed to demonstrate durability, provisions to accrue credits by allowing them to certify to family emission limits (FEL) lower than the current standard early in MYs 2022-2023, freezing OBD thresholds to current levels, and providing complete exemptions in MY 2024-2026 for certain engine applications with low volume sales such as engines used in urban buses and engines rated at or above 525 horsepower. These flexibilities were expanded upon in the 15-Day Notice Amendments allowing a limited declining number of certain legacy engines to be sold in the initial implementation years provided their higher emissions are mitigated as described in the notice. Furthermore, CARB staff is aware of several major engine manufacturers' plans to comply and make available compliant engines in the 2024 timeframe. Both Cummins' and PACCAR's plans include bringing complaint engines to California in 2024, as was stated at the August 27<sup>th</sup>, 2020 Board Hearing.<sup>18</sup> Although there may be some engine manufacturer reduction in the number of engine families offered for sale in California versus what would be offered in the absence of the Omnibus Regulation, CARB staff believes that there will be enough engine models certified to CARB's 2024 MY requirements to satisfy the California HD vehicle market.

- (a)i.2. Comment: The ISOR further describes potential aftertreatment enhancements including "thin-walled high density catalyst substrates," and again references MECA's simulations where they describe "iron and copper zeolites in a layered structure or zone-coated with two catalyst formulations

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<sup>17</sup> CARB staff's Current Assessment of the Technical Feasibility of Lower NOx Standards and Associated Test Procedures for 2022 and Subsequent Model Year Medium-Duty and Heavy-Duty Diesel Engines, April 18, 2019.

([https://ww2.arb.ca.gov/sites/default/files/classic/msprog/hdlownox/white\\_paper\\_04182019a.pdf?utm\\_medium=email&utm\\_source=govdelivery](https://ww2.arb.ca.gov/sites/default/files/classic/msprog/hdlownox/white_paper_04182019a.pdf?utm_medium=email&utm_source=govdelivery) – accessed 3/4/2021)

<sup>18</sup> Public Hearing to Consider the Proposed Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments. Board Meeting Transcript, August 27, 2020, pages 278 and 296  
<https://ww3.arb.ca.gov/board/mt/2020/mt082720.pdf>

on the front and rear of a single substrate.”<sup>19</sup> Changes to critical aftertreatment systems of that magnitude cannot be made to comply with new emissions regulations with just two-years of leadtime. That simply is not adequate time to ensure that such systems can be fully developed and verified to achieve, in a robust manner, the high NO<sub>x</sub>-conversion efficiencies from aftertreatment systems that would be required. CARB should not base aggressive new NO<sub>x</sub> standards on the modeling of unproven technologies, especially while providing inadequate leadtime. (EMA, Daimler, Navistar, Volvo)

Agency Response: No change to the Proposed Amendments was made in response to this comment. CARB staff disagrees with EMA’s assessment that the catalyst substrates mentioned in the ISOR as well as catalyst formulations mentioned in MECA’s report require more lead time than provided to develop systems to comply with new emissions standards. As indicated in MECA’s report, the substrates considered in MECA’s modeling and dynamometer testing studies are either commercial or market ready options that can be deployed on vehicles by MY 2024 to achieve 0.05 grams per brake horsepower-hour (g/bhp-hr) NO<sub>x</sub> on the FTP and 0.2 g/bhp-hr on the LLC. Since 2010, emission control manufacturers have been continuously improving and optimizing aftertreatment systems including diesel oxidation catalysts (DOC), diesel particulate filters (DPF) and SCR systems to improve NO<sub>x</sub> conversion efficiency, reduce backpressure on the engine, and reduce thermal mass for fast warm-up. Catalyst improvements included the development of high cell density, high porosity, and thinner durable substrate walls. The thinner substrate walls reduce thermal mass allowing faster warm-up, and the higher porosity allows higher catalyst loading providing increased surface area to allow sufficient contact between the exhaust gas and the active catalytic materials. These developments have allowed manufacturers to reduce the size of SCR systems by over 60 percent while achieving lower NO<sub>x</sub> emissions than first generation systems.<sup>20</sup> CARB staff believes that commercially available advanced catalysts combined with improved urea dosing controls and engine thermal management strategies can be readily applied to meet CARB’s proposed NO<sub>x</sub> standards for MY 2024 without any significant changes to the current system design. In fact, the Stage 1 program aftertreatment screening process demonstrated 0.04 g/bhp-hr NO<sub>x</sub> using a 2014 model conventional SCR system and heated dosing. Significantly lower NO<sub>x</sub> emissions could be achieved with current generation SCR systems and heated dosing.

MECA’s engine dynamometer study was based on the latest catalysts and substrates being offered to engine manufacturers today for 2024 MY engines.

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<sup>19</sup> Technology Feasibility for Model Year 2024 HD Diesel Vehicles in Meeting Lower NO<sub>x</sub> Standards, Manufacturers of Emissions Controls Association, June 2019.

<sup>20</sup> Technology Feasibility for Model Year 2024 HD Diesel Vehicles in Meeting Lower NO<sub>x</sub> Standards, Manufacturers of Emissions Controls Association, June 2019.

[http://www.meca.org/resources/MECA\\_MY\\_2024\\_HD\\_Low\\_NOx\\_Report\\_061019.pdf](http://www.meca.org/resources/MECA_MY_2024_HD_Low_NOx_Report_061019.pdf)

The engine testing focused only on hot start FTP cycles to emphasize catalyst performance as MECA did not have the ability or access to modify the engine calibration for cold-start emissions control. MECA's reported engine dynamometer results on a 13-liter 2014 MY engine showed hot start FTP NO<sub>x</sub> emissions to be reduced by about 67 percent, from a baseline 2014 model emission control system of 0.075 g/bhp-hr to 0.024 g/bhp-hr using a 2019 model emission control system.

Furthermore, MECA's simulation modeling used as an input the modified engine calibration from SwRI Stage 1 engine and three different sizes of currently commercially available 2019 SCR systems. The model has been developed over ten years of commercial system testing and correlation with field parts. Using a minimum commercial SCR volume in the market today, MECA's modeling demonstrated a 0.04 g/bhp-hr NO<sub>x</sub> composite FTP. NO<sub>x</sub> emissions were further reduced to about 0.03 g/bhp-hr by increasing the SCR catalyst volume to a level representing an average SCR volume found on 2019 trucks. Finally, with an improved currently commercially available ammonia slip catalyst, emissions were further reduced to 0.02 g/bhp-hr NO<sub>x</sub>. This result allows for a compliance margin of 60 percent at an FTP NO<sub>x</sub> emission standard of 0.05 g/bhp-hr.

The Stage 1 SwRI study screening of aftertreatment control systems also demonstrated a 0.04 g/bhp-hr NO<sub>x</sub> composite FTP with a traditional aftertreatment architecture and heated dosing, with a GHG penalty of about 0.5 percent. This result was achieved despite the engine being equipped with a turbocompound that resulted in significant exhaust heat transfer resulting in lower exhaust heat energy available at the SCR system. An engine without a turbocompound and with exhaust gas recirculation (EGR) cooler or turbocharger bypasses would have performed much better with minimal or no GHG penalties. Thus, CARB staff believes that the proposed 2024 MY standards are feasible with current commercially available or market ready aftertreatment systems.

- (a)i.3. Comment: The Board should adopt a 2024 standard at least as stringent as the 0.05 g/bhp-hr in the proposal and should consider earlier implementation opportunities to reflect the urgency of NO<sub>x</sub> reductions needed to achieve clean air standards. (ALA)
- (a)i.4. Comment: Following the adaptation of the historic ACT Rule that offers a long-term plan to transition to zero-emissions trucks, CARB should implement a plan for short-term emissions reductions...We encourage CARB to change the existing 0.2 g/bhp-hr standard to a 0.02 g/bhp-hr standard ideally by 2024 and no later than 2027. A more stringent NO<sub>x</sub> emission standard in the near-term will put California in a better position to meet our climate goals. (BREATHELA)
- (a)i.5. Comment: Given the well-documented feasibility of the proposed standard, the rule must compel cleaner technology across the combustion fleet and

avoid delays in deployment of more health-protective emission controls.  
(ALA)

- (a)i.6. Comment: As noted in the ISOR, the proposed regulation is projected to be responsible for 52 tons per day (tpd) of NOx emission reductions, nearly half of the entire NOx emission reduction commitment in the state strategy for 2031. While that is a laudable achievement, the proposed regulation falls significantly short of the NOx reductions needed to attain the ozone standard in the South Coast Air Basin (SoCAB), providing only 0.1 tpd of NOx reductions by 2023 and 7 tpd by 2031. Given the substantial emissions contribution of heavy-duty vehicles and the urgency of upcoming ozone attainment deadlines, we urge CARB to adopt the most stringent standard feasible. (SCAQMD)

Agency Responses to Comments (a)i.3 through (a)i.6: No change to the Proposed Amendments was made in response to these comments. As required by Government Code 11346.2, subdivision (b)(4), CARB staff considered and evaluated several alternatives including some submitted by stakeholders. An alternative that is similar to the scenario in the above comments was submitted by SCAQMD. SCAQMD's proposal would implement the primary 2024 MY NOx and PM requirements including FTP, RMC-SET, Clean Idle, PM standards, and LLC, and the moving average window (MAW) based in-use testing two years earlier than the primary amendments implementation year, that is, starting in MY 2022 rather than MY 2024. The primary 2027 MY requirements would also be implemented 3 years earlier starting in MY 2024 rather than MY 2027. A summary of the accelerated timeline for this alternative is provided in Table X-1 of the ISOR. As the commenters suggest, this alternative would achieve greater NOx reductions sooner but have higher costs in earlier years.

However, the accelerated schedule of the alternative would not provide enough lead time for the development of the interim engines in 2022 and the low NOx engines in 2024. Without sufficient time for engine manufacturers to conduct research, development, and durability testing, products will not be able to meet the stringent criteria. Manufacturers have identified that five to six years of lead time would be required for full product development from proof of concept to production product. The primary amendments provide manufacturers with necessary lead time for engineering development for the changes required in 2024 and the more significant changes needed in 2027 (i.e., CDA and light-off SCR). Because this alternative did not provide the necessary lead time for engineering development, it was rejected. Please refer to Chapter X of the ISOR for a detailed discussion of the emission and health benefits and the economic impacts of the various alternatives considered and evaluated by CARB staff.

It is true that the primary emissions standards will not provide emissions benefits in the early years prior to MY 2024 implementation year. However, CARB staff has included provisions that incentivize the early introduction of cleaner engines

prior to MY 2024 to achieve early emissions reductions that are critically needed in regions like the South Coast and San Joaquin Valley air basins to meet air quality goals. These incentives include: (1) provisions to accrue credits by allowing manufacturers to certify to lower FELs early in MYs 2022-2023, (2) provisions that allow manufacturers to certify to the primary requirements early in 2022 through 2030 and earn credits 1.5 to 3 times the one-to-one credits earned; and (3) provisions to certify to the optional low NOx standards and receive funds for the incremental cost of the purchase of the low NOx engine. CARB staff believes manufacturers would use some of these flexibilities to comply with the primary requirements, resulting in emission reductions in the early years prior to 2024.

- (a)i.7. Comment: ACEEE does, however, believe that CARB should consider evaluating more stringent PM emission limits, as manufacturers have already proven themselves able to meet higher standards by certifying and releasing products that meet emission levels below the proposed standards. (ACEEE)

Agency Response: No change to the Proposed Amendments was made in response to this comment. CARB staff disagrees that the PM standards should be reduced below CARB staff's proposal of 0.005 g/bhp-hr. CARB staff's objective of setting the PM standard at 0.005 g/bhp-hr level was to prevent backsliding and maintain current robust PM emission control performance at or below levels of 0.005 g/bhp-hr levels. The proposal was based on the best PM emission performance level at certification. Analysis of PM certification data for MY 2019 heavy-duty diesel engines showed that about 93 percent of the engine families' certification levels to be at or below 0.004 g/bhp-hr PM and the remaining 7 percent of the engine families at 0.01 g/bhp-hr PM. Thus, CARB staff believes that setting the PM standard at 0.005 g/bhp-hr would help maintain robust PM emission control performance preventing manufacturers from backsliding to less efficient (more porous) DPFs. As discussed in the ISOR, CARB sponsored low NOx engine demonstration program has also monitored for any PM standard compliance implications of the strategies employed to simultaneously meet NOx and GHG targets and none were found. This anti-backsliding change is feasible with existing DPF systems and would ensure that the best DPF technologies continue to be utilized for the maximum control of toxic diesel PM emissions.

It is true that some engine certification levels are significantly lower than the proposed standard of 0.005 g/bhp-hr but there are also engines certified close to the proposed standard, for example at 0.004 g/bhp-hr. Manufacturers normally certify their engines with a compliance margin at levels below the numerical standard to protect themselves against non-compliance due to minor increases in emissions in use. The certification levels also include deterioration factors (DF) to account for any increase in emissions over the useful life of an engine. Thus, proposing a PM standard that is more stringent than the proposed PM standard would require additional improvements in the DPF which in turn would likely increase back pressure to the engine, resulting in GHG penalties. Furthermore, requiring a more

stringent PM standard would have required CARB to demonstrate the technical feasibility of the DPF to meet a more stringent PM standard through the useful life without a GHG penalty, which was outside the scope of this rulemaking. CARB staff's proposed PM standard would take into account the compliance margin needed by manufacturers, while avoiding any potential GHG impacts that could occur with the use of DPFs with higher filtration efficiencies.

- (a)i.8. Comment: It is appropriate for CARB to adopt an equally stringent PM<sub>2.5</sub> standard for gasoline engines. Gasoline particulate filters (GPFs) are available today and would be able to achieve the same level of reductions found today with DPFs....<sup>21</sup> (UCS)
- (a)i.9. Comment: Fuel neutral standards should be applied to PM emissions from HD gasoline engines in the spirit of having fuel neutral standards for this sector. CARB is proposing to tighten PM by 50% [percent] to 0.005 g/bhp-hr for diesel engines and MECA believes that would not require any change in technology but only serve as a backstop to prevent backsliding under a tighter NO<sub>x</sub> limit. As fuel efficiency standards tighten and GDI injection technology becomes more common on commercial vehicle engines, the PM emissions from medium and heavy-duty gasoline engines are likely to increase dramatically. (MECA)

Agency Response to Comments (a)i.8 and (a)i.9: No change to the Proposed Amendments was made in response to these comments. CARB staff agrees that fuel neutral PM standards should be applied to all HD engines since technologies currently exist that enable lower PM standards. Accordingly, CARB staff's proposed PM standard of 0.005 g/bhp-hr applies to both HD diesel- and Otto-cycle engines, irrespective of the fuel used in these engines.

- (a)i.10. Comment: One of the challenges for diesel engines is assuring in-use-testing and compliance of Real Driving Emissions (RDE) because of the active exhaust treatment role that is needed; injection of the reducing agent needs to be controlled to both assure selective catalytic reduction of NO<sub>x</sub>, as well as prevention of release of the reagent. A technology that does not face this challenge and should be considered for baseline emissions, achievable today, is the use of spark ignited (SI) flexible fuel gasoline-ethanol engines for heavy duty and medium duty vehicles.

Powertrains that use high efficiency flexible fueled gasoline-ethanol engines can thus provide an important option for robustly addressing the challenging near term goal for improved air quality through NO<sub>x</sub> reduction and can also provide significant near-term progress in greenhouse gas reduction. CARB should consider this option in its planning. SI engines powered by gasoline

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<sup>21</sup> MECA, "Ultrafine particulate matter and the benefits of reducing particle numbers in the United States," July 2013. Online at [http://www.meca.org/resources/MECA\\_UFP\\_Report\\_0713\\_Final.pdf](http://www.meca.org/resources/MECA_UFP_Report_0713_Final.pdf).

and ethanol can meet RDE compliance across a wide range of the driving cycles. (MIT)

Agency Response: No change to the Proposed Amendments was made in response to this comment. As briefly discussed in CARB's technology and fuel assessment report,<sup>22</sup> CARB staff is aware of the study that demonstrated GHG and criteria pollutant emissions benefits from use of gasoline-ethanol blends in HD applications. CARB staff encourages manufacturers to continue to develop such technologies and certify them to the optional low NOx standards with CARB. Such engines, if certified to the optional low NOx standards, would provide near-term air quality benefits and would also become eligible for incentive moneys to cover the incremental costs for the purchase of vehicles equipped with such engines.

**(a)ii. Aftertreatment System Used to Demonstrate the New 2024 Through 2026 MY NOx Standards for HD Engines**

- (a)ii.1. Comment: CARB has not made any demonstration proving that engine calibration changes alone are capable of meeting the 75% NOx-reduction standards proposed for the 2024-2026 model years. In arguing in favor of feasibility, CARB presumes that manufacturers can and will meet the proposed 2024 MY standards – which include a FTP and the Ramped Modal Cycle (RMC) Version of the Supplemental Emission Test (RMC-SET) NOx standard of 0.050 g/bhp-hr, a PM standard of 0.005 g/bhp-hr, an idle-NOx standard of 10 Grams Per Hour (g/hr), a new LLC standard of 0.20 g/bhp-hr, and a new Three-Bin Moving Average Window (3B-MAW) approach for assessing in-use emissions utilizing a 1.5 compliance factor – without implementing any significant engine or aftertreatment hardware changes. Based on that assumption, CARB further presumes that there is sufficient leadtime for the 2024 MY standards). CARB also anticipates that manufacturers could simply utilize a “mini-burner” to help keep SCR systems at sufficiently high low-load temperatures to meet the lower 2024 MY NOx standards. (See SwRI...Schematic...).<sup>23</sup> CARB's presumptions are unfounded.

The 2024 requirements that CARB staff is proposing will necessitate significant engine and aftertreatment hardware changes, which are neither feasible on CARB's proposed timeline, nor cost-effective on any timeline. In that regard, CARB's proposed timeline creates fundamental difficulties for engine manufacturers, difficulties which manufacturers have explained

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<sup>22</sup> [Technology Assessment: Low Emission Natural Gas and Other Alternative Fuel Heavy-Duty Engines](#), September 2015.

<sup>23</sup> See the Heavy-Duty Engine Low-Load Emission Control Calibration, Low-Load Test Cycle Development, and Evaluation of Engine Broadcast Torque and Fueling Accuracy During Low-Load Operation – Low NOx Demonstration Program – Stage 2, page 2. Available at: [https://www.arb.ca.gov/lists/com-attach/1-hdomnibus2020-VDdXMFihU2IAWQlw.pdf?\\_ga=2.107806530.1994069504.1607723091-184637983.1600705717](https://www.arb.ca.gov/lists/com-attach/1-hdomnibus2020-VDdXMFihU2IAWQlw.pdf?_ga=2.107806530.1994069504.1607723091-184637983.1600705717)

directly and in detail to CARB staff on multiple occasions. (EMA, Daimler, Navistar, Volvo)

Agency Response: No change to the Proposed Amendments was made in response to this comment. CARB staff believes that the proposed standards for MY 2024 are cost effective and feasible within the proposed timeline without significant changes to the engine and aftertreatment system architecture. As discussed extensively in Chapter III and Appendix I of the ISOR as well as in Agency Responses to Comments A.(a).i.1 and A.(a).i.2, demonstration and modeling results support the feasibility of the 2024 MY NO<sub>x</sub> and PM standards without significant changes to the engine and aftertreatment system architecture. The following paragraphs summarize CARB staff's justifications for the feasibility of the proposed 2024-2026 MY requirements.

*Feasibility of the 0.05 g/bhp-hr 2024 FTP NO<sub>x</sub> Standard:* The 2024 FTP NO<sub>x</sub> standards are feasible with engine calibration modifications and current generation commercially available aftertreatment systems with heated dosing to provide exhaust energy during cold starts and low load operations. An EGR cooler bypass may also be used instead of the heated urea dosing to provide the needed exhaust energy during cold starts and low loads. Both the heated doser and the EGR cooler bypass are not significant additions to the engine-aftertreatment system. As mentioned earlier, during the Stage 1 aftertreatment system screening process, SwRI demonstrated 0.04 g/bhp-hr NO<sub>x</sub> on the FTP with a GHG penalty of approximately 0.5 percent with 2014 model aftertreatment system, engine calibration, and heated dosing. It is to be noted that this result was achieved despite the engine being a 2014 MY engine equipped with a turbocompound that significantly reduced exhaust heat energy available for the SCR system resulting in some GHG penalty. It is expected that the use of current engine architecture without a turbocompound (such as that used in the Stage 3 program<sup>24</sup>) and currently commercially available aftertreatment systems with heated dosing could result in much lower NO<sub>x</sub> emissions with minimal or no GHG emissions penalty.

In addition, modeling by MECA showed that engine calibration strategies together with a fully-aged current generation commercially available average SCR catalyst volume could reduce composite FTP NO<sub>x</sub> emission levels to 0.03 g/bhp-hr, which would provide a 40 percent margin below the proposed 0.050 g/bhp-hr NO<sub>x</sub> standard.

*Feasibility of the 0.005 g/bhp-hr 2024 FTP PM standard:* As discussed in the Agency Response for Comment A.(a).i.7 above, current PM certification levels are significantly lower than the proposed standard with 93 percent of the 2019

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<sup>24</sup> Sharp, Christopher. "Further Development and Validation of Technologies to Lower Oxides of Nitrogen Emissions from Heavy-Duty Vehicles, Low NO<sub>x</sub> Demonstration Program – Stage 3," Southwest Research Institute, ARB Contract 16MSC010, SwRI® Project Number 03.23379, Final Report, April 16, 2021.

MY engine families certifying below 0.005 g/bhp-hr NO<sub>x</sub> and 86 percent of them at or below 0.002 g/bhp-hr PM. This indicates that the PM standard is feasible with current filters.

*Feasibility of the 0.20 g/bhp-hr 2024 LLC NO<sub>x</sub> standard:* Again, demonstration program and modeling results support the feasibility of a 0.20 g/bhp-hr NO<sub>x</sub> standard on LLC. The Stage 2 program demonstrated a 0.34 g/bhp-hr NO<sub>x</sub> on the LLC with base engine calibration and stock aftertreatment system, that is on a 2014 model engine with a turbocompound and a 2014 model aftertreatment system. This result indicates that 0.20 g/bhp-hr NO<sub>x</sub> on the LLC is feasible with engine calibration changes (and/or EGR cooler bypass or heated diesel exhaust fluid (DEF) dosing) and the use of current generation aftertreatment systems. CARB staff's conclusion is supported with results from a modeling study by MECA. In this study, MECA modeled NO<sub>x</sub> emissions on the LLC using as input engine-out NO<sub>x</sub> emissions from the Stage 1 engine with modified calibration and a full useful life aged current generation SCR catalyst with an average SCR volume found on 2019 trucks. The modeled system with 50 percent ammonia coverage and heated dosing achieved 0.18 g/bhp-hr NO<sub>x</sub> on the LLC, indicating the feasibility of the proposed 0.20 g/bhp-hr LLC NO<sub>x</sub>.

*Feasibility of the 10 g/hr 2024 idling NO<sub>x</sub> standard:* Demonstration data and certification data support the feasibility of the 10 g/hr idling NO<sub>x</sub> standard without significant changes to the engine-aftertreatment system architecture. In the Stage 2 program, SwRI evaluated the emission reductions achievable by changing calibrations during idle.<sup>25</sup> The LLC contains two long idle segments that can cool the aftertreatment system temperature on current products to the point where SCR control is no longer available. One way to impede this cooling is to increase the EGR rate and reduce exhaust flow during idling events. SwRI demonstrated idling emissions of 1.6 to 2.8 g/hr depending on accessory load by reducing exhaust flow at idle, indicating the feasibility of the 10 g/hr idle NO<sub>x</sub> standard. Additionally, as shown in Figure III-3 of the ISOR, certification data for some 2019 MY engine families also show idling emissions of less than 10 g/hr again indicating the feasibility of the 10 g/hr idling NO<sub>x</sub> standard.

EMA's statement that CARB anticipates that manufacturers could simply utilize a "mini-burner" to help keep SCR systems at sufficiently high low-load temperatures to meet the lower 2024 MY NO<sub>x</sub> standards is not true. CARB staff's technical feasibility assessment for the 2024 MY identifies EGR cooler bypass or heated urea dosing as an enabling technology for the 2024 MY NO<sub>x</sub> standards but not a miniburner. As demonstrated in the Stage 3 program, bypassing the EGR cooler can increase the exhaust temperature significantly without impacting GHG emissions. Unlike the miniburner that injects fuel to the exhaust, heated

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<sup>25</sup> Sharp, Christopher. "Heavy-Duty Engine Low-Load Emission Control Calibration, Low-Load Test Cycle Development, and Evaluation of Engine Broadcast Torque and Fueling Accuracy During Low-Load Operation," Low NO<sub>x</sub> Demonstration Program – Stage 2," Southwest Research Institute, SwRI Project No. 03.22496, Final Report, May 6, 2020.

urea dosing includes a normal urea or DEF doser that injects DEF to an electrically heated catalyst assembly that provides a hot surface to help in the evaporation of the urea and the substrate also helps in the mixing. Compared to a miniburner, heated urea dosing requires less energy of about 1 to 3 kilowatts (kW) in a 24-volt system and operates for limited periods of time during cold-start or low load operations, resulting in minimal GHG penalty. See also Agency Response to Comments A.(a)iii.3 and A.(a)iii.4.

As discussed above, the 2024 MY requirements can be met with engine calibration modifications and current commercially available SCR systems with heated urea dosing without significantly changing the engine-aftertreatment system architecture. Instead of the heated doser, other engine technologies such as EGR cooler bypass could also be used as demonstrated in the Stage 3 program to raise exhaust temperatures by about 100°C during cold starts and low load operations without GHG penalty. Furthermore, as discussed in Agency Response for Comment A.(a)i.1, CARB staff is providing additional flexibilities proposed in the 30-Day Notice to reduce the time needed to develop an engine-aftertreatment system and enable manufacturers to certify compliant engines and make them available in time for the 2024 market.

- (a)ii.2. Comment: [T]he experimental results produced with the...“Stage 1B/2” technical solution, as configured by SwRI, achieved a “zero-hour” emissions level on the RMC-SET test of 0.001 g/bhp-hr. However, after aging the system to the theoretical equivalent of full useful lives (FUL), the engine and aftertreatment system RMC-SET result was 0.038 g/bhp-hr (with an intermediate point measuring 0.042 g/bhp-hr). While CARB may argue that the Stage 1B/2 system has demonstrated feasibility to a 0.050 g/bhp-hr standard, there is a serious flaw with such an assertion.

If a manufacturer were to present aging results for an engine family certification submission in line with CARB’s Stage 1B/2 RMC-SET feasibility demonstration, the original equipment manufacturers (OEM) would have to declare a multiplicative DF for NO<sub>x</sub> of 38.0 (0.038 aged result ÷ 0.001 “zero-hour” result = 38; DFs are typically less than 2). That means that if a compliance test were conducted on a production sample, and that sample engine generated a “zero-hour” RMC-SET test result of 0.002g/bhp-hr, just 0.001g/bhp-hr higher than the SwRI experimental article – easily within the range of measurement variability – that production engine would fail the compliance assessment against a 0.050g/bhp-hr standard by more than 50% (0.002 g/bhp-hr x 38 = 0.076 g/bhp-hr). In other words, given the rapid deterioration of the SwRI prototype, a production sample that tested at a level of just 4% of the standard, nonetheless would fail the RMC-SET standard. Consequently, CARB has not come close to making a demonstration of the technical feasibility of the 2024 MY 0.050g/bhp-hr standard at FUL, even with an elaborate and complex technical solution for which there is inadequate

development time within the two-year leadtime period that would be available. (EMA, Daimler, Navistar, Volvo)

Agency Response: No changes to the Proposed Amendments were made in response to this comment. As discussed extensively in the ISOR and in Agency Responses to Comments A.(a)i.1, A.(a)i.2, and A.(a)ii.1, the feasibility of the 0.05 g/bhp-hr NOx standard for MY 2024 was not predicated on the final aftertreatment technology package and strategies used in the Stage 1B/2 program and the final test results achieved in that program. As a result, the above comment on DFs does not apply to CARB's requirements for MY 2024. Nonetheless, CARB staff would like to provide some explanation on the emissions degradation observed in the Stage 1B RMC results.

The Stage 1 program objective was to demonstrate the feasibility of 0.02 g/bhp-hr NOx levels without or with minimal GHG impacts. Because of the damage that occurred to the canning of the Stage 1 aftertreatment system during the aftertreatment aging process, the desired results of the Stage 1 program were not achieved. To determine how much of the emissions deterioration was due to the canning failure, a similar aftertreatment system was aged in a new Stage 1B program, and tests were conducted on the same Stage 1 engine. The Stage 1B program resulted in significantly lower NOx emissions of about 0.023 g/bhp-hr FTP NOx compared to 0.034 g/bhp-hr FTP NOx in the Stage 1 program. For RMC, the Stage 1B program resulted in 0.032 g/bhp-hr NOx compared to Stage 1 program result of 0.038 g/bhp-hr NOx. FTP and RMC results clearly showed that the Stage 1 results were heavily impacted by the canning failure of the aftertreatment system. However, RMC results of the Stage 1B program still showed significant deterioration compared to the deterioration observed on FTP. As explained by SwRI,<sup>26</sup> the increased deterioration of the RMC results was associated with ammonia oxidation at the prototype SCR catalyst placed on the DPF (SCRf) due to shift in selectivity caused by possible precious metal contamination left on SCRf surface from incomplete ash cleaning and the high temperatures caused by the elevated backpressure, which resulted in increased NOx emissions at the tailpipe. SwRI assessment was that additional transient SCR control to reduce ammonia oxidation, better substrate designs and coatings, and additional proper ash cleaning to remove precious metal contamination would have recovered the NOx conversion efficiency further to achieve lower NOx emissions at the tailpipe than observed. Thus, CARB staff believes with further improvements in urea injection controls and improved SCR hardware, emission deterioration could have been significantly reduced.

Furthermore, the Stage 1 demonstration program was the first attempt of its kind to demonstrate significantly lower NOx emissions using engine and aftertreatment technologies and strategies that were available in 2014, that is 10 years and 13 years before the proposed implementation dates of the

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<sup>26</sup> "Stage 1b Final Summary Update Report," Sharp, Christopher, Southwest Research Institute, August 30, 2019.

0.05 g/bhp-hr NOx standards and the 0.02 g/bhp-hr NOx standards, respectively. Since then, a number of technologies and strategies with improved emissions performance and durability have been identified. Some of these technologies include dual-dosing split SCR system, CDA, dynamic CDA, advanced turbochargers (e.g., SuperTurbo, electric turbochargers), EGR pump, mild hybrid 48-volt system electrification, and opposed piston engine architecture.<sup>27</sup> Some of these technologies/strategies such as dual-dosing split SCR system and CDA have already been evaluated and demonstrated in the Stage 3 program to achieve significantly lower and durable NOx emissions. Tula and Cummins have been evaluating dynamic CDA, and simulations using engine test data show NOx reduced by 74 percent and carbon dioxide (CO2) reduced by 5.0 percent on the LLC compared to the baseline engine with conventional thermal management. SwRI evaluated SuperTurbo as a thermal management strategy in the Stage 3 program and reported an increase in exhaust temperature of about 70°C with some CO2 penalty. Achates Power continues to develop their opposed piston engine and has reported emissions results that are below the proposed 2027 MY standards for the FTP, RMC, LLC and idle test cycles. In addition to CDA, Eaton is continuing to develop other engine technologies such as the 48-volt driven EGR pump and has reported potential thermal efficiency improvements while meeting the 2027 emissions requirements.<sup>28</sup>

Additionally, a rework of the Stage 3 SCR technology configuration that replaced the zone coated catalyzed soot filter (which combined the functions of both DOC and DPF) with a separate DOC and DPF architecture was evaluated, demonstrating even lower NOx emissions than CARB-funded Stage 3 demonstration program. The Stage 1B/2 program may not have demonstrated the needed durability for the aftertreatment system to achieve 0.02 g/bhp-hr NOx, but the knowledge gained, and lessons learned from the Stage 1B/2 effort was leveraged and applied to improved low NOx technology on a more flexible and representative engine platform under the Stage 3 program.

- (a)ii.3. Comment: The ISOR nonetheless tries to make the case for a 0.050 g/bhp-hr FTP NOx standard by 2024 on the basis of three considerations. First, CARB reports that the SwRI evaluation of a turbocompound engine (the “Stage 1” engine) achieved a 0.090 composite FTP result with “engine calibration only.” Second, CARB asserts that about 40% of HD engine families already have certified FTP/RMC-SET levels below 0.10 g/bhp-hr. And third, CARB cites simulation-model results from MECA (the trade association that represents the manufacturers of exhaust aftertreatment systems) that projected a 0.02 g/bhp-hr result with commercially available aftertreatment systems.

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<sup>27</sup> CARB. “Current and Advanced Emission Control Strategies and Key Findings of CARB/SwRI Demonstration Work. Appendix I to the Staff Report for the Heavy-Duty Omnibus Regulation.” June 23, 2020 (<https://ww2.arb.ca.gov/sites/default/files/classic/regact/2020/hdomnibuslownox/appi.pdf>)

<sup>28</sup> Matheaus, A., Bitsis, D., Hopkins, J., and McCarthy, J., “Improving Brake Thermal Efficiency Using High Efficiency Turbo and EGR Pump While Meeting 2027 Emissions,” Abstract. SAE Technical Paper 2021-01-1154, 2021.

A 0.090 g/bhp-hr FTP demonstration does little to demonstrate feasibility, when, as CARB notes, some 40% of HD engines are already certifying at deteriorated results lower than that level today – some as low as 0.050 g/bhp-hr. There are good reasons why such very low FTP-based certification test results nonetheless still need to utilize the resultant large compliance margins to ensure conformity with all of the HDOH long-term compliance requirements associated with today's 0.20g/bhp-hr NOx standard.

CARB needs to consider all of the factors that manufacturers have taken into account, since they all have made the unanimous determination to certify end-of-useful-life FELs that are no lower than today's standard. CARB should take all of those same factors into account, and should add a similarly sufficient compliance margin to any new proposed 2024 FTP/RMC-SET low-NOx standard. Not doing so will result in those standards being infeasible.

CARB staff would never accept manufacturers' simulation results as a full demonstration of product compliance, so they likewise should not be satisfied with MECA's simulation results as the basis for setting aggressive new emission standards. (EMA, Daimler, Navistar, Volvo)

Agency Response: No changes to the Proposed Amendments were made in response to this comment. CARB staff disagrees with the commenter's statement that CARB staff, in the ISOR, said reaching a 0.09 g/bhp-hr NOx level with engine calibration only demonstrates feasibility of the 0.05 g/bhp-hr NOx standard. CARB staff's mention of the 0.09 g/bhp-hr NOx achieved in the Stage 1 program was mainly to indicate the potential of engine calibration methods in increasing exhaust temperatures and reducing cold-start NOx emissions without changing the aftertreatment system. Moreover, a 0.04 g/bhp-hr NOx level was demonstrated by SwRI in the Stage 1 screening of aftertreatment systems using heated dosing, base engine calibration, and 2014 model traditional SCR system albeit with a small GHG penalty of about 0.5 percent.

Similarly, CARB staff used current engine certification levels as one of several justifications for the feasibility of the proposed 0.05 g/bhp-hr NOx standard. It is true that an engine manufacturer may certify at levels of 0.06 g/bhp-hr NOx to have a large compliance margin to conform with all the applicable requirements, but that does not refute that emissions from the same engine could be further reduced with incremental improvements in the engine and aftertreatment system and certified to below 0.05 g/bhp-hr NOx standard still with enough compliance margin to meet the 0.05 g/bhp-hr NOx standard. It is up to the manufacturer's internal engineering decision to choose the certification level as well as the compliance margin. It is to be noted that there are also manufacturers that certify their engines with little or no compliance margin. However, to the extent that compliance margins are needed when setting a standard, CARB staff has considered compliance margins in setting the 2024 MY requirements. CARB staff

believes that bigger compliance margins can be achieved through relatively moderate increases in catalyst volume or improvements in catalyst substrates, while still maintaining the size of future emission controls below those on MY 2010 trucks. SwRI demonstration of a 0.04 g/bhp-hr provides a compliance margin of about 20 percent while MECA's modeling result of 0.03 g/bhp-hr NOx with an SCR catalyst volume that represents an average SCR volume found on 2019 trucks provides a compliance margin of about 40 percent.

Furthermore, EMA's comment that CARB staff would never have accepted manufacturers' simulation results as a full demonstration of product compliance is speculation on the part of EMA. EMA could have run a simulation model and provided the results to CARB staff for consideration in setting the requirements. But EMA chose not to provide the results of any simulation model. CARB accepted MECA's modeling results because the simulation model has been developed over ten years of commercial system testing and has been correlated with field data providing reliable results.

- (a)ii.4. Comment: CARB's ISOR goes on to posit an array of aftertreatment configurations that manufacturers could deploy to meet the 2024 MY standards. But conceptual drawings do not make the case for the technical feasibility of a 0.050 g/bhp-hr standard by 2024. (EMA, Daimler, Navistar, Volvo)
- (a)ii.5. Comment: In essence then, CARB has not even tried to demonstrate the feasibility of the full suite of low-NOx standards and requirements proposed for the 2024 MY. For example, while the FTP/RMC-SET standard will be set at 0.05 g/bhp-hr, CARB concedes that the demonstration program at SwRI was only able to achieve a 0.09 g/bhp-hr composite FTP/RMC-SET result from the 2024 MY "Stage 1" prototype engine and aftertreatment system. (ISOR, p. ES-12.) (EMA, Daimler, Navistar, Volvo)
- (a)ii.6. Comment: With respect to specific issues of 2024 MY technological infeasibility, it is noteworthy that the schematic for CARB's Stage 1B/2 prototype system...includes a close-coupled passive NOx adsorber (PNA). That device is not a simple add-on, since it has a significant impact on aftertreatment system designs, as well as a significant impact on vehicle and engine packaging to accommodate the installation of the PNA so close to the outlet of the turbocharger. Moreover, multiple PNA washcoat formulations have been developed by several major catalyst suppliers over the recent years, but none have proven sufficiently robust to pass repeated-cold-start durability tests, as conducted by a major engine manufacturer. Additionally, PNAs behave like a sponge with a fixed capacity for NOx adsorption. Once that capacity has been reached, NOx emissions flow through the catalyst unaffected. In that regard, the capacity of a PNA is sized and designed for targeted operating cycles, such that a PNA's effectiveness in-use is highly variable. CARB has not demonstrated any in-use control capability with the

prototype PNA system. In fact, CARB's analysis fails to account for any of the foregoing issues.

Packaging a PNA near the turbocharger also would require a redesign and retooling of many if not all vehicle hoods in the industry. Such a modification to hood designs will have a negative impact on aerodynamics, increasing the emission of greenhouse gases and effectively increasing the stringency of the Phase 2 GHG standards. (EMA, Daimler, Navistar, Volvo)

Agency Response to Comments (a)ii.4 through (a)ii.6: No changes to the Proposed Amendments were made in response to these comments. For a discussion on feasibility of the 0.05 g/bhp-hr standard, please see Agency Responses to Comments A.(a)ii.1 to A.(a)ii.3. As EMA claims above, CARB never conceded that the demonstration program at SwRI was only able to achieve a 0.09 g/bhp-hr composite FTP/RMC-SET result from the 2024 MY "Stage 1" prototype engine and aftertreatment system. Again, as mentioned above, in Agency Response to Comment A.(a)ii.3, the mention of 0.09 g/bhp-hr was only to indicate the potential of engine calibration strategies in raising exhaust temperatures and reducing cold-start emissions.

Furthermore, as discussed above and in the ISOR, the use of PNA was never predicated for meeting the 0.05 g/bhp-hr NO<sub>x</sub> standard for MY 2024. PNA was evaluated to demonstrate feasibility with the 0.02 g/bhp-hr NO<sub>x</sub> standard for 2027 MY engines. EMA may believe that PNA is not durable enough to meet any of CARB staff's proposed exhaust emissions standards. However, PNA is not the only technology solution to meet CARB staff's proposed requirements. As demonstrated in the Stage 1 aftertreatment screening processes and the Stage 3 program, there are also other engine hardware and aftertreatment systems such as durable advanced SCR systems and engine hardware strategies that a manufacturer may use to meet the proposed HD engine requirements.

### **(a)iii. Fuel Economy and GHG Emissions Related to the 2024 MY Standards**

- (a)iii.1. Comment: The ISOR also states that "engine calibration strategies that may be used for rapid exhaust warm-up and reduced engine-out NO<sub>x</sub> may include increased idle speed, intake and exhaust throttling, post injection, and increased EGR rates." Significantly, each of those potential technologies is detrimental to CO<sub>2</sub> control, and, without adequate demonstration as part of a complete technology package, cannot represent a showing of the feasibility of achieving the combination of the proposed 2024 MY low-NO<sub>x</sub> standards and the rigorous 2024 GHG limits. (EMA, Daimler, Navistar, Volvo)

Agency Response: No changes to the Proposed Amendments were made in response to this comment. In Sections III.A.1.2.1 and III.A.1.2.3. of the ISOR as well as in Agency Responses to Comments A.(a)ii.1 and A.(a)ii.2, CARB staff

discussed the feasibility of a 0.05 g/bhp-hr NO<sub>x</sub> standard on the FTP and the RMC-SET and a 0.20 g/bhp-hr on the LLC for MY 2024 through 2026 engines. The analysis showed that no significant changes to the engine and aftertreatment architecture would be necessary for compliance, and it would not significantly impact GHG emissions. In fact, two HD engine families are already certified to a 0.06 g/bhp-hr NO<sub>x</sub> exhaust emission level on the FTP and RMC while also meeting the 2024 MY Phase 2 GHG standards. For these engine families, minor improvements will still be necessary to decrease the FTP and RMC NO<sub>x</sub> emissions to below the proposed 2024 MY standards. For the majority of engine families, improvements will be required in at least one of the following areas: improved engine calibration strategies, improved catalysts with larger volume or better packaging, thin-walled high-cell density catalyst substrates, and heated dosing or EGR cooler bypass. Many of these technologies are off-the-shelf technologies where manufacturers can select and create a technology system design in which the engine would meet the proposed standards.

Engine calibration strategies such as increased idle speed, increased EGR, intake air or exhaust throttling, and post injection may be needed when the engine is cold (such as for example for the cold FTP test during the first 475 seconds), for rapid warm up of the exhaust or to reduce engine-out NO<sub>x</sub> or both. While these engine calibration techniques used to increase exhaust temperatures and reduce NO<sub>x</sub> emissions may inherently increase CO<sub>2</sub> emissions, these strategies may be optimized in order to minimize any GHG emission impacts. For example, one strategy of offsetting the additional CO<sub>2</sub> emissions produced during the cold operation, is to operate the engine, once it is warm, at a higher fuel economy mode with higher engine-out NO<sub>x</sub> emissions and subsequently reduce the higher engine-out NO<sub>x</sub> with high conversion efficiency, improved SCR systems. As discussed in the following paragraphs, other emission control options that do not impact GHG emissions may be utilized in combination with engine calibrations to increase exhaust temperatures during cold start. Furthermore, manufacturers' need to comply with existing Phase 2 GHG requirements would prevent them from employing strategies that impact GHG emissions. See also Agency Responses to Comments A.(a)iii.3 and A.(a)iii.4. For example, one strategy of offsetting the additional CO<sub>2</sub> emissions produced during the cold operation is to operate the engine, once it is warm, at a higher fuel economy mode with higher engine-out NO<sub>x</sub> emissions and subsequently reducing the higher engine-out NO<sub>x</sub> with high conversion efficiency improved SCR systems.

Additionally, instead of the engine calibration strategies, a manufacturer may use an EGR cooler bypass to keep the exhaust temperature hot and enable quicker light-off of the existing SCR. In the Stage 3 engine hardware evaluation process, under steady state tests of 1000 revolutions per minute (rpm) and 2.5 bar brake mean effective pressure (BMEP), a 100 percent EGR cooler bypass provided a temperature increase of 100 degrees Celsius (°C) without any additional fuel penalty. This may be combined with more precise urea injection controls as well

as improved ammonia storage management of the SCR to decrease exhaust emission levels below the proposed FTP, RMC, and LLC standards without any impact on GHG emissions. In addition, instead of an EGR cooler bypass, a manufacturer could use heated urea dosing to enable injection of urea at lower exhaust temperatures without the formation of deposits in the emission control system, which would result in minimal or no GHG increases.

Another possibility is to place an additional SCR upstream of the DPF to take advantage of the hot exhaust coming out of the DOC. This configuration can be packaged as a compact, one box system for additional optimization. As announced by Cummins Emissions Solutions, even more advanced SCR systems have already been developed for commercial use to meet current NOx standards.<sup>29</sup> The SCR architecture developed by Cummins includes a close-coupled dual-dosing twin SCR system for use on Scania V8 engines. Additionally, Appendix I of the ISOR references technical papers that describe potential emission control technologies, which would not impact fuel economy, including air gap insulated exhaust manifolds, advanced catalyst substrates, and DEF management controls.

Furthermore, a manufacturer could comply by pursuing hybrid or HD ZEV technologies. The NOx credits generated from HD ZEV sales in the CA-ABT program could be used to offset NOx emissions from engines that have been certified to FELs above the applicable proposed emissions standards. Another method of compliance is that a manufacturer could use existing diesel engine technology coupled with mild hybrid systems as a way to reduce both criteria and GHG emissions.

In summary, while some engine calibration strategies may increase GHG emissions, as discussed above, a manufacturer may choose emission control options that would not increase GHG emissions such as an EGR cooler bypass, aftertreatment changes, packaging optimization, and mild hybridization. A manufacturer may also consider generating or purchasing credits in the amended ABT program, such as HD ZEV credits newly introduced in the ABT program that could be used to meet 2024 through 2026 MY requirements, described in more detail in subparagraph I.15.B.3.(j) of the Diesel Test Procedures.

- (a)iii.2. Comment: CARB also concedes that its 2024 MY requirements likely will result in fuel-penalties of at least 2-3%. Similarly, CARB has not demonstrated the feasibility of the proposed LLC standard (or the 3B-MAW standards) with the Stage 1B/2 prototype, nor has CARB quantified the additional fuel penalty that will result from the compliance requirements with the LLC and the lower idle emission standards (which will require higher idle speeds). (EMA, Daimler, Navistar, Volvo)

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<sup>29</sup> Cummins develops dual-dosing system for the new Scania V8, News Release, Cummins, February 22, 2021. <https://www.cummins.com/news/releases/2021/02/22/cummins-develops-dual-dosing-system-new-scania-v8> – accessed 3/1/2021

Agency Response: No changes to the Proposed Amendments were made in response to this comment. CARB staff disagrees with EMA's comment that CARB staff conceded that the 2024 MY requirements would result in at least 2-3 percent fuel penalty. It is true that the final demonstration of the Stage 1 program resulted in a 2 to 3 percent fuel penalty. However, this fuel penalty occurred in the course of demonstrating a 0.02 g/bhp-hr NO<sub>x</sub> on a turbocompound engine which used a miniburner for thermal management and not in trying to demonstrate the 2024 MY requirements as EMA alludes to in the above comment. A miniburner would not be needed to meet the 2024 MY requirements, and thus a fuel consumption penalty from the miniburner of 2 to 3 percent would not be expected with meeting the 2024 MY requirements.<sup>30</sup> In demonstrating a 0.02 g/bhp-hr NO<sub>x</sub>, the turbocompound engine presented limited options for addressing on engine controls such as exhaust bypasses for turbocharger or charge air cooler or EGR cooler, requiring SwRI to use a complicated aftertreatment system which included the miniburner and thus the resulting fuel penalty. Meeting the 2024 MY requirements, however, would not require the miniburner and thus would not have 2-3 percent fuel penalty. For information regarding the technologies with minimal or no fuel/GHG emission impacts for 2024 MY compliance, please see Agency Response to Comment A.(a)iii.1 as well as Agency Responses to Comments A.(a)iii.3 and A.(a)iii.4.

MECA's modeling demonstrated NO<sub>x</sub> LLC levels as low as 0.18 g/bhp-hr using as input engine calibration strategies from the SwRI Stage 1 engine, heated dosing, and ammonia management strategies with commercially available aftertreatment system. These emission control strategies are not expected to result in any GHG penalty. For additional information regarding technological feasibility and the fuel impact on the LLC, please see the Agency Response to Comment A.(a)vii.2. For a response to the comment regarding the feasibility of the idle standard, please see the Agency Response to Comment A.(a)viii.2. For a response to the comment regarding the feasibility of the 3B-MAW standards, please refer to the Agency Response to Comment A.(b)i.1.

- (a)iii.3. Comment: With respect to specific fuel-economy concerns, CARB has not demonstrated (through its work at SwRI or otherwise) that any system that purportedly could meet the planned 2024 NO<sub>x</sub> reductions also could comply with the Phase 2 GHG standards, or meet the same performance over the EPA/CARB engine fuel maps when assessed in [Greenhouse Gas Emissions Model] GEM, without additional vehicle technologies. If more technologies or system modifications are needed, that essentially constitutes an unauthorized back-door increase in the stringency of the GHG Phase 2 engine and vehicle standards.

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<sup>30</sup> Sharp, Christopher A., Cynthia C. Webb, Gary D. Neely, and Ian Smith, Webb. "Evaluating Technologies and Methods to Lower Nitrogen Oxide Emissions from Heavy-Duty Vehicles," Southwest Research Institute, Project No. 19503, Final Report, April 2017.

For example, if a given NOx technology had a \$1,000 per-engine cost and a 1.0% fuel penalty, that penalty would need to be assessed in a similar—but opposite—manner as EPA did in its HD GHG Phase 2 Rulemaking. First, CARB would need to identify new technologically-feasible fuel-saving technologies to offset the fuel-penalizing NOx technology. Those technologies would need to be above and beyond all those that EPA (and CARB) already identified in the Phase 2 rulemaking. Even if a hypothetical new fuel-saving technology was both feasible within the limited leadtime provided, and optimistically had the same \$1079 cost per-percent fuel-efficiency improvement as shown in EPA’s HD GHG Phase 2 rulemaking,<sup>31</sup> that would nearly double the assumed \$1,000 low-NOx technology cost: \$2079 per engine (\$1,000 + \$1079). However, if CARB were not able to identify new fuel-savings technologies to offset the fuel-penalizing NOx technologies, then the feasibility of the HD GHG Phase 2 standards would need to be reassessed.

Further, before any low-NOx technology could be deemed not to result in a fuel penalty, that technology would need to be evaluated in a manner consistent with the Phase 2 engine FTP/RMC-SET standards, the Phase 2 GEM-based vehicle standards, and under real-world driving conditions. CARB has not conducted any aspect of that necessary full fuel-penalty assessment. Rather, SwRI has simply concluded that CARB-sponsored Stage 1B/2 system results in a 2.5% fuel penalty on the FTP and a 1.6% fuel penalty on the RMC-SET, before even considering any GEM-based or real-world results. Thus, CARB has failed to address this core feasibility issue in any sufficient manner. (EMA, Daimler, Navistar, Volvo)

- (a)iii.4. Comment: Tellingly, CARB admits that manufacturers “may find it more difficult to comply with the 2024 GHG standards because of the Proposed Amendments.” (ISOR, p. III-26.) CARB’s answer to that is simply to state that manufacturers “may need to add additional GHG technologies to bring their engine families into compliance with the 2024 Phase 2 GHG standards,” without providing any evidence of the feasibility (or associated costs) of doing so between the time that the Omnibus Regulations would be finalized and the start of the 2024 MY. Here again, CARB has utterly failed to prove the feasibility or reasonableness of its Omnibus proposals. (EMA, Daimler, Navistar, Volvo)

Agency Response to Comments (a)iii.3 and (a)iii.4: No changes to the Proposed Amendments were made in response to the comments. While some engine calibration changes may be needed to comply with the proposed 2024-2026 MY standards, a manufacturer may choose from various options that would not impact the engine fuel map, which is an input to the GEM model to determine vehicle GHG compliance. For example, changes may be made to the

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<sup>31</sup> See U.S. EPA estimates from 2016 HD Greenhouse Gas Phase 2 Regulation at 81FR73559, Table II-7, and also pp. 73620-73621, Tables III-26 and III-27.

aftertreatment system to improved catalysts with larger volume or better packaging or thin-walled high-cell density catalyst substrates or EGR cooler bypass.

Even if the engine map is modified to optimize a calibration, a manufacturer may fine-tune the calibration such that there are minimal GHG impacts while relying on other engine emission control strategies, such as an EGR cooler bypass or aftertreatment improvements, for additional NOx emission control. It should be noted the SwRI testing conducted on the Stage 1B/2 system was to evaluate potential emission control technologies to comply with the proposed 2027 0.02 g/bhp-hr NOx, not the 2024 0.05 g/bhp-hr NOx. Many of the expected 2024 MY emission control strategies would not impact fuel economy. For further information on CARB staff's analysis for the emission control technologies necessary to comply with the 2024 NOx standard, please see the Agency Responses to Comments A.(a)ii.1 through A.(a)ii.3 and A.(a)iii.1.

Although CARB staff also does not generally expect that there would be any GHG emission penalty to comply with the proposed 2024-2026 MY NOx standards, meeting the proposed 0.05 g/bhp-hr NOx standard simultaneously with the 2024 Phase 2 GHG standards may make it more difficult to comply on some engines. If a manufacturer finds it more difficult to comply with the 2024 GHG standards because of the 2024-2026 MY NOx requirements, the manufacturer may need to add additional GHG technologies such as further combustion efficiency improvements associated with engine friction reduction, piston coatings, and fuel injection system improvements to bring its engine families into compliance with the 2024 Phase 2 GHG standards. Thus, in the ISOR section IX.B.1.1, CARB staff had conservatively added an additional one percent of GHG penalty to the cost of GHG technology needed to reduce GHG emissions. CARB staff used U.S. EPA's technology cost estimates in the federal Phase 2 GHG Regulation to estimate incremental costs per vehicle for every one percent of GHG emission reductions. As noted in the ISOR, the resulting additional GHG technology costs for 2024-2026 MY engines are \$501 for HHDD engines and \$100 for medium-duty, light heavy-duty diesel (LHDD), and MHDD engines (which equates to a small approximately 0.33 percent increase in cost for a new \$150,000 Class 8 sleeper cab tractor<sup>32</sup> and even smaller 0.13 percent increase in cost for a \$75,000 new Class 6 HD box truck.<sup>33</sup>)

- (a)iii.5. Comment: CARB's ISOR sets forth CARB's assessment of the technical feasibility of the proposed progressively-lower NOx standards for HDOH engines, which standards would apply to model years 2024-2026, and to 2027 and subsequent model years. [T]he low-NOx standards that CARB staff

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<sup>32</sup> How Much Does a New Semi Truck Cost? (<https://www.costowl.com/automotive/auto-semi-truck-new-cost.html>) - accessed 7/23/2021)

<sup>33</sup> How Much Does a New Box Truck Cost? (<https://www.costowl.com/automotive/auto-box-truck-new-cost.html>) - accessed 7/23/2021)

envision under the Omnibus Regulations...almost certainly would require increased fuel and DEF consumption rates. (EMA, Daimler, Navistar, Volvo)

Agency Response: No change to the Proposed Amendments was made in response to this comment. As noted in the Agency Responses to Comments A.(a)iii.1 and A.(a)iii.2, fuel consumption should be minimally impacted based on CARB staff's analysis in the ISOR. While some emission control strategies may increase fuel consumption rates, many other strategies may be used in place of or in combination with strategies that reduce fuel consumption to minimize overall fuel consumption and GHG emission impacts.

Since the proposed standards are designed to reduce NOx emissions significantly under the majority of vehicle operations including those operations currently not controlled using SCR, such as low load urban driving and idling, it is expected that more DEF will be consumed to meet the proposed requirements compared to current emission control calibrations. CARB staff has considered cost impacts of the additional DEF consumed. Table IX-7 of the ISOR summarizes the annual total incremental change in operational costs due to DEF consumption for 2024-2026 and 2027+ MY engines by engine service class. Depending on the intended engine service class for 2024-2026 MY engines, the annual incremental DEF consumption cost ranges between approximately \$29 to \$90 (in 2018\$) and between approximately \$24 to \$108 (in 2018\$) for 2027 and subsequent MY engines. Please see also Agency Response to Comments A.(a)iii.3 and A.(a)iii.4.

- (a)iii.6. Comment: Significantly, many of the engine technologies that might be deployed to make up for the fuel-efficiency losses at issue have the effect of reducing exhaust temperatures, which compounds the challenge of achieving additional NOx reductions...CARB clearly has not done an adequate job of quantifying the aggregate adverse fuel-economy impacts of its Omnibus proposals. Nonetheless, analyzing the RMC-SET modal data that EMA obtained from SwRI, EMA has attempted to assess corresponding GEM fuel maps. Compared to GEM results using EPA's 2024 MY stringency fuel maps, CARB-sponsored Stage 1B/2 technology and calibrations resulted in additional significant fuel penalties for each of the Phase 2 vehicle categories. (EMA, Daimler, Navistar, Volvo)

Agency Response: No changes to the Proposed Amendments were made in response to this comment. CARB staff never assumed that the aftertreatment system with a miniburner used in the Stage 1/2B program would justify the feasibility of the requirements for MY 2024. In Appendix I of the ISOR, CARB staff referenced technical papers that describe various potential emission control strategies. Many of these technologies, such as EGR cooler bypass, airgap insulated exhaust manifolds, heated DEF dosing, advanced catalyst substrates, and DEF management controls, were demonstrated in the SwRI Stage 3 program to substantially improve NOx control at current exhaust temperatures or

help maintain higher exhaust temperature and improved NOx control during extended operation at low engine loads. It should be noted the SwRI testing conducted on the Stage 1B/2 system was to evaluate potential emission control technologies to comply with the proposed 2027 0.02 g/bhp-hr NOx standard, not the 2024 0.05 g/bhp-hr NOx standard. Many of the expected 2024 MY emission control strategies would not impact fuel economy. For further information on CARB staff's analysis for the emission control technologies necessary to comply with the 2024 NOx standard, please see the Agency Response to Comment A.(a)iii.1. For further discussion on fuel or CO2 penalties to meet the 2024 MY standards, please see the Agency Response to Comments A.(a)iii.3 and A.(a)iii.4.

- (a)iii.7. Comment: [M]anufacturers essentially have finalized the architecture, hardware, and performance specifications for their engines and aftertreatment systems to meet the 2024 MY Phase 2 GHG standards. Consequently, CARB's proposals for sweeping low-NOx requirements in 2024 will create unworkable disruptions to manufacturers' product-development and readiness plans, and, given the inherent trade-off between lower NOx and higher GHG emissions, unacceptable increases in fuel-consumption and GHGs, thereby threatening manufacturers' implementation of cost-effective compliance strategies for the Phase 2 GHG standards. Accordingly, not only are CARB's low-NOx proposals infeasible on the proposed timeline, but also any low-NOx technologies or calibrations that might be implementable could render the Phase 2 GHG standards infeasible as well, especially for the 2024 timeframe, since Phase 2's largest increase in the tractor-engine CO2-standard stringencies occurs in the 2024 MY, relative to EPA's Phase 2 baselines. But more fundamentally, and as noted, manufacturers' design and production plans are already established for the 2024 MY, which, again, makes the type of redesign-forcing low-NOx program that CARB has proposed inherently unworkable and infeasible. The impacts of the ongoing COVID-19 crisis only exacerbate those fundamental constraints. (EMA, Daimler, Navistar, Volvo)

Agency Response: No changes to the Proposed Amendments were made in response to this comment. With the release of CARB's white paper on April 18, 2019, CARB staff informed affected stakeholders, such as engine manufacturers, of the basic elements of the proposed Omnibus Regulation, including the proposed emission standards for FTP, RMC, and LLC. CARB staff's proposed emission standards in the final proposal in the ISOR and subsequently approved by the Board at the August 27, 2020 Hearing are identical to those released in the white paper, and thus, engine manufacturers have been aware of these reduced emission standards since 2019. That being said, engine manufacturers have had time to begin the planning and design process anticipating the finalizing of these lower emission standards. In addition, CARB staff's analysis showed that no significant changes to the engine and aftertreatment architecture would be necessary for compliance and thus should not require disruptions to

manufacturers' product-development and readiness plans. For more information on emission control strategies for 2024 MY compliance, please see Agency Response to Comment A.(a)iii.1. For a response to the comment regarding the on-going COVID crisis, please refer to the Agency Response to Comment A.(l)vi.4.

- (a)iii.8. Comment: Another critical feasibility issue relates to whether the Low-NOx Regulations will adversely impact compliance with the GEM-based vehicle-level Phase 2 GHG standards. Any impact to GEM outputs from the engine designs and calibrations required to meet the Low-NOx standards could disrupt manufacturers' ability to comply with the Phase 2 vehicle standards.

In that regard, while some GEM simulations may be included in the future as part of the SwRI low-NOx research project, it is unlikely that those limited simulations, if they are actually completed, will establish the continued feasibility of the Phase 2 Standards. A major OEM has performed GEM simulations using one of their 2021 MY GHG and criteria emissions-compliant engines. Those GEM simulations were coupled with EPA's "stringency setting vehicle" design configurations. EPA used those stringency-setting vehicle configurations to establish the 2021 MY CO<sub>2</sub> vehicle-emission standards, by powering the vehicles with an engine fuel map from a theoretical "stringency engine." Vehicle CO<sub>2</sub> targets were thereby established for the various HDOH vehicle categories. The OEM conducted the GEM analysis on over 100 customer vehicle configurations, modeling them with both the EPA stringency-setting engine, and the OEM's 2021 MY emissions-compliant engine. When simulated over a range of vehicle regulatory categories (vocational, line-haul, heavy-haul) and engine ratings matching those of the stringency-setting engine, the OEM's engine design generated GEM outputs anywhere from 1.6% to 13.8% worse than the stringency-setting engine, though both were compliant with the 2021 engine-based CO<sub>2</sub> standards. That work amounts to additional support for the conclusion that CARB's proposed low-NOx standards are infeasible, especially when assessed in the context of the previously adopted Phase 2 GHG standards.

Designing for criteria emissions and GHG (engine and vehicle) compliance is a very challenging engineering effort. The foregoing analysis performed by the OEM shows how much variation in tailpipe emissions there can be with very similar test articles (the simulated vehicles were identical, and the engines were similarly compliant). Thus, the research discussed above clearly illustrates that when setting aggressive new NOx standards, while also adding new certification cycles and protocols, the resultant deviations in GEM performance can widen considerably. CARB has failed to address this additional, critically important issue, which is another material deficiency in this rulemaking. (EMA, Daimler, Navistar, Volvo)

Agency Response: No change to the Proposed Amendments was made in response to this comment. For 2024 MY compliance, CARB staff disagrees with the commenter that the low NOx engine fuel maps will significantly impact GEM and its vehicle-based outputs. As discussed in Sections III.1.2.1 and III.1.2.3. of the ISOR, CARB staff's analysis of the feasibility of the 2024 MY standards showed that no significant changes to the engine and aftertreatment architecture would be necessary for compliance and that it would not significantly impact GHG emissions or fuel increases. Additionally, many of the available emission control technologies do not impact the engine fuel map, such as EGR cooler bypass and improvements to the aftertreatment system. For further information on the technologies available for 2024 MY compliance that do not impact fuel usage, please refer to the Agency Response to Comment A.(a)iii.1.

- (a)iii.9. Comment: As noted, in addition to the proposed NOx reductions, CARB also is proposing to reduce the PM standard from 0.01 to 0.005 g/bhp-hr... However, the increase in backpressure that would result from manufacturers adopting "less porous" DPFs would (again) cause higher CO2 emissions. CARB has not quantified the CO2 penalty associated with requiring the use of DPFs with higher filtration efficiency. (EMA, Daimler, Navistar, Volvo)

Agency Response: No change to the Proposed Amendments was made in response to this comment. As discussed in section III.A.2. of the ISOR and in Agency Response to Comment A.(a)ii.1, to comply with the current 0.01 g/bhp-hr PM standard that has been in place since the 2007 MY, typical certification data show that most engines have PM certification levels well below the standard, certifying close to 0.001 g/bhp-hr. Over the last few MYs, however, a few engine families have been certified to PM emission levels that are much higher than they used to be certified, about 0.01 g/bhp-hr. CARB staff suspects that the reason for the increase in PM emission levels may be due to engine manufacturers choosing to use less efficient (more porous) DPFs to reduce engine backpressure and improve fuel economy. This DPF change would result in higher PM emission levels, although still compliant with the current PM standard. Thus, to prevent backsliding and maintain current robust PM emission control performance at 0.001 g/bhp-hr levels, the proposed PM standard is 0.005 g/bhp-hr. For most engines, the proposed 0.005 g/bhp-hr does not change the DPF system currently in use.

To determine if the proposed PM standard would impact GHG emissions, CARB sponsored low NOx engine demonstration monitored for any PM standard compliance implications of the strategies employed to simultaneously meet NOx and GHG targets, and no impacts were found.<sup>34</sup> Thus, CARB staff believes that the proposed PM standard is feasible with existing DPF aftertreatment systems

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<sup>34</sup> Khalek, I., Badshah, H., Premnath, V., and Brezny, R., "Solid Particle Number and Ash Emissions from Heavy-Duty Natural Gas and Diesel w/SCR Engines," SAE Technical Paper 2018-01-0362, 2018, <https://doi.org/10.4271/2018-01-0362>.

and would ensure that the best DPF technologies continue to be utilized for the maximum control of toxic diesel PM emissions.

**(a)iv. New 2027 and Subsequent MY NO<sub>x</sub> Emission Standards for HD Engines**

- (a)iv.1. Comment: CARB again has not made a sufficient showing of feasibility. While CARB's demonstration testing at SwRI focuses on the technology set described above, CARB's ISOR goes on for four pages describing various presentations, papers, research programs and similar endeavors related to other potential low-NO<sub>x</sub> technologies and calibration strategies (ISOR, pp. III-17 through 21.) Such passing references to academic work and aftertreatment-supplier development efforts do nothing, however, individually or in combination, to make the case for the technical feasibility of FUL-compliance with CARB's proposed 2027 MY standards, while simultaneously meeting all of the Phase 2 GHG obligations already on the books in the same timeframe. (EMA, Daimler, Navistar, Volvo)

Agency Response: No change to the Proposed Amendments was made in response to this comment. As described in the ISOR, CARB staff's proposal is supported with a multimillion dollar funded low NO<sub>x</sub> demonstration program conducted by a well-established research institution, the SwRI, in collaboration with major engine manufacturers and component suppliers including aftertreatment system and engine hardware developers. EMA, as a member of the Program Advisory Group, was periodically updated on the progress of the research program and provided input to the progress of SwRI's low NO<sub>x</sub> program. In addition, CARB staff also used publicly available information including papers published by research engineers in the HD engine industry including engine manufacturers, component suppliers, and the academia to support the feasibility of the proposed 2027 MY standards. CARB staff believes the additional information from published literature is as important as the demonstration program itself in supporting CARB staff's proposal and thus the inclusion of it in the ISOR. Thus, CARB staff disagrees with the commenter that the developed prototype engine and aftertreatment technologies demonstrated at SwRI and the research and testing done by others is not sufficient to demonstrate feasibility of the 2027 standard. As to the comment about meeting the standards at full useful life, please see Agency Response to Comment A.(a)iv.2. With regards to what impacts the 2027 standards would have on meeting the Phase 2 GHG standards, please see Agency Responses to Comments A.(a)vi.2 and A.(a)vii.2.

- (a)iv.2. Comment: CARB's statement that "technologies exist today that are capable of meeting the proposed 2027 NO<sub>x</sub> standards" (ISOR p.III-16) is simply not true. Again, while it is true that CARB can list emission control strategies and components that do exist, those multiple components and strategies have never been fully deployed in a production-ready HD diesel engine, and have never been installed in any HDOH vehicle, not even in a prototype vehicle as

a part of CARB's "demonstration" work at SwRI. Thus, there is no evidence whatsoever in this rulemaking record to establish that: (i) the large and complex multi-component "Stage 3" prototype aftertreatment system that CARB is relying on could be sized, configured and installed in a drivable HDOH vehicle; (ii) CDA systems can be developed in a sufficient manner to reduce the noise, vibration and harshness issues that have stymied those systems' introduction into HDOH vehicles to date; (iii) the Stage 3 prototype, if ever installed in a HDOH vehicle, could meet the proposed 3B-MAW standards; (iv) the Stage 3 engines and vehicles that CARB is envisioning could still meet the Phase 2 GHG standards in a cost-efficient manner, or in a manner that would not undermine the cost-effectiveness and feasibility premises of the Phase 2 GHG rulemaking; (v) the complex multi-component Stage 3 prototype engine and aftertreatment configuration could ever meet the durability and FUL requirements that CARB is establishing as additional elements of its Omnibus Regulations, especially since CARB concedes that the initial Stage 3 prototype was "aged" only to the current useful life period of 435,000 miles, and that the final prototype has only been aged to 290,000 miles (ISOR, p. III-27), not the 800,000 mile FUL that the Omnibus Regulations will mandate; or (vi) the complex Stage 3 prototype engine and aftertreatment system could ever be equipped with sufficient OBD sensing and diagnostic capabilities to satisfy the other myriad HD OBD Regulations that CARB has imposed as preconditions to the certification of HDOH vehicles and engines. (EMA, Daimler, Navistar, Volvo)

Agency Response: No change to the Proposed Amendments was made in response to this comment. CARB staff believes that technologies exist today that are capable of meeting the proposed 2027 NOx standards. Many of the technologies listed in the ISOR have already been screened and used in the final demonstration of the Stage 3 program to demonstrate the feasibility with the 2027 standards on current production engines. In the above comment, EMA refers to CARB's supposed failure to demonstrate the Stage 3 aftertreatment system on a production-ready HD diesel engine and installed on a vehicle. CARB staff does not agree with the above comment as CARB is not responsible for fully deploying the 2027 prototype aftertreatment system in a "production-ready" HD diesel engine and installing it on a HD vehicle. Historically, CARB or U.S. EPA never have had to develop a whole engine and aftertreatment system, integrate them on a vehicle, and run them in the field to demonstrate the feasibility of any of the previous standards. For example, the HD engine certification standards are engine dynamometer-based standards, and therefore U.S. EPA and CARB have historically demonstrated feasibility on engine dynamometer rather than on a vehicle. As another example, the existing HDIUT program, which relies on emissions measurements when the vehicle is in-use, was never demonstrated on vehicle by either CARB or U.S. EPA. The in-use thresholds for the HDIUT were provided as multiples of the engine dynamometer certification standards and were never based on emissions measured by testing vehicles in-use. CARB staff believes it is each manufacturer's responsibility to design and develop a

“production-ready” engine-aftertreatment system and test it installed on a vehicle. It is more appropriate for individual manufacturers rather than regulatory agencies to conduct this detailed design and production work, after regulatory agencies establish the technical feasibility of the standards. Each item listed in the above comment is discussed in detail below.

(1) First, EMA states that CARB did not demonstrate the *“large and complex multi-component “Stage 3” prototype aftertreatment system could be sized, configured and installed in a drivable HDOH vehicle.”* It is true that CARB did not demonstrate the Stage 3 prototype aftertreatment system installed on a vehicle. However, except for the addition of the small close coupled SCR catalyst upstream of the DOC, the downstream aftertreatment system demonstrated was a “one box” aftertreatment system that includes both the DPF and the SCR system in one box. This technology is currently an existing system on engines produced by Volvo<sup>35</sup> and Detroit Diesel engines.<sup>36</sup> Thus, CARB staff believes that the downstream system will not bring any significant complexities integrating it on the vehicle since similar systems are being integrated with vehicles today. However, some engineering work may be needed to shift and relocate under-hood components to accommodate the light-off SCR close to the turbocharger in the engine compartment. While fitting the light-off SCR under-hood close to the turbocharger may present some complexities, it is considered feasible for 2027 MY engines coming to the market in six years. In fact, Cummins Emissions Solutions just recently announced that it successfully integrated a close-coupled dual-dosing twin SCR architecture that is similar to the Stage 3 aftertreatment system on a Scania V8 engine in Europe.<sup>37</sup> Cummins is the first to introduce dual-dosing architecture to the trucking industry, bringing a solution capable of meeting the next low NOx levels being proposed in North America and Europe. In addition, manufacturers have been given enough lead time to develop a complete system that meets the 2027 requirements as well as to resolve any issues that may arise with the integration of the engine-aftertreatment system into each of their vehicles.

(2) EMA further states that CARB did not demonstrate *“CDA systems can be developed in a sufficient manner to reduce the noise, vibration and harshness issues (NVH) that have stymied those systems’ introduction into HDOH vehicles to date.”* CARB staff understands that NVH issues associated with CDA systems need to be addressed not only during engine dynamometer testing but also in-use during vehicle operation, since NVH issues on a vehicle are different than on an engine dynamometer. At the beginning of the Stage 3 demonstration program, SwRI and Eaton, the manufacturer which supplied the CDA technology,

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<sup>35</sup> Volvo One-Box Aftertreatment. <https://www.volvotrucks.us/trucks/emissions/> - accessed 6/17/2021

<sup>36</sup> “The Aftertreatment Treatment” Transport Topics. September 21, 2018  
<https://www.ttnews.com/articles/aftertreatment-treatment> - accessed 6/17/2021)

<sup>37</sup> Cummins develops dual-dosing system for the new Scania V8, News Release, Cummins, February 22, 2021. <https://www.cummins.com/news/releases/2021/02/22/cummins-develops-dual-dosing-system-new-scania-v8> – accessed 3/1/2021.

conducted linear and torsional vibration measurements and developed a CDA control strategy that avoided NVH problems on the test engine.<sup>38 39</sup> In addition, OEMs and component suppliers in many parts of the world are conducting extensive testing to address NVH issues with CDA technology including testing on engine dynamometer and installing on vehicles to meet future criteria pollutant and GHG emissions regulations.<sup>40 41</sup> For example, as of late 2020, Jacobs Vehicle Systems reported they had conducted extensive testing of CDA components (including High Power Density® or HPD® engine brake technology) on 19 different HD engine platforms and eight HD truck road tests demonstrating CDA's durability over more than 75,000 miles of driving and 15,000 hours of dynamometer and endurance testing.<sup>42</sup> Moreover, Jacobs Vehicle Systems recently announced that its HPD® engine brake technology that uses CDA mechanisms went into production with a major Chinese truck manufacturer.<sup>43</sup> Thus, significant CDA development activity to resolve NVH issues as well as improve engine emissions and efficiency is being carried out by manufacturers and technology developers. CARB staff believes CDA technology will become feasible by 2027 if not earlier.

(3) EMA also states that CARB did not demonstrate “*the Stage 3 prototype, if ever installed in a HDOH vehicle, could meet the proposed 3B-MAW standards.*” As already mentioned above, it is true that CARB staff did not install the Stage 3 aftertreatment system on a vehicle to collect in-use emissions data. However, SwRI did collect emissions data by testing the Stage 3 aftertreatment system on an engine dynamometer on a simulated CARB Southern NTE Route—a route that CARB frequently uses for in-use compliance testing. The emissions data collected were analyzed using the 3B-MAW method and the results showed compliance with the proposed in-use thresholds for all the three bins – idle, low load, and mid/high load bins. See also Agency Responses for Comments in (b), for further discussion on feasibility of 3B-MAW in-use testing protocol.

(4) EMA also states that CARB did not demonstrate that “*the Stage 3 engines and vehicles that CARB is envisioning could still meet the Phase 2 GHG*

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<sup>38</sup> Neely, G., Sharp, C., Pieczko, M., and McCarthy, J., “Simultaneous NOx and CO2 Reduction for Meeting Future California Air Resources Board Standards Using a Heavy-Duty Diesel Cylinder Deactivation-NVH Strategy,” SAE Int. J. Engines 13(2):191-209, 2020, DOI: <https://doi.org/10.4271/03-13-02-0014>.

<sup>39</sup> Reinhart, T., Matheaus, A., Sharp, C., Peters, B., Pieczko, M. and McCarthy Jr., J., “Vibration and emissions quantification over key drive cycles using cylinder deactivation,” International Journal of Powertrains (IJPT), 2020 Vol.9 No.4, page(s): 315 - 344. DOI: 10.1504/IJPT.2020.111245.

<sup>40</sup> The Latest Developments in CDA Technology. <https://www.jacobsvehiclesystems.com/blog/latest-developments-cda-technology> - accessed 5/17/2021.

<sup>41</sup> Srinivasan, V., Wolk, B., Cai, X., Henrichsen, L. et al., “Application of Dynamic Skip Fire for NOx and CO2 Emissions Reduction of Diesel Powertrains,” SAE Technical Paper 2021-01-0450, 2021. <https://doi.org/10.4271/2021-01-0450> .

<sup>42</sup> “The Latest Developments in CDA Technology.” <https://www.jacobsvehiclesystems.com/blog/latest-developments-cda-technology> - accessed 5/17/2021.

<sup>43</sup> “Jacobs High Power Density Engine Brake Specified by Chinese Truck maker,” News and Events, Jacobs, November 10, 2020. <https://www.jacobsvehiclesystems.com/news-events/jacobs-high-power-density-engine-brake-specified-chinese-truck-maker> – accessed 3/9/2021.

*standards in a cost-efficient manner, or in a manner that would not undermine the cost-effectiveness and feasibility premises of the Phase 2 GHG rulemaking.”* The objective of the Stage 3 program was to demonstrate low NOx emissions with minimal to no impacts to GHG emissions. To that end, SwRI has demonstrated on a thermally and chemically aged Stage 3 prototype aftertreatment system, NOx conversion efficiencies of approximately 99.2 percent on the composite FTP, 97.9 percent on the LLC, and 99.4 percent on the RMC while at the same time maintaining GHG emissions at levels comparable to the baseline. In addition, on the Phase 2 GHG cycles, the Stage 3 engine produced CO2 levels either comparable to or lower than the baseline engine over a wide variety of vehicle configurations and application classes. Thus, CARB’s objective of demonstrating low NOx with minimal to no impacts to GHG emissions was achieved.

(5) EMA further states that CARB did not demonstrate the *“multi-component Stage 3 prototype engine and aftertreatment configuration could ever meet the durability and full useful life requirements that CARB is establishing as additional elements of its Omnibus Regulations, especially since CARB concedes that the initial Stage 3 prototype was “aged” only to the current useful life period of 435,000 miles, and that the final prototype has only been aged to 290,000 miles (ISOR, p. III-27), not the 800,000 mile full useful life that the Omnibus Regulations will mandate.”* It is true that the proposed full useful life emission standards were not demonstrated at the full useful lives of 600,000 miles for 2027 and 800,000 miles for 2031. However, when establishing the stringency of MY 2027 and 2031 standards, CARB staff considered the deterioration that would occur if the engine and aftertreatment system were aged to the proposed full useful life. The Stage 3 aftertreatment system was chemically and thermally aged up to the current useful life of 435,000 miles. In developing the proposed 600,000-mile and 800,000-mile emissions standards, CARB staff used the same methodology that manufacturers currently use to demonstrate compliance with the applicable emissions standards at full useful life. The methodology relies on aging the engine-aftertreatment system to a portion of useful life (typically 35-50 percent of full useful life) and measuring the tailpipe emissions for a minimum of three emissions test points (using equally spaced intervals). Engine manufacturers then use a linear regression model combined with the measured emissions data to extrapolate the emission test results at full useful life. Information from the regression analysis is used to estimate the DF for the engine at full useful life. The resulting DF value is then used in conjunction with the low-hour emissions test data, and the infrequent regeneration adjustment factors (IRAFs) to estimate the full useful life emission test results.

CARB staff used the same process on the Stage 3 engine to estimate the emissions results at 600,000 and 800,000 miles and used test data to establish the numerical value of the emissions standards. Given that the same methodology is currently being used by engine manufacturers to demonstrate compliance with the emission standards, CARB staff believes that it can also be

used to establish the numerical value for the emissions standards at full useful life.

(6) Lastly, EMA states that CARB did not demonstrate “*the complex Stage 3 prototype engine and aftertreatment system could ever be equipped with sufficient OBD sensing and diagnostic capabilities to satisfy the other myriad HD OBD Regulations that CARB has imposed as preconditions to the certification of HDOH vehicles and engines.*” As indicated above, CARB staff does not believe that there will be issues with equipping the Stage 3 engine-aftertreatment system with OBD sensing and diagnostic capabilities. Both CDA and dynamic CDA systems are currently being used on light-duty vehicles and no issues have been reported in equipping these vehicles with OBD sensing and diagnostic capabilities. In addition, Cummins has developed the dual-dosing twin SCR system for use in European HD trucks, and no issues related to OBD sensing and diagnostic capabilities of the aftertreatment system have been identified. Moreover, CARB staff has proposed to freeze the OBD monitoring thresholds at current levels, and therefore CARB staff does not believe there will be issues in meeting the current OBD requirements.

In general, CARB staff believes that it is the engine manufacturer responsibility to develop a “production-ready” HD engine equipped with all the OBD sensing and monitoring devices, install it on a vehicle, and refine the engine-vehicle integration design so that it also performs well in-use. CARB staff also believes that a lead time of 6 years is more than enough to develop a production-ready engine that complies with the proposed 2027 requirements.

- (a)iv.3. Comment: CARB has proposed adjusted, higher NOx standards for the period after what CARB refers to as the “Intermediate Useful Life,” which is today’s 10 year/435,000 mile benchmark. From that “intermediate” point on, the engine would have to comply with the adjusted, slightly-higher NOx standards until the new fully-extended FUL is reached. CARB’s implicit recognition of emissions degradation, however, does not excuse CARB from having to demonstrate the technical feasibility of the 2027 and later MY standards out to the new fully-extended FUL as part of the rulemaking process. CARB’s failure to make that requisite demonstration is additional proof that CARB has failed to demonstrate the feasibility of the proposed Omnibus Regulations. (EMA, Daimler, Navistar, Volvo)

Agency Response: No change to the Proposed Amendments was made in response to this comment. It is true that CARB did not age the Stage 3 engine-aftertreatment system to full useful life of 600,000 miles for 2027 MY and 800,000 miles for 2031 MY. However, in determining the full useful life NOx standards, CARB staff considered the deterioration that would occur at the proposed full useful life. CARB staff followed a DF calculation methodology that is currently used in the certification of HD engines that takes into account the full useful life deterioration of the HD engine and aftertreatment system. Please see

Agency Response to Comment A.(a)iv.2, for a detailed discussion of the methodology used to determine the 2027 and 2031 MY full useful life NOx standards.

- (a)iv.4. Comment: CARB provided insufficient data to justify the proposed weakening of the 2027 HHDD engine target related to emissions control deterioration (from 0.02 to 0.035 g/bhp-hr). Moreover, the work at SwRI does not appear to support such a large reduction in stringency. While UCS does not dispute the fact that catalysts in emissions control systems deteriorate with age, CARB has not provided any data in support of the proposed reduction in stringency and specific numerical values for the 2027 and 2031 FUL heavy heavy-duty (HHD) standard on the FTP cycle. This adjustment could undermine the anticipated benefit of CARB's extension of the warranty period and full-useful life. It is plausible that advances in catalysts in the timeframe of the rule will continue to reduce the amount of deterioration, resulting in a much weaker in-use standard than is appropriate and, as a result, increased NOx emissions. CARB staff should provide additional justification for any such adjustment prior to final adoption. (UCS)

Agency Response: No change to the Proposed Amendments was made in response to this comment. CARB staff does not agree that the proposed standards for 2027 and 2031 MY engines are weak. UCS did not provide any data that suggests more stringent standards are technically feasible and cost-effective at the proposed longer full useful life. In establishing the proposed full useful life standards, CARB staff considered the technical feasibility, cost, and lead time needed to develop compliant engine-aftertreatment systems to meet the increasingly more stringent NOx standards applicable to 2024, 2027, and 2031 MY engines. In addition, in developing the NOx emissions standards at the extended useful lives for 2027 and 2031, CARB staff used emissions test data from the SwRI Stage 3 program and DF analyses methodology that is currently used by engine manufacturers in the certification process of HD engines. Please also see Agency Response to Comment A.(a)iv.2, for a detailed discussion of the methodology used to derive the 2027 and 2031 MY engine full useful life NOx emission standards.

- (a)iv.5. Comment: The proposed rule does not reflect the adoption of the ACT standard—UCS believes that the rule's emission standards should be strengthened to reflect both the baseline requirements of the ACT standard and the availability of electrification as an emissions reduction strategy. The best way to do this is to increase stringency to reflect all achievable reductions—UCS calculates that ACT volumes warrant an increase in stringency from 0.05 to 0.045 g/bhp-hr in 2024 and from 0.02 (LHDD/MHDD) and 0.035 (HHDD) to 0.013 (LHDD/MHDD) and 0.027 (HHDD) g/bhp-hr in 2027... We support use of the low NOx rule to further incentivize progress towards the state's goal of widespread truck electrification, but credits for

electric trucks should be awarded only once ACT volumes have been achieved. (UCS)

- (a)iv.6. Comment: The stringency of the Omnibus Rule should reflect that UCS has calculated that the stringency of the rule should be 0.045 gram NOx standard in 2024, 0.013 for light- and medium heavy-duty trucks in 2027, and 0.027 for heavy heavy-duty trucks in 2027, in order to account for electric trucks from the ACT requirements.

These stronger standards will result in 15 percent lower emissions than the proposed Rule and incentivize the adoption of zero-emission trucks beyond the bare minimum requirements of the ACT, helping to transition the industry to a zero-emission future ahead of schedule. (UCS)

- (a)iv.7. Comment: Tesla strongly supports a stringent NOx standard. Because this Regulation is part of a suite of aligned policies, it's important that it recognize the existence of and be harmonized with these related initiatives. In the case of this proposed rule, Tesla has identified some disconnects in this regard. The most fundamental example of this is the stringency of the standard itself, which does not reflect the anticipated availability of zero-emission vehicles, or Zero-Emission Vehicles (ZEVs). This is a striking omission, given the efforts of CARB and other State agencies to drive the manufacture and adoption of these vehicles. We ask that this be amended by increasing the stringency accordingly. (Tesla)

- (a)iv.8. Comment: Despite the unambiguous advantages that ZEV offer in terms of NOx mitigation, the current proposed standard in the NOx rule is not set at levels that reflect the expected uptake of ZEVs in the coming years. By not recognizing the impact of ZEVs in the NOx standard, the current rule is less stringent than it should be and appears inconsistent with the other policies CARB is developing to transition the HD transportation sector to zero emission technologies, including the ACT rule and the forthcoming ZEV fleet purchase mandate. To address this, we strongly encourage CARB to increase the stringency in the NOx rule to reflect the expected penetration of HD ZEV vehicles pursuant to these policies. (Tesla)

Agency Responses to Comments (a)iv.5 through (a)iv.8: No change to the Proposed Amendments was made in response to these comments. CARB staff does not agree that availability of zero-emission technology should be considered in setting the stringency of the proposed standards in the Omnibus Regulation. ZEVs are considered in a separate regulatory program called the ACT program.<sup>44</sup> ACT requires manufacturers who certify Class 2b-8 chassis or complete vehicles with combustion engines to sell zero-emission trucks as an

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<sup>44</sup> CARB Advanced Clean Trucks Program webpage – provides information about the Advanced Clean Trucks Regulation, California Air Resources Board. <https://ww2.arb.ca.gov/our-work/programs/advanced-clean-trucks> – accessed 3/17/2021

increasing percentage of their annual California sales from 2024 to 2035. The Omnibus Regulation's objective is to develop the most stringent standards specific to "combustion engines" that are technically feasible and cost-effective. CARB staff's proposed NOx emission standards are based on emissions test data from low NOx test programs and were demonstrated to be cost-effective and technically feasible within the proposed timeline. Furthermore, recognizing the availability of zero emissions vehicles, the Omnibus Regulation includes credit provisions that incentivize the early introduction of ZEVs. At the hearing, the Board directed CARB staff to limit the usage of heavy-duty zero-emission powertrain (HD-ZEP) credits from 2030 to 2026 MY engines so as to ensure stringent combustion standards and to assist the manufacturers as they transition to more stringent NOx standards. The Omnibus Regulation includes FEL caps that will ensure HD engines will become lower emitting than today despite any use of credits. CARB staff believes the approved credit provisions will also accelerate the early introduction of HD-ZEP technology since many manufacturers would want to utilize the zero-emission credits as a pathway to transition to the new lower NOx engine standards starting with the 2024 MY engines. All in all, CARB staff believes the HD ZEV provisions and numerical standards and FEL caps in the Omnibus Regulation will together ensure combustion engines are as low-emitting as feasible while simultaneously providing manufacturers incentives to both comply with CARB's ACT Regulation and make HD ZEVs earlier than required.

- (a)iv.9. Comment: California will not be able to meet its State Implementation Plan (SIP) obligations unless the Board adopts a lower NOx emissions standard. Indeed, NOx emissions from HD trucks need to decline by about 80 percent to meet the South Coast 2008 ozone standard in 2031. This calls for a shift to zero-emissions trucks, and where combustion vehicles are purchased the lowest NOx limit feasible. Accordingly, our organizations ask that ARB accelerate the compliance deadline for the 0.02 g/bhp-hr standard up to the earliest date possible instead of waiting until 2027 for this shift. (Earthjustice)

Agency Response: No change to the Proposed Amendments was made in response to these comments. As discussed in Agency Response to Comment A.(a)i.6, CARB staff considered implementing the requirements earlier than proposed, i.e., implementing the 2024 requirements in 2022 and the 2027 requirements in 2024. This scenario was evaluated as an alternative in Chapter X of the ISOR. This alternative would achieve greater NOx reductions sooner but have higher costs in earlier years. However, the accelerated schedule would not provide enough lead time for the development of the interim engines in 2022 and the low NOx engines in 2024. Without sufficient time for engine manufacturers to conduct research, development, and durability testing, products will not be able to meet the stringent criteria. As a result, CARB staff rejected this alternative.

**(a)v. Aftertreatment System Used to Demonstrate the New 2027 and Subsequent MY NOx Emission Standards for HD Engines**

- (a)v.1. Comment: Turning to the complex multiple-SCR systems that CARB also envisions for achieving the proposed 2027 MY standards, the control of far less complex systems continues to challenge manufacturers. Manufacturers today still face significant challenges in consistently controlling stored [ammonia] NH<sub>3</sub> levels over the SCR substrate under all ambient and transient operating conditions. That parameter must be modeled (it is not measurable), and fluctuations in exhaust flow and temperature can have significant impacts on NH<sub>3</sub> levels, and can lead to NO<sub>x</sub> “breakthroughs.” The ability to accurately control DEF flow and storage with *two* SCR systems under the proposed 2027 technology scheme will be *more* than twice as challenging. The capabilities of that dual system, including the control of stored NH<sub>3</sub>, have only been assessed to a limited degree in CARB-funded Stage 3 prototype work at SwRI. (EMA, Daimler, Navistar, Volvo)

Agency Response: No change to the Proposed Amendments was made in response to these comments. CARB staff understands that achieving high NO<sub>x</sub> conversion efficiencies at all operating conditions requires accurate DEF dosing and ammonia coverage control consistently under those operating conditions. The Stage 3 low NO<sub>x</sub> program was able to achieve high NO<sub>x</sub> conversion efficiencies over several test cycles including the FTP, RMC, and LLC using model-based controls augmented with DEF dosing and ammonia storage management strategies. The controller settings were not changed through the different drive cycles tested, which demonstrates the ability of the controller to adapt to different operating conditions with no user input. SwRI was able to achieve this performance with limited resources in time and funds. CARB staff believes manufacturers have enough lead time and the resources needed to fine tune the DEF dosing and ammonia coverage control strategy developed by SwRI further such that conditions that lead to NO<sub>x</sub> breakthroughs are controlled and high NO<sub>x</sub> conversion efficiencies are achieved consistently under all operating conditions.

For example, the emissions control technology used by U.S. EPA to demonstrate the 2010 NO<sub>x</sub> standards was significantly different both in size and type of aftertreatment system to that used by manufacturers to comply with the regulations. After U.S. EPA adopted, in 2001, the standards for 2010, a collaborative effort between industry, federal, state, and local air agencies continued to demonstrate and refine different emissions control technologies including NO<sub>x</sub> adsorber and SCR aftertreatment systems.<sup>45</sup> Beginning in 2010, most manufacturers chose urea-based SCR aftertreatment system to comply with the 2010 standards, which is different than the NO<sub>x</sub> adsorber technology used for feasibility demonstration. Even after implementation in 2010,

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<sup>45</sup> Sverdrup, George M. “Overview of Advanced Petroleum-Based Fuels-Diesel Emissions Control Program (APBF-DEC).” United States. (<https://www.osti.gov/servlets/purl/827872> - accessed 7/23/2021)

improvements of the urea-based SCR system continued. Indeed, today's aftertreatment systems are 40 percent lighter, 60 percent smaller, and substantially less expensive compared to emission controls on 2010 MY engines.<sup>46</sup>

- (a)v.2. Comment: Among the many problems facing control and calibration engineers would be the significant challenge of dealing with the thermal inertia effects of two SCR units. While the close-coupled SCR would heat up faster than the post-DPF SCR of today's 2010-compliant systems, it also would delay the warming of the second SCR system. Without CDA, or, without CO<sub>2</sub>-penalizing heating strategies such as a mini-burner, there would be no more energy in the exhaust to heat those envisioned dual systems than there is today. The dual systems would share the system's heat energy, as available. While the smaller close-coupled SCR could heat up faster under load, it likewise would cool down faster at idle or light load. In real-world in-use applications (not just under highly-controlled laboratory conditions with continuous calibration adjustments), the job of converting NO<sub>x</sub> would be shared between the two SCR units through a thermal balancing act, with little or no positively compounding thermal effect. Moreover, extended idle-NO<sub>x</sub> would only be marginally improved by the dual-SCR concept, even where exhaust temperatures are purposely elevated to maintain SCR conversion temperatures during extended idle. Idle-NO<sub>x</sub> emissions under those conditions are expected to be similar to those under today's systems regardless of the heating strategy that is deployed. (EMA, Daimler, Navistar, Volvo)

Agency Response: No change to the Proposed Amendments was made in response to this comment. CARB staff agrees with EMA's comment that without CDA use (at least for the Stage 3 SCR prototype system), there would be challenges dealing with the thermal inertia effects of the two SCR systems and NO<sub>x</sub> emissions would not be reduced to the proposed levels especially at light loads and idling. However, CARB staff never suggested in the ISOR or anywhere else that it is possible to generate heat in the exhaust without CDA or another heat generating device to achieve significant NO<sub>x</sub> conversion efficiencies under a wide range of vehicle operations including idle. The Stage 3 aftertreatment solution leverages CDA to increase the exhaust temperature during light load operations with CO<sub>2</sub> benefits or without CO<sub>2</sub> penalty. Thus, the challenges of dealing with the thermal inertia effects of two SCR units described in the above comment would not apply to CARB's low NO<sub>x</sub> demonstration program.

Moreover, in the above comment, EMA states that extended idle-NO<sub>x</sub> would only be marginally improved by the dual-SCR concept, even where exhaust

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<sup>46</sup> Technology Feasibility for Model Year 2024 Heavy-Duty Diesel Vehicles In Meeting Lower NO<sub>x</sub> Standards. MECA. June 2019 ([http://www.meca.org/resources/MECA\\_MY\\_2024\\_HD\\_Low\\_NOx\\_Report\\_061019.pdf](http://www.meca.org/resources/MECA_MY_2024_HD_Low_NOx_Report_061019.pdf) - accessed 7/23/2021)

temperatures are purposely elevated to maintain SCR conversion temperatures during extended idle. EMA further states that idle-NOx emissions under those conditions are expected to be similar to those under today's systems regardless of the heating strategy that is deployed. CARB staff disagrees with EMA's statement. With the use of CDA and the dual-dosing twin SCR system, the Stage 3 program demonstrated significantly lower tailpipe NOx emissions at 435,000 miles on CARB's extended idle test as well as the LLC. The mode 1 test at curb idle speed of 600 rpm was 0.1 g/hr NOx and the mode 2 test at 1100 rpm was 0.3 g/hr NOx. These are significant reductions compared to the current standard of 30 g/hr or the proposed 5 g/hr idle NOx standards for MY 2027. In addition, SwRI also tested the Stage 3 system on an 8-hour long extended idle with accessory load to mimic "hoteling" on a sleeper cab. The test results are 3 g/hr engine-out idle NOx and 1 gram per hour tailpipe NOx, indicating the systems performance on extended long duration idling. These test results show that EMA's statement that idle-NOx emissions under extended idle conditions will remain similar to those under today's systems regardless of the heating strategy is incorrect.

- (a)v.3. Comment: [T]he close-coupled SCR system would be exposed directly to the exhaust stream, including direct hydrocarbon (HC) exposures, without the protective pre-filtering effects of the DPF in today's systems. That would necessitate increased regeneration activities (desulfation (DeSOx) events) to purge the close-coupled SCR system from the accumulations of HC and sulfur contaminants and from urea (DEF) crystals, which purging can only be accomplished through sustained elevated exhaust temperatures that are not always possible to achieve on all cycles, especially idle and LLC cycles, and which would result in a significant adverse GHG impact. (EMA, Daimler, Navistar, Volvo)
- (a)v.4. Comment: CARB relies on highly complex CDA technology, of unknown feasibility, reliability and durability in the HD engine market, to provide the elevated exhaust temperatures needed for more frequent DeSOx events, including over the LLC. According to CARB, the LLC was developed to evaluate operation under lightly-loaded duty cycles, which for some vehicles is representative of practically all operation. However, CARB staff has failed to demonstrate any successful DeSOx reactions over the LLC or idle test cycle... At just 33% aging to the current FUL period of 435,000 miles (and in reference to the 2027 MY standard of 0.020 g/bhp-hr FTP/RMC, and 0.050 g/bhp-hr LLC), the importance of achieving a complete DeSOx event is clear (refers to table in comment letter.) Composite FTP results are approximately double the standard after a 500°C DeSOx event, and even after a 550°C DeSOx event, the emissions from the feasibility-demonstration engine exceed the proposed FTP low-NOx standard.

The higher the required target temperature for effective DeSOx, the more difficult the DeSOx event will be to achieve during normal operation of the

vehicle when operating over lightly-loaded cycles, including the LLC. Temperature escalations under load will be cooled during idle periods. Consequently, it is difficult to assess the real-world feasibility implications without a vehicle test, especially in cold ambient conditions. CARB has not performed any of those necessary in-use vehicle tests. Neither SwRI nor CARB has even hypothesized how a manufacturer would achieve DeSOx with the Stage 3 system under ambient conditions as low as -7°C (the minimum for valid testing in-use). In addition, enhanced regeneration would not address the accelerated poisoning of the close-coupled SCR due to fuel impurities not pre-filtered by the DPF, since that catalyst-poisoning effect is not reversible through regeneration. That effect would be compounded by the fact that, by virtue of its close proximity to the engine and turbocharger outlet, the Light Off (LO)-SCR would degrade more quickly than current SCR systems. (EMA, Daimler, Navistar, Volvo)

Agency Response to Comments (a)v.3 and (a)v.4: No change to the Proposed Amendments was made in response to these comments. CARB staff agrees that the close-coupled light-off SCR would be exposed directly to contaminants in the exhaust such as sulfur oxides and crystal deposits from DEF. However, CARB staff disagrees with EMA's statements that it is difficult to achieve the high exhaust temperatures needed for desulfation of the light-off SCR during low load engine operations and that CARB staff has failed to demonstrate desulfation of the light-off SCR over the useful life of 435,000 miles. As discussed in detail in the Stage 3 Final Report, SwRI has successfully demonstrated desulfation of the light-off SCR through the useful life of 435,000 miles.

CARB staff understands that, to maintain high conversion efficiencies of the SCR system, the contaminants need to be removed periodically by increasing the exhaust temperatures to levels of about 550°C or higher. The sulfur removal can be facilitated by either operating the engine rich or providing a localized source of hydrogen (such as hydrogen produced from DEF during ammonia oxidation). To remove sulfur and other contaminants from the prototype light-off SCR system, the Stage 3 program included both of these strategies, that is elevating the exhaust temperatures to 550°C and providing a localized source of hydrogen. Since there was no DOC in front of the light-off SCR system, heat could not be generated through an exotherm generated by post injection or in exhaust fuel addition in front of the DOC, which also would have impacted fuel consumption. Thus, the heat needed for desulfation of the light-off SCR was generated directly from the engine using CDA, and the hydrogen needed to remove the sulfur was provided by ammonia oxidation by increasing the ammonia-to-NOx ratio to 1.3. The use of CDA allowed desulfation over a wide operating range of the engine including at low loads with minimal fuel consumption impacts.

SwRI's desulfation experimentation determined two modes of desulfation strategies for the light-off SCR: a long-term sulfur management at temperatures of 550°C to fully recover the performance of the light-off SCR and a short-term,

more frequent desulfation events at temperatures of about 450°C to remove loosely bound sulfur dioxide or SO<sub>2</sub> on the light-off SCR. Specifically, the short-term more frequent sulfur removal mode which SwRI indicates is easier to arrange, would be more useful for duty cycles with extended periods of operation at low temperatures. SwRI's conclusion from the Stage 3 desulfation experiments was that removal of sulfur and other contaminants from the light-off SCR is feasible with robust and flexible desulfation strategies to minimize fuel consumption.

EMA also states that CARB or SwRI has not demonstrated how a manufacturer would achieve desulfation with the Stage 3 system under ambient conditions as low as -7°C (the minimum for valid testing in-use). It should be noted that desulfation happens infrequently and once the engine determines that a desulfation event is needed, it looks for the next available operating condition to successfully deploy this event. EMA's comment seems to indicate that there are some new operating conditions that would limit the opportunity to perform desulfation, but this is not the case because engines made to comply with the Omnibus Regulation would be the same as diesel engines today that look for the right operating conditions to carry out this operation. It should be noted that diesels with CDA engine technology will have an enhanced ability to carry out desulfation by reducing the number of cylinders in operation during lower engine load operating events. This will help maintain or elevate exhaust temperatures for extended desulfation operation.

- (a)v.5. Comment: In addition to being exposed to fuel-based contaminants, the LO-SCR, a key catalyst element in meeting the 2027 technology demonstration, will be subject to oil poisoning at a rate higher than experienced by today's SCR systems. Oil derived poisons are known to deposit heavily on the first catalyst brick encountered in the aftertreatment array. The poisons deposit on the front face of the catalyst, which acts to delay catalyst LO under cold conditions. Oil-derived poisons are not reversible under any engine-based regeneration strategy, and they also can act to reduce the catalyst channel size. Moreover, the interaction of DEF deposits with oil deposits is unknown (particularly under cold-start, and low load operation), but may lead to a further reduction of the catalyst channel size, leading to increased backpressure and associated CO<sub>2</sub> penalties.<sup>47</sup> (EMA, Daimler, Navistar, Volvo)

Agency Response: No change to the Proposed Amendments was made in response to this comment. It is true that the light-off SCR will be exposed to oil

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<sup>47</sup> That poisoning effect would be exacerbated by the "thin wall, high-cell density" substrates proposed as a potential low-NO<sub>x</sub> technology solution by MECA. Oil poisoning is linear with exposure. In that regard, the accelerated catalyst aging demonstration performed at SwRI exposed the catalyst to only 1/3 of the expected "intermediate UL" (435k mile) oil quantities. No consideration was given to the level of oil exposure expected under the proposed extended FUL of 800k miles (nearly double). That is an inadequate demonstration of the durability of the close-coupled SCR due to oil-derived poisoning.

and other contaminants more than current SCR systems since there will be no DOC or DPF in front of it, as there are in current aftertreatment architectures. However, SwRI successfully aged the light-off SCR as well as the other components of the aftertreatment system thermally and chemically on engine dynamometer for the current useful life of 435,000 miles. The aftertreatment system performed well at the end of the aging process maintaining high NOx conversion efficiencies, with some expected deterioration and without CO2 penalties. Furthermore, as mentioned in Agency Response for Comment A.(a)iii.1, Cummins Emissions Solutions has already commercially introduced an aftertreatment system with a close-coupled light-off SCR for use on Scania V8 engines. As a result, CARB staff does not agree with EMA's comment that direct exposure of the light-off SCR to the engine-out exhaust will result in significant backpressure and CO2 penalty.

- (a)v.6. Comment: The “one-box” aftertreatment system that SwRI has utilized is configured to promote heat retention of the SCR catalysts to enable more engine operation with favorable NOx-conversion efficiencies. However, not only does that type of configuration present undue challenges to vehicle packaging, it also complicates the process for designing for “replaceable” SCR cores. The proposed stringent low-NOx standards coupled with the nearly doubling of the FUL requirements, all but guarantee that the SCR cores will require replacement at least once during the FUL of the HDOH engines and vehicles at issue. To facilitate the cost-effective replacement of catalyst cores in the field, “in-line” designs (rather than one-box) are preferred. The additional heat loss that comes with the in-line system must be made up for by adding more heat to the exhaust, which translates into higher CO2 emissions than what CARB is currently forecasting from the results of its low-NOx research program. (EMA, Daimler, Navistar, Volvo)

Agency Response: No change to the Proposed Amendments was made in response to this comment. As mentioned in Agency Response to Comment A.(a)iv.2, the one-box aftertreatment system is currently in use by several engine manufacturers, and therefore, CARB staff does not agree with the comment that the one-box system brings undue challenges to vehicle packaging. In fact, the use of the one-box system has helped manufacturers achieve smaller system packaging and significant weight reduction compared to other systems.<sup>48</sup>

CARB staff does not agree with EMA's statement that it is challenging to design the one-box aftertreatment system such that the core can be replaced easily. The one-box system has been in-use for several years now on current Volvo and Detroit Diesel engines. These manufacturers would not have used this system if it was not cost-effective to use and maintain it including the replacement of

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<sup>48</sup> Volvo Press Release: Volvo Trucks to now offer a one-box Exhaust Aftertreatment System for improved body flexibility, fuel efficiency. 5/6/2016  
<https://www.volvotrucks.us/news-and-stories/press-releases/2016/may/volvo-trucks-to-offer-a-one-box-exhaust-aftertreatment-system/> - accessed 6/18/2021

damaged SCR cores. Although, the Stage 3 program used a one box system for the downstream aftertreatment system to demonstrate the feasibility of 0.02 g/bhp-hr NO<sub>x</sub>, CARB is not mandating the use of the one-box system. Manufacturers may choose to design an in-line aftertreatment system with improved insulation to obtain similar thermal control of the aftertreatment system. Thus, it is up to the manufacturer's design decisions to use the one-box system or the in-line system or any other system for that matter to comply with CARB staff's Proposed Amendments.

- (a)v.7. Comment: The control strategy that CARB proposes also includes an NH<sub>3</sub> sensor. Today, there is only one NH<sub>3</sub> sensor on the market from a single supplier. That device is not adequately durable, showing significant drift after as little as 30,000 to 50,000 miles. OEMs that have used that device for emissions control systems in prior model years have found that, even when new, those sensors do not have adequate accuracy stability. The lack of accuracy, coupled with the in-use drift and sensitivity to other exhaust gases that can lead to false readings, make the current NH<sub>3</sub> sensors unacceptable for use in future low-NO<sub>x</sub> emissions control systems. Other sensor suppliers are working on the development of NH<sub>3</sub> sensors, but they are in the early stages of development, and therefore it is highly uncertain whether they will be in a production-ready design stage when engine manufacturers would need to begin their long-term testing for 2027 MY products. (EMA, Daimler, Navistar, Volvo)
- (a)v.8. Comment: Taking a broader view of NH<sub>3</sub> and NO<sub>x</sub> sensor accuracy issues, those sensors do not have the necessary long-term accuracy to provide effective tailpipe emissions control at CARB's proposed stringent low-NO<sub>x</sub> levels. A set of NO<sub>x</sub> sensors that is "reading low" (the system doses less DEF than nominally required) in combination with an NH<sub>3</sub> sensor that is "reading high" (the system thinks it is dosing too much DEF leading to NH<sub>3</sub> slip) will result in significant under-dosing of the system, and thereby potentially non-compliant NO<sub>x</sub> levels. There is insufficient accuracy in the current NO<sub>x</sub> and NH<sub>3</sub> sensors to deal with that issue. Additionally, adaptive control strategies, which are intended to ensure emissions compliance as components age, rely on the accuracy of those sensor-based inputs. It would be extremely challenging to design and calibrate adaptive strategies given the inherent inaccuracies of those sensors, especially since those inaccuracies only increase as the sensors age. (EMA, Daimler, Navistar, Volvo)

Agency Response for Comments (a)v.7 and (a)v.8: No change to the Proposed Amendments was made in response to these comments. To maintain high NO<sub>x</sub> conversion efficiency in the SCR catalysts, there is a need for a control system that ensures adequate ammonia coverage in the SCR system at all times.<sup>49</sup> In the Stage 3 aftertreatment system, a model-based DEF controller was used to

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<sup>49</sup> M. Van Nieuwstadt, I. Dpadhyay, et al., "Control of Urea SCR Systems for US Diesel Applications" in IFP Energies Nouvelles International Conference, Dearborn, USA, 2011, pp. 655-665.

predict and manage appropriate storage targets in the SCR system.<sup>50</sup> The key parameter modeled in the model-based DEF controls is ammonia storage, and therefore an ammonia sensor was used to provide a real-time feedback of how accurate the storage model is actually predicting. As EMA stated, it is true that currently commercially available ammonia sensors do not have the needed accuracy at lower ammonia levels (below 30 parts per million (ppm)) and may show significant drift over longer periods of use. However, in the Stage 3 program, SwRI research engineers indicate that the mid-bed ammonia sensor was used in a way that does not require high accuracy. They indicated that it was used for model state correction based on comparison of the ammonia storage to the model predicted value at the mid-bed location. The function of the ammonia sensor was primarily to observe the presence of an unexpected high ammonia storage, or the absence of a predicted ammonia storage in the SCR. As SwRI indicated, this control strategy using an ammonia sensor allowed the feedback algorithm to correct ammonia storage over a timescale of seconds to minutes.

Currently there is only one ammonia sensor on the market from a single supplier. However, other suppliers are currently developing improved ammonia sensors with higher accuracy at low ammonia levels (0 to 30 ppm levels) and better stability at higher exhaust temperatures (550°C and higher). Driven by demand for accurate control of ammonia storage in the SCR to achieve significantly high NO<sub>x</sub> conversion efficiencies at all operating conditions and realizing the role that ammonia sensors could play to achieve this objective, CARB staff believes the development of improved ammonia sensors will accelerate to become available in time for 2027 MY engines.

- (a)v.9. Comment: Taking into account all of the foregoing additional issues, it is even more apparent that CARB has not demonstrated the feasibility of the envisioned Stage 3 aftertreatment system or the 2027 MY standards. (EMA, Daimler, Navistar, Volvo)
- (a)v.10. Comment: EMA also is concerned about certain process steps related to the aging-demonstration work that CARB is sponsoring at SwRI. More specifically, the calibration of the Stage 3 test article has undergone numerous changes and adjustments over the course of the aging-demonstration process, including, to improve emissions results or to improve the effectiveness of DeSO<sub>x</sub>. As a result, SwRI has lost track of the baseline condition against which to compare final aged emission levels. A robust demonstration would have involved freezing the calibration from the low-hour test point to the final emissions test. The only way for SwRI to attempt to recover from that lack of a baseline condition is to replace the aged aftertreatment with a “degreened” aftertreatment system of the same configuration, and conduct the full suite of emissions tests with the final version of the engine and aftertreatment control calibration. That would

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<sup>50</sup> Rao, S., Sarlashkar, J., Rengarajan, S., Sharp, C. et al., “A Controls Overview on Achieving Ultra-Low NO<sub>x</sub>,” SAE Technical. Paper 2020-01-1404, 2020, doi:10.4271/2020-01-1404.

provide an honest assessment of baseline emissions levels, deterioration impacts, and CO2 impacts across the range of regulated and test cycles. Yet neither SwRI nor CARB has any plans to conduct any such necessary baseline testing. (EMA, Daimler, Navistar, Volvo)

Agency Response to Comments (a)v.9 and (a)v.10: No change to the Proposed Amendments was made in response to these comments. CARB staff agrees that the calibration of the Stage 3 test article has undergone numerous changes and adjustments over the course of the aging-demonstration process. These calibration adjustments were done to improve desulfation as well as improve emission performance of the engine-aftertreatment system. CARB staff does not see any issues with how SwRI conducted the aging process including making calibration adjustments during the aging process. It is true that, ideally, it would have been preferred to have a single calibration throughout the aging and desulfation process or alternatively adjust the calibration during the aging process as was done in the Stage 3 program and test the final engine and aftertreatment calibration on a degreened aftertreatment system of the same configuration. Either one of these two methods would have provided the real degradation of the aftertreatment system at the end of the aging process. However, since this is the first demonstration program of its kind, it was necessary for SwRI to adjust the engine and aftertreatment calibration to ensure proper desulfation so that emissions control performance would be maintained at the highest possible level. It should be noted that the change in desulfation calibration that resulted in higher SCR temperature also resulted in an increased level of deterioration, which was needed to determine the appropriate standard at the equivalent 435,000 miles of aging. Thus, the actions taken by SwRI, in consultation with the Program Advisory Group, in which EMA and its members participated, agreed to this change to more accurately reflect aftertreatment performance capabilities along with increased thermal aging of the system. CARB staff does not agree that the steps taken by SwRI in the aftertreatment aging process do not properly account for the deterioration of the aftertreatment system for the 2027 MY engine NOx standard.

- (a)v.11. Comment: A closer look at SwRI's aging-demonstration test results reveals significant concerns about the inability of the Stage 3 engine and aftertreatment hardware to maintain even marginally-compliant results for just a portion of the proposed FUL requirements. In its July 2020 program update webinar,<sup>51</sup> SwRI presented the results of the FTP, RMC and LLC certification tests of the Stage 3 prototype at the initial "zero hour" and subsequent intermediate test points. The figure below shows the FTP NOx and CO2 results when plotted against CARB's proposed 2027 NOx and CO2

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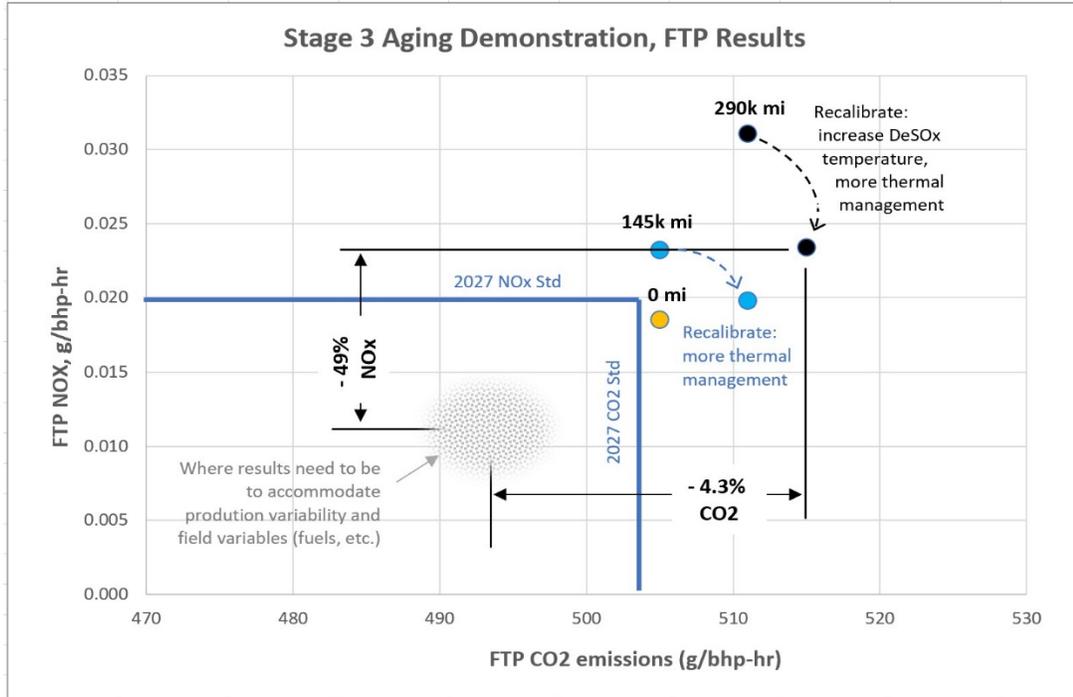
<sup>51</sup> Heavy-Duty On-Highway Low NOx Update; Regulatory Status and Latest Demonstration Program Results, Chris Sharp, Southwest Research Institute, July 2, 2020, pp. 24 and 25

standards.<sup>52</sup> The zero-hour, 145,000-mile, and 290,000-mile test points are plotted. SwRI performed a DeSOx event to purge accumulated sulfur compounds from the LO-SCR prior to testing emissions levels. The DeSOx event, however, failed to achieve the targeted 525°C exhaust temperature, leaving a level of residual sulfur that led to a 0.038 g/bhp-hr composite FTP result (not shown on the figure below, which is scaled only to 0.035 g/bhp-hr). SwRI then readjusted and reran the DeSOx routine to achieve the targeted 525°C DeSOx temperature, which improved the composite FTP result to the 0.023 g/bhp-hr level plotted at the 145,000-mile point. (See figure's blue dots.) To make up for the non-compliant 0.023 g/bhp-hr result, SwRI then made an additional engine calibration adjustment to add additional thermal management to the hot FTP, improving the composite FTP result to 0.020 g/bhp-hr. That additional recalibration increased CO2 emissions by an additional 1%.

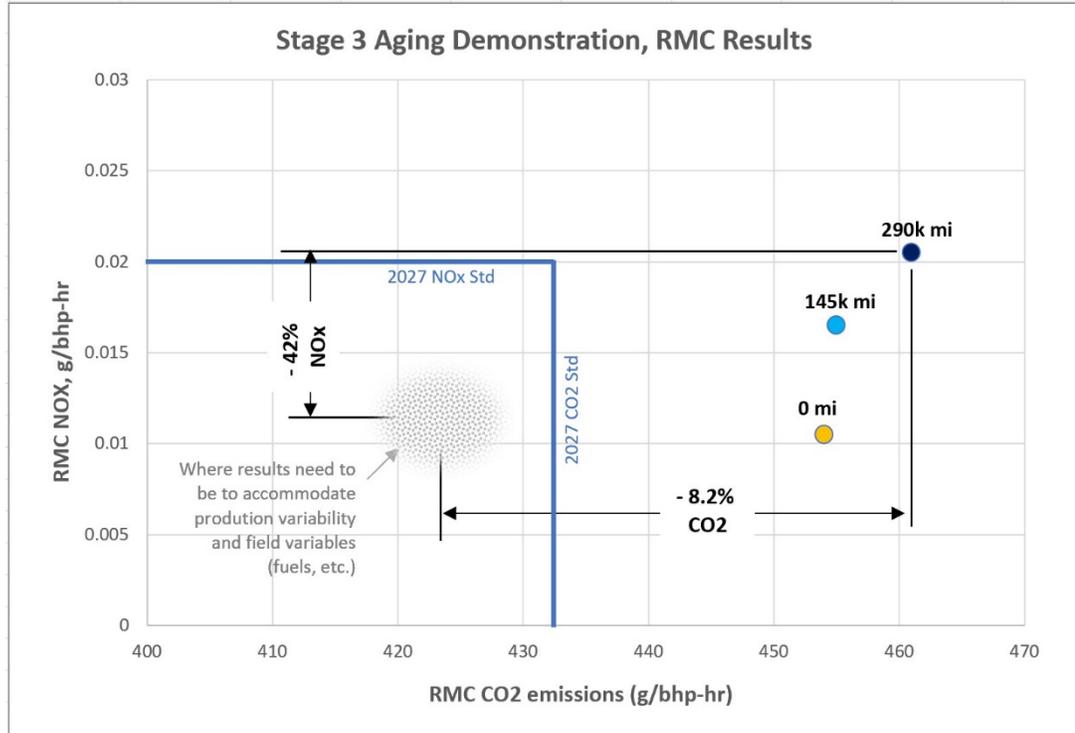
Similarly, after SwRI aged the aftertreatment system further to an equivalent of 290,000 miles, SwRI measured an FTP composite above 0.030 g/bhp-hr. To improve upon that result, which was 50% higher than the proposed FTP standard, SwRI reran the DeSOx event, this time with a targeted temperature of 550°C. The increased DeSOx temperature was effective in driving off more sulfur such that, in combination with the addition of even more thermal management in the hot FTP through even more recalibrations, SwRI was able to achieve a composite FTP result of 0.023 g/bhp-hr. (See figure's black dots.) While still non-compliant with the proposed FTP standard, that improved result came at the expense of another 1% increase in CO2 to deliver still more thermal management during the hot FTP. (EMA, Daimler, Navistar, Volvo)

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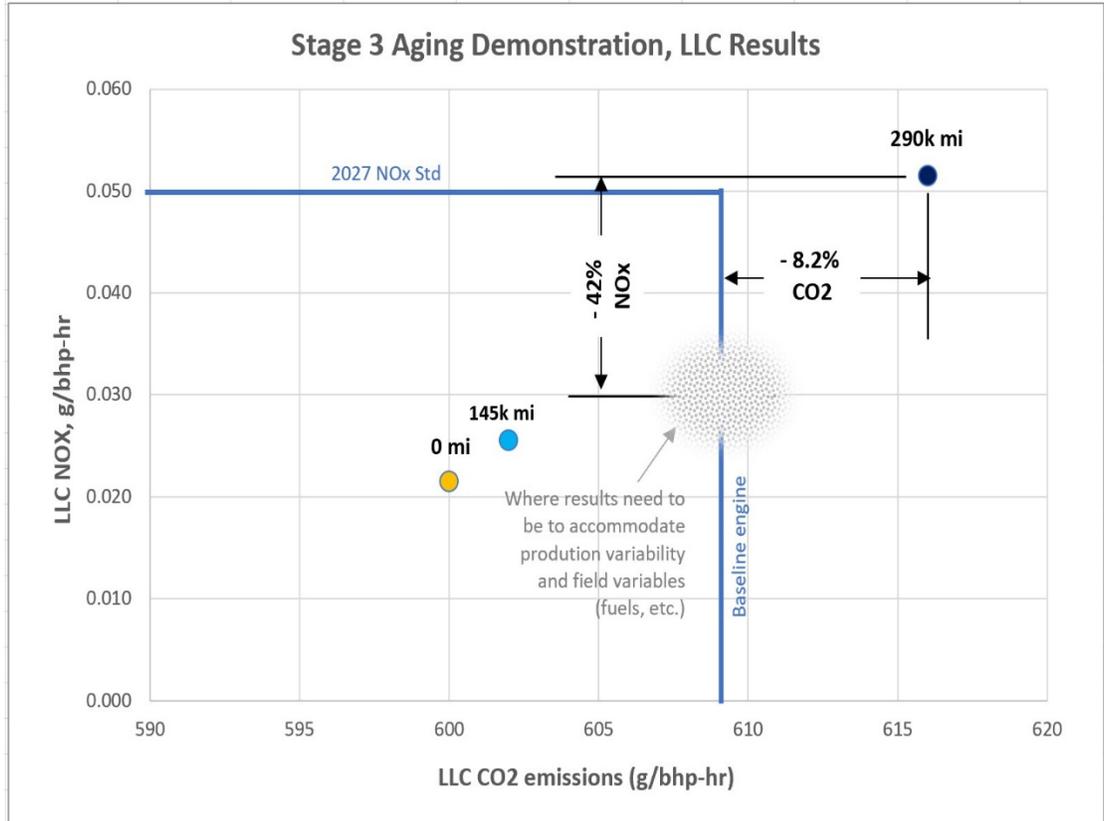
<sup>52</sup> The emission results reflected in the charts on pages 24 and 25 of the SwRI update do not include IRAFs, as required under the applicable CARB regulations. SwRI has separately reported the IRAFs to be in the range of 0.001 to 0.002, so 0.0015g/bhp-hr (the average) was added to the reported emissions results as plotted.



(a)v.12. Comment: SwRI’s RMC results are represented below. There is less detail in the SwRI update concerning the RMC emissions levels that SwRI achieved before the DeSOx temperature improvements described above. (Thermal management recalibrations likely did not impact the RMC results or the engine’s CO2 emissions over the RMC.) Those results, while arguably compliant with the 2027 NOx standard (albeit without any compliance margin), are well in excess of the 2027 GHG/CO2 standard. (EMA, Daimler, Navistar, Volvo)



(a)v.13. Comment: [T]he LLC results that SwRI achieved during its accelerated FUL testing are plotted below. There is no 2027 LLC CO2 standard, so the baseline engine's CO2 emission level over the LLC is represented instead.... Nevertheless, for this purpose, the more conservative baseline CO2 emission level was retained.)



Several observations can be made when reviewing the foregoing data-plots. First, with testing complete only to the level of 290,000 miles, which is only 67% of CARB’s proposed *Intermediate* Useful Life, and just 36% of the 2031 FUL, significant emissions deterioration occurs to the point of NOx-non-compliance on all three compliance tests. Second, the uniformly non-compliant NOx (and CO2) results were achieved even after SwRI made several adjustments to the DeSOx routines and thermal management strategies during the course of the test. Third, for manufacturers to include anything close to the NOx-compliance margins that are necessary (even at the levels needed to ensure FUL compliance at today’s NOx standards, which are 10 times higher than the proposed low-NOx standards), additional NOx reductions on the order of 40% or more would be needed if the significant deterioration trends that SwRI observed continue out to the 435,000-mile test-point. Fourth, the additional 40% NOx-compliance margin would help to account for the observed increases in NOx emissions caused by sulfur compound accumulation and soot accumulation, both of which were mitigated by the high-temperature DeSOx and DPF regeneration events that SwRI performed before each emissions test. While SwRI did not report the even higher emission results immediately prior to those DeSOx and regeneration events, manufacturers’ products necessarily would have to be compliant under those conditions. And fifth, while CARB did not set a goal to meet the 2027 CO2 engine standards in this FUL demonstration, manufacturers nonetheless *must* meet those standards, and will be

compelled to supplement the Stage 3 technology set with even more costly technology to reduce CO<sub>2</sub> by another 4 to 8% to comply with the stringent Phase 2 GHG gas standards (EPA would estimate that additional technology to cost from approximately \$4500 to \$9000). Significantly, that does not include vehicle-level CO<sub>2</sub> emission impacts based on GEM outputs, since SwRI did not conduct any analysis whatsoever of those issues. Thus, from all the foregoing, it is clear that SwRI and CARB have not demonstrated the feasibility of the proposed 2027 MY low-NO<sub>x</sub> standards over the proposed extended FUL periods. (EMA, Daimler, Navistar, Volvo)

- (a)v.14. Comment: The SwRI Stage 3 prototype yields emission test results that fail to meet the 0.02 g/bhp-hr NO<sub>x</sub> standard after just two-thirds (290,000 miles) of the required first-stage “Intermediate” FUL aging. Moreover, throughout their demonstration effort, the research scientists at SwRI have been compelled to adjust their calibrations, adjust their regeneration parameters, and modify the aging protocol to improve results. All of those recalibrations and regeneration strategies have resulted in increased CO<sub>2</sub> emissions at levels that would not meet the Phase 2 GHG standards for the 2027 MY. And none of the SwRI “demonstration” results include any NO<sub>x</sub>-compliance margin, let alone the 40% margins that manufacturers likely will need. In addition, and tellingly, notwithstanding the multiple recalibrations that SwRI was compelled to make to the State 3 prototype, SwRI and CARB have made no plans to rerun, or even re-baseline the Stage 3 engine and aftertreatment system to get a true view of the actual deterioration at issue. In addition, only a single “real-world” replay cycle has been used in SwRI’s test cell to assess the Stage 3 systems’ performance under the newly proposed in-use 3B-MAW protocol and standards. And not an ounce of fuel has been burned in any actual “in-use” vehicle test to demonstrate feasibility, nor has there been any technical evaluation of a manufacturer’s ability to package the Stage 3 systems in a HDOH vehicle.

Simply stated, CARB has not made the requisite feasibility demonstration for the proposed Omnibus Regulations. As a result, the Board should not adopt those Regulations. (EMA, Daimler, Navistar, Volvo)

Agency Response to Comments (a)v.11 through (a)v.14: No change to the Proposed Amendments was made in response to these comments. As discussed in Agency Responses to Comments A.(a)v.3 and A.(a)v.4, the aging process of the Stage 3 aftertreatment system required desulfation to be conducted twice at the 145,000 miles intermediate point (or 334-hour of aging period). The first desulfation of the light-off SCR at 525°C was needed since during the aging process, the desulfation modes failed to reach the targeted 525°C exhaust temperature leaving a deposit of sulfur on the light-off SCR. However, exhaust temperature of 525°C was also not high enough to remove all the sulfur from the light-off SCR and therefore a second desulfation mode at 550°C was run to remove the remaining sulfur. After the 550°C desulfation, hot start FTP test

resulted in 0.16 g/bhp-hr NO<sub>x</sub>, which was not low enough to provide sufficient margin for degradation. Thus, SwRI applied long-term trim to the ammonia storage target and a small modification to the engine calibration resulting in improved hot start FTP of about 0.012 g/bp-hr NO<sub>x</sub>, which is nearly equal to the 0-hour level of 0.011 g/bhp-hr NO<sub>x</sub>. The increased thermal management resulted in a 1 percent upward shift in CO<sub>2</sub> emissions (compared to CO<sub>2</sub> emissions associated with the hot start FTP of 0.016 g/bhp-hr NO<sub>x</sub>). However, compared to baseline, CO<sub>2</sub> emissions improved by 1 percent. The final composite FTP NO<sub>x</sub> result was 0.018 g/bhp-hr NO<sub>x</sub> and 511 g/bhp-hr CO<sub>2</sub> (about same as baseline CO<sub>2</sub> emissions).

The system was again tested at the intermediate point of 290,000 miles (667-hour of aging period) and hot start FTP NO<sub>x</sub> was 0.024 g/bhp-hr. With further modifications to the thermal management calibration, the hot start FTP was reduced to 0.015 g/bhp-hr NO<sub>x</sub>. With the calibration changes needed to provide additional thermal management, CO<sub>2</sub> emissions for the hot FTP was comparable to baseline. The change in calibration resulted in a half percent increase in CO<sub>2</sub> emissions compared to that measured before calibration modification. The composite FTP NO<sub>x</sub> was at 0.022 g/bhp-hr, which is slightly higher than the target. Composite FTP CO<sub>2</sub> emissions were about 515 g/bhp-hr.

RMC emissions were at 0.015 g/bhp-hr NO<sub>x</sub> at the 145,000 miles test point and 0.019 g/bhp-hr NO<sub>x</sub> at the 290,000 miles test point, with CO<sub>2</sub> emissions comparable to baseline.

SwRI also measured NO<sub>x</sub> and CO<sub>2</sub> emissions on the LLC at the 145,000 miles and 290,000 miles test points. The LLC NO<sub>x</sub> standard is 0.050 g/bhp-hr. NO<sub>x</sub> emissions at the 145,000 miles test point were well below the target emission rate at 0.024 g/bhp-hr. The corresponding CO<sub>2</sub> emissions were similar to baseline emissions. However, at the 290,000 miles test point, LLC NO<sub>x</sub> emissions deteriorated and were at about the target emission rate of 0.047 g/bhp-hr with a 1 percent increase in CO<sub>2</sub> emissions compared to baseline. It should be noted that there is no LLC GHG standard under the Phase 2 GHG Regulation.

The system was finally tested at the end of the useful life aging at 435,000 miles (or 1000-hour aging period). The final test results after ash cleaning and without further changes to thermal management were 0.023 g/bhp-hr NO<sub>x</sub> on the composite FTP, 0.022 g/bhp-hr NO<sub>x</sub> on the RMC, and 0.047 g/bhp-hr NO<sub>x</sub> on the LLC. Both composite FTP and RMC NO<sub>x</sub> emissions were slightly higher than the target NO<sub>x</sub> of 0.020 g/bhp-hr, while the LLC was at the target NO<sub>x</sub> of 0.050 g/bhp-hr. CO<sub>2</sub> emissions were 515 g/bhp-hr on the composite FTP, 461 g/bhp-hr on the RMC, and 617 g/bhp-hr on the LLC. CO<sub>2</sub> emissions on the FTP and RMC were comparable to baseline but were higher compared to baseline by 1 percent on the LLC.

CARB staff agrees that the Stage 3 program did not achieve the target NOx emission rate of lower than 0.02 g/bhp-hr on the FTP and RMC at the 290,000- and 435,000-miles test points. However, the results indicated that with additional improvements to the engine-aftertreatment system, the NOx emission targets are in reach. SwRI identified a number of additional improvements that could be applied to make the system more robust against aging and to significantly reduce NOx emissions with sufficient margin for compliance while reducing or maintaining CO2 emissions neutral. Such improvements may include:

- Replacing the zone coated catalyzed soot filter with a traditional DOC+DPF architecture in the downstream one box aftertreatment system (Stage 3 Re-work). With U.S. EPA's funding support, SwRI evaluated this aftertreatment system in combination with the other Stage 3 engine and aftertreatment components.<sup>53</sup> The Stage 3 Re-work system was aged to a useful life of 435,000 miles and resulting emissions were significantly improved compared to the Stage 3 system. Composite FTP was at 0.020 g/bhp-hr NOx down from 0.023 g/bhp-hr for Stage 3. The RMC test was also reduced at 0.019 g/bhp-hr NOx down from 0.022 g/bhp-hr and LLC was at 0.029 g/bhp-hr NOx down from 0.047 g/bhp-hr NOx. CO2 emissions remained neutral, except for the LLC which increased by 1 percent compared to baseline.
- Improved DEF mixing on the downstream system.
- Using a slightly larger downstream catalyst volume, by roughly 10 percent to provide more durability reserve.
- Improvement in the light-off SCR formulation to better resist chemical poisoning.
- Improvement in the downstream SCR formulation to retain selectivity of the ammonia oxidation function over time.
- Calibration of the aging model algorithm in the controller (which was not within the available scope of the Stage 3 demonstration), which could allow the models to better track storage and performance changes over time.
- Further refinement of long-term trim algorithms.

Note that the SwRI program was the first research effort of its kind launched to demonstrate NOx emissions 90 percent below current levels without impacting CO2 emissions with engine technologies and aftertreatment systems that were available 10 years before the 2027 implementation year. In addition, there were a lot of unknowns at the beginning of the program and adjustments needed to be made along the way during the aging process to achieve the desired target emission rates. SwRI's objective of performing tests at the intermediate test points allowed an opportunity to look at system performance and how it might degrade over time, prior to the final test points. They also allowed for corrections to the strategy to be made based on what was observed. SwRI research program

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<sup>53</sup> "Stage 3 and Beyond, Continuing Low NOx Efforts," Sharp, Christopher, Southwest Research Institute, WCX Digital Summit, April 13-15, 2021.

provided a wealth of information that could be used to further enhance future developments of engine-aftertreatment system by the HD engine industry.

Furthermore, CARB sponsored low NO<sub>x</sub> projects were intended to illustrate the scale of reductions achievable from available, production-intent components. However, they were not intended to be a full commercialization exercise, and CARB staff recognizes that certain validation work typical of any commercialization process will be needed for each engine brought to market.

#### **(a)vi. Cylinder Deactivation Technology**

- (a)vi.1. Comment: The real challenge, however, is to implement CDA on a HD diesel engine, and have it deliver consistent, reliable, durable performance over 800,000 miles, without creating HD vehicle and cab NVH issues or driveline torsional problems. That has never been achieved before. Nonetheless, CARB's Low-NO<sub>x</sub> Regulations would leave engine manufacturers no alternative (save for exiting the California market) but to successfully deliver CDA on all HD diesel engine platforms installed in all HD vehicle less than 6 years after the Omnibus Regulations are finalized. That is not feasible. And no "modeling" or literature review can make it so.

It is instructive first to consider the design aspects of CDA. CDA is not a bolt-on, one-size-fits-all system that an OEM can purchase off-the-shelf from a component supplier. Each engine valvetrain design is likely to require a unique CDA design adaptation, even if the design strategy is the same. CDA likely will require higher oil flow rates, oil pressures, and distribution to the cylinder heads, and possibly significant engine block and head redesign. Additional electronic communication channels will be needed. Manufacturers also would need to undertake a very substantial amount of work related to electronic control system strategies, and for completely new mapping of gas-flow models, thermal models, and other thermodynamic functions. In addition, engines with CDA are susceptible to oil-control problems when an inactive cylinder acts against a vacuum on the intake stroke while the intake valve is closed. Oil control issues can significantly accelerate SCR degradation. (EMA, Daimler, Navistar, Volvo)

- (a)vi.2. Comment: CDA also will introduce new and potentially catastrophic failure modes, for example, failures to open the exhaust valve on the exhaust stroke of a firing cylinder, and subsequent intake valve and valvetrain failures as the intake valve attempts to open under extremely high pressures. CDA designs under development for HD engine applications could experience that extreme failure mode due to a malfunction of any one of several components in the system. There are no cost-effective "maintenance" actions that can be established to overcome those concerns, and major overhaul of the CDA system before the end of FUL as a means of ensuring FUL emissions compliance clearly would be cost-prohibitive. (EMA, Daimler, Navistar, Volvo)

(a)vi.3. Comment: Another major concern associated with CDA, as mentioned above, relates to NVH. The in-line six-cylinder engine configuration that dominates the HD diesel engine market has inherent torsional balance advantages over other configurations. When individual cylinders are deactivated, that natural balance is disturbed, so the engine vibration levels are increased and torsionals in the engine and driveline systems are elevated. The result is increased noise levels and cab vibration levels that can be uncomfortable to the driver, and that can cause increased wear and stress on cranktrain and drivetrain components, and vibration levels throughout the vehicle that can cause performance and fatigue issues for on-board systems. While SwRI did model some work to assess possible deactivation combination schemes to reduce vibration as measured in the test cell, there is a vast difference between vibration characteristics “as modeled” in an emissions laboratory, and those experienced in a HD vehicle on the road. That fact was duly noted by Neely, et al., of SwRI in their related SAE article,<sup>54</sup> where they stated, “Acceptability standards to linear vibration (e.g. measured at the seat, steering wheel, foot pedal, frame rails, etc.) are better understood in a vehicle environment. The system driveline in a vehicle will differ from that in a dyno (test cell) as well, and it is recommended to evaluate driveline response in a typical vehicle setting.”

Indeed, one OEM’s experience with a prototype CDA in a Class 8 vehicle has shown that, at the lowest loads and speeds, drivers’ responses to the experienced NVH issues are not favorable, especially when the minimum number of cylinders are active. Depending on the extent of CDA at a given load and speed, NVH can vary from mildly perceptible to very significant and fatiguing. The concern for manufacturers and fleet operators then becomes whether CDA would adversely impact driver attentiveness, fatigue and ultimately retention. While increasing the number of active cylinders and engine speed can result in a more positive driver response, that reduces the benefits derived from the elevated temperature of CDA. Passive or active engine mounts can help improve those negative responses, but there is insufficient data on the broad range of truck powertrain configurations to know whether those issues can be addressed in a sufficiently effective manner.

Manufacturers of Class 2b-3 vehicles (14,000 lbs and less), where gasoline engines of smaller displacements have been fitted with CDA, are very familiar with the magnitude of the engineering challenges to overcome NVH issues. Each engine installation on each unique vehicle model is its own project, requiring significant resources, multiple technical solutions, and significant verification time. The technical solution, depending on the vehicle model, can

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<sup>54</sup> Simultaneous NOx and CO2 Reduction for Meeting Future California Air Resources Board Standards Using a HD Diesel CDA-NVH Strategy, Neely et al., Southwest Research Institute, SAE article 03-13-02-0014.

include engine-mount tuning, active noise-cancellation systems, exhaust butterfly valves and pipe geometry modifications, active-tuned dampers, and high-torque-converter slip settings. Manufacturers do not have a sufficient body of knowledge on the broad range of HD truck powertrain configurations to know how effective those potential technical solutions might (or might not) be in larger engines and vehicles. Moreover, some of those solutions will have negative fuel efficiency impacts.

As noted, the CDA engineering challenge is multiplied by the fact that each CDA installation requires an engineering investigation and a unique combination of solutions. Given the significant differences among HD truck configurations and applications, those technical challenges could be insurmountable. When the level of customization that occurs with each customer's purchase in the HD vehicle market is taken into account, the level of effort, resources and time it could take to implement CDA effectively could quickly become overwhelming. (EMA, Daimler, Navistar, Volvo)

- (a)vi.4. Comment: Accordingly, while SwRI used CDA in its Stage 3 engine prototype, there are serious questions about its viability for actual HD engine and vehicle applications before the end of 2026. Engine designers strive to develop the most efficient engine assembly with the fewest moving/wearing parts to maximize reliability and reduce costs. The addition of individual electro-hydraulic valve actuators, along with all of the associated control components, represents significant diagnostic and durability challenges for successfully deploying CDA. If HDOH manufacturers are unable to address all of those significant issues and challenges with each engine adaptation of CDA, as integrated into each vehicle model and each customer specification, they will be unable to meet CARB's aggressive low-NOx 2027 MY standards. In that regard, CARB offers no alternative solution that accomplishes the combination of CO2 and NOx reductions that CDA enabled SwRI to demonstrate with its Stage 3 prototype. As a result, given the inherent risks and uncertainties that pertain to the actual deployment of CDA in actual HDOH vehicles, CARB has not adequately demonstrated the feasibility of the 2027 MY low-NOx standards. (EMA, Daimler, Navistar, Volvo)

Agency Response to Comments (a)vi.1 to (a)vi.4: No change to the Proposed Amendments was made in response to these comments. CARB staff understands the challenges of designing and integrating CDA into various engine platforms, demonstrating it for the longer useful life, and addressing NVH issues on a vehicle. However, CARB staff believes a lead time of 6 years is enough for engine manufacturers to develop CDA technology and integrate the technology in their engine platforms. As discussed in Agency Response for A.(a)iv.2, the Stage 3 demonstration program has already successfully demonstrated NVH control with an EATON supplied CDA system on an engine

dynamometer.<sup>55</sup> <sup>56</sup> In addition, OEMs and component suppliers in many parts of the world are conducting extensive testing to address NVH control with CDA technology including testing on engine dynamometer and installed on vehicles to meet future criteria pollutant and GHG emissions regulations.<sup>57</sup> For example, as of late 2020, Jacobs Vehicle Systems has conducted extensive testing of CDA components (including High Power Density® or HPD® engine brake technology) on 19 different HD engine platforms and 8 HD truck road tests, demonstrating CDA's durability over more than 75,000 miles of driving and 15,000 hours of dynamometer and endurance testing.<sup>58</sup> These technology development efforts are still in progress. Moreover, Jacobs Vehicle Systems recently announced that its HPD® engine brake technology that uses CDA mechanisms went into production with a major truck manufacturer in China, indicating the maturity of the technology.<sup>59</sup> Tula has commercialized a highly capable control strategy for maximizing CDA opportunities while eliminating NVH issues. Tula's technology is already in widespread production in pickup trucks and has been demonstrated on heavy duty diesel engines in collaboration with Cummins for a number of years.<sup>60</sup> <sup>61</sup> <sup>62</sup> This have been proven out on both leading HD diesel CDA providers' hardware. Also, Navistar included CDA in their Department of Energy SuperTruck II technology package.<sup>63</sup>

SwRI with U.S. EPA funding is continuing to develop the Stage 3 engine (with CDA) on a different aftertreatment system and demonstrate durability up to the extended useful life of 600,000 and 800,000 miles.<sup>64</sup> The demonstrated results

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<sup>55</sup> Neely, G., Sharp, C., Pieczko, M., and McCarthy, J., "Simultaneous NOX and CO2 Reduction for Meeting Future California Air Resources Board Standards Using a Heavy-Duty Diesel Cylinder Deactivation-NVH Strategy," SAE Int. J. Engines 13(2):191-210, 2020, <https://doi.org/10.4271/03-13-02-0014>.

<sup>56</sup> Reinhart, T., Matheaus, A., Sharp, C., Peters, B., Pieczko, M. and McCarthy Jr. "Vibration and emissions quantification over key drive cycles using cylinder deactivation," J., International Journal of Powertrains (IJPT), 2020 Vol.9 No.4, page(s): 315 - 344. DOI: 10.1504/IJPT.2020.111245.

<sup>57</sup> The Latest Developments in CDA Technology. <https://www.jacobsvehiclesystems.com/blog/latest-developments-cda-technology> - Accessed 5/17/2021

<sup>58</sup> The Latest Developments in CDA Technology. <https://www.jacobsvehiclesystems.com/blog/latest-developments-cda-technology> - Accessed 5/17/2021

<sup>59</sup> Jacobs High Power Density Engine Brake Specified by Chinese Truck maker, News and Events, Jacobs, November 10, 2020. <https://www.jacobsvehiclesystems.com/news-events/jacobs-high-power-density-engine-brake-specified-chinese-truck-maker> – accessed 3/9/2021

<sup>60</sup> Srinivasan, V., Wolk, B., Cai, X., Henrichsen, L. et al., "Application of Dynamic Skip Fire for NOx and CO2 Emissions Reduction of Diesel Powertrains," SAE Technical Paper 2021-01-0450, 2021, doi:10.4271/2021-01-0450.

<sup>61</sup> Farrell, Lisa, T. Frazier, M. Younkins, J. Fuerst. "Diesel Dynamic Skip Fire (dDSF™): Simultaneous CO2 and NOx Reduction," 41<sup>st</sup> International Vienna Motor Symposium. April 2020.

[https://www.tulatech.com/wp-content/uploads/2021/05/Final\\_paper\\_dDSF\\_Simultaneous\\_CO2\\_and\\_NOx\\_Reduction\\_Cummins\\_Tula\\_Vienna2020.pdf](https://www.tulatech.com/wp-content/uploads/2021/05/Final_paper_dDSF_Simultaneous_CO2_and_NOx_Reduction_Cummins_Tula_Vienna2020.pdf) - accessed 7/24/2021)

<sup>62</sup> [Cummins And Tula Announce Collaboration Demonstrating The Benefits Of Diesel Dynamic Skip Fire \(dDSF™\)](#) Apr 22, 2020. Columbus, Indiana and San Jose, California.

<sup>63</sup> [Jacobs Vehicle Systems Supporting Super Truck II Program](#) October 29, 2019.

<sup>64</sup> Stage 3 and Beyond, Continuing Low NOx Efforts," Sharp, Christopher, Southwest Research Institute, WCX Digital Summit, April 13-15, 2021.

from the widespread CDA development activity currently in progress by manufacturers and technology developers indicates a high probability of success for to integrating CDA on future engine platforms and vehicles to resolve NVH issues as well as improve engine emissions and efficiency performance. CARB staff believes CDA technology will be feasible for 2027 MY engines if not earlier. As seen above, each component type of the CDA system exists or has direct analogues in automotive production today, from the collapsible mechanical elements shared with engine brakes, to the sophisticated firing order controls, to applying hydraulic control of valvetrain elements with engine oil driven actuators and electrohydraulic valves. Integrated HD diesel CDA systems have already been demonstrated on a wide variety of engine platforms and valvetrain architectures, clearing the way for OEMs to proceed with validating their particular product design decisions for release to production.

CARB staff disputes the commenter's assertion that CARB has not demonstrated feasibility of the 0.02 g/bhp-hr standard and that feasibility is somehow tied exclusively to CDA. CARB staff notes that in addition to the Stage 3 CDA/dual-dosing split SCR configuration, the 0.02 g/bhp-hr NOx level performance has been achieved on the opposed piston engine which has no traditional valvetrain at all and a simple conventional DPF/SCR layout aftertreatment system.<sup>65</sup> <sup>66</sup> The easier control of exhaust temperature afforded by the opposed piston architecture has been examined for its ability to reduce thermal aging of catalysts for longer durability or reduced aftertreatment cost.<sup>67</sup> Manufacturability costing study of the opposed engine indicates its unit cost of production at the 0.02 g/bhp-hr NOx level with reduced GHG emissions would be less than today's 0.2 g/bhp-hr diesels.<sup>68</sup> This opposed piston engine technology is already being prepared for production by Cummins and the US Army for use in heavy combat vehicles.<sup>69</sup> <sup>70</sup>

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<sup>65</sup> "Achatas Power Opposed-Piston Heavy-Duty Diesel Engine Demonstration Performance Results – Ultralow NOx without additional hardware," Achatas Power, December 17, 2020. (<https://achatespower.com/wp-content/uploads/2020/12/Achatas-Power-Opposed-Piston-Heavy-Duty-Diesel-Engine-Demonstration-Performance-Results-Ultralow-NOx-without-additional-hardware.pdf> – accessed 3/8/2021).

<sup>66</sup> Achatas Power Opposed-Piston Engine Oil Consumption & Durability Results. Achatas Power February 2021. (<https://achatespower.com/wp-content/uploads/2021/02/Durability-Assessment-of-OP-Engines-Feb-2021.pdf> - accessed 7/23/2021)

<sup>67</sup> Patil, S., Sahasrabudhe, A., Youngren, D., Redon, F. et al., "Cold-Start WHTC and WHSC Testing Results on Multi-Cylinder Opposed-Piston Engine Demonstrating Low CO2 Emissions while Meeting BS-VI Emissions and Enabling Aftertreatment Downsizing," SAE Technical Paper 2019-26-0029, 2019, doi:10.4271/2019-26-0029.

<sup>68</sup> Achatas Power Opposed-Piston Engine Cost Comparison. March 2020. ([https://achatespower.com/wp-content/uploads/2020/03/Achatas-Power-Cost-Study-White-Paper\\_March-2020.pdf](https://achatespower.com/wp-content/uploads/2020/03/Achatas-Power-Cost-Study-White-Paper_March-2020.pdf) - accessed 7/25/2021)

<sup>69</sup> Jacobs, Caleb. How Cummins Designed a 14.3L Flat-Four With Eight Pistons, No Valves and 1,000 HP. The Drive. August 3, 2020. (<https://www.thedrive.com/news/35330/how-cummins-designed-a-14-3l-flat-four-with-eight-pistons-no-valves-and-1000-hp> - accessed 7/24/2021)

<sup>70</sup> Achatas Power continues development of opposed-piston technology for US Army vehicles. Green Car Congress. January 28, 2021. (<https://www.greencarcongress.com/2021/01/20210128-achates.html> - accessed 7/24/2021)

**(a)vii. LLC**

- (a)vii.1. Comment: CARB is proposing to add a new low-load certification test cell cycle to the certification requirements for HDOH engines. The new LLC that CARB staff proposes is a 92-minute test cycle that includes approximately 30 minutes of idle operation, a significant portion of high-to-low load operation with extreme air-flow-induced cooling (i.e., downhill operation), and a significant portion of low-to-high load transient operation (i.e., drayage work). The selected LLC also has an average power that is approximately 6% of maximum power, and an average vehicle speed that is approximately 10 miles per hour (mph). It is an extreme cycle, especially as applied to every HDOH engine, regardless of the vehicle type and application in which the engine might be installed.

EMA has repeatedly questioned the analyses that CARB, SwRI, and National Renewable Energy Laboratory (NREL) relied on to develop the LLC. One concern relates to the portion of the LLC that has been dubbed, “v11660\_5”. That portion’s combination of engine, transmission, 6x4 axle configuration, and 4.20 axle ratio appears to be a heavy-haul configuration, which should mean heavier parts all around. However, the mass—after SwRI’s mass reduction and after EMA subtracts a hypothetical 15,000-pound empty trailer—is 11,333 pounds for a GEM-simulated tractor. That tractor weight is not at all realistic. Even a heavy-haul single unit vehicle, like a dump truck, typically is heavier than 26,333 pounds (i.e., without subtracting an empty trailer). Thus, it would seem that CARB’s LLC is not representative of the actual operation of any actual HDOH vehicle. Similarly unrepresentative is the LLC auxiliary load that CARB is applying. CARB should increase the LLC auxiliary load for HHDD engines from 3.5 kW to a higher value in the range of 5.0 to 5.5 kW, so that it is more representative of real-world auxiliary loads.<sup>71</sup> (EMA, Daimler, Navistar, Volvo)

Agency Response: No change to the Proposed Amendments was made in response to this comment. To develop the speed-torque trace of the LLC, SwRI and NREL modified the GEM vehicle simulation model so that inputs of actual vehicle configurations in the NREL database specific to the low load segment from which the LLC is assembled can be simulated. The simulation exercise was to match the work accumulation between the model output and the field data over the course of the profile as well as match the total work accumulated to within 5 percent. Thus, several modifications such as grade profiles and test weights were necessary to match the accumulated work over the course of the profile. This process was iterated as a function of vehicle mass and grade until an acceptable match was obtained.

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<sup>71</sup> CARB also must detail how to include accessory loads in the power mapping procedure for both the engine-based LLC and the vehicle-based LLC.

Note that vehicle mass was not specified in the NREL database, so a series of model runs at different masses was generally used to select a final vehicle mass for a given profile. EMA in the above comment is questioning the test weight input to the GEM used for profile “v11660\_5.” EMA assumes the tractor is pulling an empty trailer weighing about 15,000 pounds, which leaves about 11,333 pounds for the tare weight of the tractor, which is too low to be considered as the tare weight of a HD tractor. EMA then concludes that the test weight is not realistic and as a result the LLC is not representative of the actual operation of any actual HD vehicle. CARB staff disagrees with EMA’s conclusion since it is based not on facts but on assumptions which are not necessarily correct.

Since the vehicle mass was not given in the database, EMA’s assumption of the tractor pulling an empty trailer is not the only scenario that could have happened in the real world to result in a test weight of 26,333 pounds. A likely scenario that may have happened is the tractor may have been in the course of picking up a load without a trailer, in which case the test weight of 26,333 pounds would be valid. Another possible scenario is the tractor may have been pulling a container chassis which weighs approximately 6,600 pounds, leaving about 20,000 pounds for the tare weight of the tractor, in which case the test weight of 26,333 pounds would also be valid. Therefore, the vehicle test weight used in the GEM model to simulate the vehicle profile “v11660\_5” is not an uncommon vehicle weight that could occur in real-world vehicle operations. Nevertheless, the main objective of the GEM modeling exercise was to develop an engine loading pattern that is representative of the profile and not the determination of a vehicle weight, grade, or vehicle configuration. To that end, SwRI achieved the objective of developing an engine loading pattern that is representative of the low load profile v11660\_5.

CARB staff does not agree with EMA’s suggestion to increase the accessory load that is applied to the idle segments of the LLC. CARB staff’s proposed accessory loads are consistent with accessory loads used in U.S. EPA’s GEM used to calculate GHG emissions from HD vehicles for certification with the HD Phase 2 GHG standards.

- (a)vii.2. Comment: The SwRI testing that CARB is sponsoring has indicated that current HDOH engine baseline NO<sub>x</sub> emissions over the proposed LLC are, on average, approximately 1.00 g/bhp-hr. An EMA survey of member companies’ baseline LLC test results corroborated SwRI’s 1.00 g/bhp-hr baseline conclusion for HHDD engines. However, the MHDD engine LLC baseline was significantly higher, on the order of 1.5-2.5 g/bhp-hr. Yet CARB is proposing an LLC NO<sub>x</sub> standard of 0.20 g/bhp-hr in 2024 for all HD engines, which amounts to an 80% reduction from the current HHDD engine baseline, and an 87-92% reduction from a likely MHDD engine baseline. That is not reasonable given the available leadtime.

Although SwRI has reported 93% NO<sub>x</sub> reductions (i.e., 0.07 g/bhp-hr) with a partially-aged aftertreatment system and no resulting net LLC test-cycle fuel

penalty on its Stage 1B/2 research engine, that research engine at SwRI includes significant hardware and calibration changes that CARB concedes are not feasible to develop fully and introduce into production in the 2024 MY timeframe, including a passive NOx adsorber and a mini-burner. Even SwRI concurs that the Stage 1B/2 (and now the “Stage 3”) research engines at issue are 2027 prototypes, not 2024 demonstration engines. It is clear, then, that the proposed LLC emission standard is not feasible without significant hardware changes. Moreover, SwRI has not evaluated the prototype engine’s fuel-consumption impact over any of the Phase 2 GHG engine and vehicle cycles, or over any real-world drive cycles save for CARB’s “Southern Route”, which was actually an assessment conducted by EMA. It is highly likely that the Stage 2/Stage 3 engine would exhibit a significant fuel penalty on those cycles.

Due to the lack of actual feasibility-demonstration data, CARB’s ISOR again turns to simulation “modeling” results from MECA to make the case for the feasibility of the 0.20 g/bhp-hr LLC standard (ISOR III-14). By simulating the effects of increased PM loading on the DPF to the “high end of today’s commercially available DPFs” and heated dosing (a technology not yet verified and in production in the HD marketplace), MECA claims to have modeled an LLC NOx result of 0.18 g/bhp-hr. Critical to that modeled result was a pre-conditioning of the system using the LLC cycle to set up a 50% NH3 storage level at the start of the LLC emissions test. Pre-conditioning with the FTP (as would be required by CARB’s proposed Omnibus Regulations), however, produced results in other MECA simulations of the same system that were 65% higher than with the LLC pre-conditioning. Consequently, following CARB’s actual proposed procedures for LLC certification testing, including pre-conditioning over the FTP, likely would generate a result as high as 0.30 g/bhp-hr, 50% higher than the proposed standard. (EMA, Daimler, Navistar, Volvo)

Agency Response: No change to the Proposed Amendments was made in response to this comment. In the above comment, EMA mentions the baseline LLC NOx results of 1 g/bhp-hr on the Stage 3 engine and other elevated baseline LLC NOx emission results from manufacturers tests. However, EMA did not mention that the baseline LLC NOx results of 0.34 g/bhp-hr on the Stage 1/2 engine, which was achieved with base engine calibration and stock aftertreatment system. This tailpipe NOx was achieved from engine-out NOx level of 3.4 g/bhp-hr representing a 90 percent NOx conversion efficiency of the stock aftertreatment system. The proposed 0.20 g/bhp-hr NOx LLC standard for MY 2024 is 41 percent below baseline LLC NOx of some current engines, as opposed to EMA’s claim of 80 percent below current baseline levels.

EMA’s statements that SwRI has not evaluated the prototype engine’s fuel-consumption impact over any of the Phase 2 GHG engine and vehicle cycles or over any real-world drive cycles are simply incorrect. To help quantify the impact

of the Stage 3 low NOx configuration on vehicle CO2 emission results generated using the GEM model, SwRI ran both Phase 2 GHG steady-state fuel mapping and cycle average fuel map tests on the baseline engine and the Stage 3 low NOx engine. The steady state fuel mapping results indicated that over most of the engine map, the Stage 3 engine performance was essentially the same as the baseline engine. However, at the lightest load points, where CDA is active, the Stage 3 engine showed substantial fuel savings (as much as 45 percent in some cases) and as much as 25 percent at idle. SwRI also ran cycle average fuel mapping tests on the ARB-transient, the 55 mph and 65 mph Cruise Cycles for the nine default vehicle configurations prescribed in title 40 Code of Federal Regulations (CFR) 1065.540 (or 40 CFR 1065.540). SwRI testing indicated that the Stage 3 engine showed fuel saving benefits of about 1.3 percent on average. For the Cruise cycles, the Stage 3 Low NOx engine was essentially fuel consumption neutral, although a few of the heavier vehicles showed some fuel consumption penalty which SwRI attributed it to CDA hardware design issues which would be not an issue with a production engine. Tailpipe NOx was below 0.02 g/bhp-hr on all cycles.

In addition, SwRI evaluated the impacts of the Stage 3 low NOx engine configuration on GHG emissions using GEM version 3.5.1. SwRI ran simulation modeling on a variety of vehicle configurations including vehicle configuration used to set the stringency of the 2027 Phase 2 GHG standards. The overall conclusion from the GEM modeling exercise was that the Stage 3 engine was essentially fuel consumption neutral as compared to the baseline engine.

As discussed in Agency Responses to Comments A.(a)i.2 and A.(a)ii.1, MECA's simulation modeling demonstrated an LLC NOx result of 0.18 g/bhp-hr with heated dosing and preconditioning using the LLC cycle and 50 percent ammonia coverage at the start of the emissions test. Preconditioning the system with the FTP test cycle and an ammonia coverage of 20 percent resulted in a tailpipe NOx of 0.38 g/bhp-hr. EMA in the above comment claims that since CARB requires preconditioning with the FTP cycle to demonstrate compliance with the LLC standard, the stored ammonia (20 percent) would not be sufficient enough to reduce emissions to the levels achieved with the LLC preconditioning. CARB staff agrees that applying the same ammonia to NOx ratio with different preconditioning cycles can result in different amounts of ammonia stored in the SCR. However, with FTP preconditioning, ammonia storage can be increased with increased DEF dosing to increase the ammonia to NOx ratio. Using a model-based controller such as that used in the SwRI low NOx program, ammonia storage can be optimized to result in optimum SCR conversion efficiency. However, with increases in ammonia to NOx ratio, there is the potential for increased ammonia slip. Any increases in ammonia slip may also be controlled with improved formulations of ammonia slip catalyst to further minimize potential increase in NOx emissions.

- (a)vii.3. Comment: Compounding the infeasibility of the proposed 2024 MY standards, including the LLC standard, CARB also has proposed significant revisions to the current well-established “pre-conditioning” cycles.... CARB has proposed to reduce the number of allowed preconditioning cycles, and to mandate that any emissions occurring during preconditioning cycles must be included in the certified test results. None of those proposed changes has been assessed through any analysis linked to the already-minimal allowance for compliance testing margins.

The case of the LLC is especially problematic since CARB has proposed to require two hot-FTP emissions tests prior to the start of the LLC. There is no obvious way to include FTP-generated emissions results into an LLC test (as they are dissimilar tests), and there has been no assessment of the impacts on the LLC standard as proposed, which there almost certainly will be. For example, Infrequent Regeneration Adjustment Factors (IRAF) will be impacted and increased by the new preconditioning provisions (which would require the inclusion of any emission increases that occur during all phases of an aftertreatment “regeneration” event), and will adversely impact the feasibility of the LLC. Accordingly, CARB should not proceed with the proposed changes to pre-conditioning cycles and IRAFs. Further analysis and collaboration with emissions-measurement and testing experts is needed to determine better data-driven alternatives. (EMA, Daimler, Navistar, Volvo)

Agency Response: No change to the Proposed Amendments was made in response to this comment. CARB’s proposed language is consistent with existing language in 40 CFR 1065.518(c)(1): “Precondition the engine by running at least one hot-start transient cycle. We will precondition your engine by running two hot-start transient cycles.” Therefore, it is CARB’s position that the number of preconditioning cycles has not been changed. CARB will allow an extra preconditioning cycle if justified. All extra preconditioning cycle emissions must be included in the IRAF analysis.

Currently, CARB has left open the option for manufacturers to propose IRAF calculations for inclusion in the LLC cycle emissions. Industry has not agreed on the best solution here, therefore, CARB has decided not to provide a single approach for the IRAF calculations. CARB will accept proposals based on good engineering judgment as submitted by each manufacturer.

- (a)vii.4. Comment: The new preconditioning and IRAF requirements only add to the conclusion that CARB’s technology assessment to demonstrate LLC feasibility as of 2024 is built upon simulations of unproven technology, enhanced by favorable but prohibited pre-conditioning steps, that produce a result with a mere 10% compliance margin, and with clear evidence that the appropriately tested result would be at least 50% above the proposed standard. That does not amount to a sufficient showing of feasibility. In that regard, it should be noted that CARB’s highlighting of “modeling” work that

MECA claims to have performed to support the feasibility of CARB's proposed standards (see ISOR, p. III-14) is not equivalent to an actual demonstration of feasibility with an actual engine and aftertreatment system in an actual emissions testing facility. (EMA, Daimler, Navistar, Volvo)

Agency Response: As discussed in Agency Responses to Comments A.(a)i.2, A.(a)ii.1, and A.(a)vii.2, MECA's modeling demonstrated 0.018 g/bhp-hr NOx over the LLC using as input engine-out NOx emissions from the Stage 1 engine with modified calibration and a full useful life aged current generation SCR catalyst with an average SCR volume found on 2019 trucks, heated dosing and 50 percent ammonia coverage. CARB staff accepted MECA's simulation model results since the model was developed over ten years of commercial system testing and has been correlated with field data providing reliable results.

In addition, as discussed in Agency Response for comments A.(a)v.12 through A.(a)v.14, SwRI evaluated the Stage 3 engine-aftertreatment system by replacing the zone coated catalyzed soot filter with a traditional DOC+DPF architecture in the downstream one box aftertreatment system (Stage 3 Re-work). The Stage 3 Re-Work system was thermally and chemically aged to a useful life of 435,000 miles. Testing at the end of the aging process resulted in 0.029 g/bhp-hr NOx on the LLC, albeit with a 1 percent increase in CO2 emissions compared to baseline. This result provides approximately 40 percent compliance margin compared to the proposed 2027 LLC NOx standards of 0.050 g/bhp-hr. As described in Agency Response to Comment A.(a)v.14, further improvements can be made to the system to further reduce NOx and CO2 emissions.

- (a)vii.5. Comment: Engines using single-point injection of gaseous fuels have delayed torque response in highly transient cycles such as the LLC and cannot meet all the cycle validation statistical criteria of §1065.514. Cummins recommends CARB revise the LLC cycle regression limits for single-point injection, gaseous-fueled engines. (Cummins)

Agency Response: CARB staff agrees that gaseous-fueled engines using single point fuel injection have delayed torque response on highly transient cycles such as the LLC and ARB Transient Cycle. Accordingly, CARB staff, in the 30-Day Notice, proposed cycle validation criteria with revised regression limits for gaseous-fueled engines that address the needs of engines with a "single-point" injection system.

- (a)vii.6. Comment: South Coast AQMD staff firmly believes that an established technology pathway is already available and can be implemented in a commercial product prior to 2024 for a 0.02 g/bhp-hr NOx standard. In light of the current developments, OEM progress and technology readiness, the draft Omnibus Regulation should be more stringent than proposed. South Coast Air Quality Management District (AQMD) staff is particularly concerned about the proposed 2024-2026 LLC standards... which are not stringent enough to

help the South Coast Air Basin to meet the 2023 and 2031 ozone attainment goals. While staff agrees with CARB's assessment that the proposed LLC initial phase-in level of 0.20 g/bhp-hr NO<sub>x</sub> is more technically feasible and cost-effective, however, the current proposed LLC limit is also 4 times higher than the 2024-2026 FTP certification limit and 6 times higher when considering low-load in-use standards... While South Coast AQMD recognizes CARB's response on South Coast AQMD's previous comments on adopting the proposed amendment three years early, for the reasons listed in this comment letter, staff continues to urge CARB to adopt the most stringent standards for 2024-2026 that encourages critical low-NO<sub>x</sub> technology advancement and to ensure future attainment goals can be met. (SCAQMD)

Agency Response: No change to the Proposed Amendments was made in response to this comment. As discussed in Agency Responses for Comment A.(a).i.6 and A.(a).i.9, CARB staff considered implementing the requirements earlier than proposed, i.e., implementing the 2024 requirements in 2022 and the 2027 requirements in 2024. CARB staff evaluated that scenario as an alternative to the primary standards in Chapter X of the ISOR. This alternative would achieve greater NO<sub>x</sub> reductions sooner but have higher costs in earlier years. However, it was rejected since the accelerated schedule would not provide enough lead time for the development of the interim engines in 2022 and the low NO<sub>x</sub> engines in 2024. Without sufficient time for engine manufacturers to conduct research, development, and durability testing, products will not be able to meet the stringent criteria and hence this alternative was not considered as the final proposal.

#### **(a)viii. Idle Emission Standards**

- (a)viii.1. Comment: Additionally, CARB is proposing that for 2024 and later MYs, manufacturers certifying to the optional idle NO<sub>x</sub> standard must demonstrate that there is no increase in emissions of [carbon monoxide] CO, PM, or [non-methane hydrocarbons] NMHC when tested over the longest idle segment of the LLC certification test.<sup>72</sup> That requirement will force manufacturers to use two PM measurement systems during the LLC cycle, creating unnecessary costs and test burdens. Moreover, a manufacturer using bag-sampling for gaseous emissions would have to perform continuous measurements for comparison of results to the LLC idle segment. If manufacturers are meeting the criteria emissions standards for the LLC and the idle NO<sub>x</sub> standard, the proposed comparison should be unnecessary. (EMA, Daimler, Navistar, Volvo)

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<sup>72</sup> The idle segment beginning at 4231 seconds and ending at 5120 seconds in the test schedule.

Agency Response: CARB staff agrees with the above comment. In the 30-Day Notice, CARB staff removed the proposed provision<sup>73</sup> for 2024 and subsequent MY HD engines that requires manufacturers to use the CO, PM, or NMHC emission test results from the longest idle segment of the low-load certification cycle to compare them with CO, PM, or NMHC emissions from the idling test procedure. CARB staff did not intend to propose this requirement during the initial 60-Day Notice of proposed rulemaking. The requirements were initially introduced as concepts for discussion purposes with stakeholders in versions of the regulatory documents (13 CCR 1956.8 and the associated test procedures) that were distributed to the Low NOx Workgroup members on March 2, 2020. Later, CARB staff realized that the existing procedures referenced in 13 CCR 1956.8 were sufficient to demonstrate compliance with CO, PM, and NMHC requirements of the idling regulation, and recognized that adding new procedures would add unnecessary complexity without any additional benefits. Accordingly, CARB staff removed these provisions from 13 CCR 1956.8 prior to the issuance of the 60-Day Notice regulatory package. However, the same text was inadvertently retained in the test procedures. Thus, in the 30-Day Notice Amendments, CARB staff proposed to remove the new language from the test procedures and retain the existing language that would allow manufacturers to continue using the existing process of ensuring CO, PM, and NMHC emissions are not increased at the expense of reducing idling NOx emissions.

- (a)viii.2. Comment: CARB also is proposing to reduce the current low-NOx engine idling standard — from 30 g/hr to 10 g/hr starting with the 2024 MY. CARB staff have presented limited data regarding the feasibility of that new low-NOx idling standard as of the 2024 MY. The ISOR references the SwRI “Stage 2” report as justification for the reduced Clean Idle Standard. The referenced data, however, were generated with an engine equipped with an intake air throttle to achieve reduced exhaust flow, and with high EGR rates, both of which SwRI reported as key components for achieving the reported levels. However, at idle conditions in cold ambient temperatures, high EGR rates raise concerns about EGR-cooler fouling. In addition, while an intake throttle is a known technology, it is not realistic to expect that the device can be engineered onto all engines or packaged into all chassis by 2024. Furthermore, EMA has surveyed its members’ optional “Clean Idle” test data submissions to CARB. Based on an aggregate analysis of those data, while it might be technologically feasible to set lower Clean Idle standards, separate stringencies would be necessary for the two different “modes” of CARB’s Clean Idle test procedures.

The 2008 dynamometer-based certification test for the Clean Idle standards involves 30 minutes at low idle and 30 minutes at 1100 rpm idle after a period of engine warm-up. That certification test will present significant feasibility issues for the new Clean Idle standards, since the long periods of idle would

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<sup>73</sup> Section 11.B.6.3.2.2 of the California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Year Heavy-Duty Diesel Engines and Vehicles.

result in SCR cooling and reduced SCR NO<sub>x</sub>-conversion efficiencies, and a corresponding inability to sustain “certified” NO<sub>x</sub> levels over the more-extended periods of idle. That will pose additional serious challenges relating to compliance with the new in-use idle test, described below, especially in colder ambient temperatures. Another concern is that in order to control engine-out NO<sub>x</sub> to satisfactory levels during the low-idle mode, calibrations typically will result in elevated hydrocarbon levels. The hydrocarbons in the exhaust stream can accumulate on the surface of the SCR over periods of extended idle. When they are subsequently “burned off” as the engine resumes powered operation after extended idling, the catalyst can be damaged, resulting in reduced long-term NO<sub>x</sub> conversion efficiencies due to the “over-temperature” conditions. SCR systems also would experience a temporary loss of conversion efficiency due to the accumulated hydrocarbons blocking catalysis sites until they are burned off. There has been inadequate demonstration during the course of this rulemaking regarding how these well-known challenges will be managed by the SwRI Stage 3 prototype. (EMA, Daimler, Navistar, Volvo)

Agency Response: No change to the Proposed Amendments was made in response to these comments. As discussed in Agency Response to Comment A.(a)ii.1, CARB staff’s proposed idling NO<sub>x</sub> standards of 10 g/hr for MY 2024 was based both on the Stage 2 test program as well as engine certification data for 2019 MY engines.

EMA raises concerns of EGR cooler fouling with using high EGR rates at cold ambient conditions as a strategy to reduce idling NO<sub>x</sub> emissions, but CARB staff does not agree with EMA’s assessment. This is because most of the currently certified HD diesel engines use EGR to meet the optional idling NO<sub>x</sub> standard, with some having certification levels below the proposed 10 g/hr idle NO<sub>x</sub>. To CARB staff’s knowledge, no issues of EGR cooler fouling have been reported on these engines. In addition, EMA states that the intake air throttle that enabled the Stage 2 engine to reduce exhaust flow rate and, together with the use of EGR, to achieve low idle emissions may not be feasible to engineer onto all engines or packaged into all chassis by 2024. CARB staff’s proposals identify strategies and technologies that enable engines meet the proposed standards, however, they do not mandate the use of any device to meet the standards. It is up to the manufacturer’s choice which technology to adopt to meet the proposed standards.

Again, CARB staff does not agree with EMA’s suggestion that separate stringencies be established for the two different “modes” of CARB’s Clean Idle test procedures. As demonstrated in the SwRI Stage 3 program, the proposed idle NO<sub>x</sub> standard is feasible on both modes of the test procedure. SwRI demonstrated CARB extended idle test at the 1000-hour test point represented 435,000 miles of operation to the current full useful life. The mode 1 (curb idle) test result was 0.1 g/hr tailpipe NO<sub>x</sub> and the mode 2 (1,100 rpm) test result was

0.3 g/hr tailpipe NOx, showing the feasibility of the proposed 2027 idle NOx standard of 5 g/hr on both idle modes of CARB's Clean Idle test procedure. In addition, in the Stage 3 program, SwRI also performed an 8-hour long idling test with an accessory load of 3.5 kW to simulate "hoteling" on a sleeper cab tractor. In this test, engine out NOx of 3 g/hr and tailpipe NOx of 1 gram per hour were achieved. These results were achieved at a stabilized engine-out temperature of 165°C, with the light-off SCR temperature at 145°C. Despite the low exhaust temperatures, the light-off SCR achieved about 66 percent NOx conversion efficiency due to the low exhaust flow rate and the associated reduced catalyst space velocity. While conducting all of these tests, SwRI research scientists did not observe any issues of concern with HC accumulation on the surface of the SCR system. EMA's concern of catalyst damage due to subsequent burning of the accumulated HC over the catalyst is therefore not valid.

- (a)viii.3. Comment: Jacobs is happy to see CARB's proposed idling emission standard of 10 g/hr in MY2024 as a first step, but feels it could be even more stringent. This idling standard is feasible and is a less stringent standard than what was demonstrated to be achievable by SwRI.<sup>74</sup> (JVS)

Agency Response: No change to the Proposed Amendments was made in response to this comment. It is true that SwRI Stage 3 program demonstrated idle emissions that are lower than the proposed 2024 idle NOx standards. However, SwRI's test results are achieved with the Stage 3 engine and aftertreatment system that are predicated to be employed to meet the 2027 MY standards and not the 2024 MY standards. CARB staff's proposed 10 g/hr MY 2024 idle NOx standard is expected to be met with increased EGR rates and does not presume the application of advanced engine and aftertreatment technologies, such as CDA and light-off SCR technologies.

#### **(a)ix. OBD System**

- (a)ix.1. Comment: Just as current Portable Emissions Measurement System (PEMS) NOx-measurement capabilities render CARB's proposed in-use low-NOx standards unenforceable and invalid, so too do the current emission-assessment capabilities of OBD systems and sensors. Through its necessary acknowledgements of the detection limits of current OBD systems and sensors, CARB admits that current in-use enforcement systems and compliance protocols are incapable of assessing emissions at the low-NOx levels that CARB is proposing, and that, as a result, the proposed emission standards are, again, as in the case with PEMS, inherently unenforceable as a practical matter, which renders them inherently unreasonable and invalid. (EMA, Daimler, Navistar, Volvo)

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<sup>74</sup> CARB, Staff Report: ISOR, p. III-15.

(a)ix.2. Comment: Similarly, today’s OBD NO<sub>x</sub>-sensor-based capabilities are insufficiently precise to detect and “bin” in-use NO<sub>x</sub> emission as CARB is proposing, or to assess in-use emissions compliance or potential emission-control malfunctions down at the low-NO<sub>x</sub> levels that the Omnibus Regulations would mandate. To the contrary, the current OBD NO<sub>x</sub>-malfunction threshold is no lower than 0.40 g/bhp-hr. Tellingly, CARB is proposing to retain, not lower, that OBD malfunction threshold under the new Low-NO<sub>x</sub> Regulations, implicitly conceding that OBD NO<sub>x</sub> sensors and related emission-detection systems are not accurate or robust enough to allow for the implementation of lower in-use OBD malfunction and enforcement thresholds. In fact, CARB expressly acknowledges that, “these higher OBD thresholds could allow emissions to exceed existing malfunction thresholds before detecting a fault, which could reduce the benefits of the proposed emission standards by allowing affected engines to operate without indication of the need for repair” (ISOR, III-10). In effect, then, CARB is proposing to maintain the NO<sub>x</sub>-related OBD in-use compliance-assessment and enforcement criteria at a level that is an order of magnitude above the proposed applicable “3B-MAW”-based in-use NO<sub>x</sub> emission standards.

The net result is that CARB is proposing in-use low-NO<sub>x</sub> standards that cannot be accurately detected, measured or enforced through the PEMS and OBD systems that CARB is relying on as the tools of in-use compliance-assessment. In fact, given the current and near-term capabilities of PEMS and OBD systems, CARB is for all intents and purposes constrained to adopt in-use NO<sub>x</sub> standards (be they “3B-MAW”-based or not) that reflect the measurement capabilities of the latest PEMS and OBD systems, which do not allow for in-use OBD NO<sub>x</sub>-malfunction thresholds much below where they are now – 0.40 g/bhp-hr – and which still require the use of a PEMS-based NO<sub>x</sub> measurement allowance of 0.15 g/bhp-hr. Adding that requisite measurement allowance to CARB’s lowest proposed in-use NO<sub>x</sub> standard yields a lowest feasible and enforceable in-use NO<sub>x</sub> standard of 0.18 (0.03+0.15) g/bhp-hr, which still would need to be adjusted upward to match the current OBD NO<sub>x</sub> threshold of 0.40 g/bhp-hr. (EMA, Daimler, Navistar, Volvo)

(a)ix.3. Comment: Under the proposed new low-NO<sub>x</sub> standards, the in-use NO<sub>x</sub> standard would be lowered substantially, to 1.5x a standard of 0.050 g/bhp-hr (2024-2026MY) or 0.020 g/bhp-hr (2027 and later MYs), with a corresponding OBD NO<sub>x</sub> threshold (if not adjusted) of 0.040 to 0.10 g/bhp-hr. The in-use PM standards would be similarly reduced. CARB acknowledges that it is impossible to diagnose emission thresholds at those values, and therefore would not require it for OBD at this juncture, but nonetheless is leaving the issue open for a potential tightening of the OBD thresholds through a follow-on OBD rulemaking. It is unrealistic to expect that OBD systems, strategies and calibration schemes will advance to the extent that CARB seemingly envisions. If a manufacturer cannot diagnose a system at such a low NO<sub>x</sub> level, then guaranteeing emissions

performance at such levels is inherently infeasible. CARB must take this into account fully before finalizing any new in-use emission standards. In that regard, CARB also should respect its own longstanding position that manufacturers should not be required to implement technologies that they cannot diagnose. (EMA, Daimler, Navistar, Volvo)

Agency Response to Comments (a)ix.1 through (a)ix.3: No changes were made in response to these comments. The commenter is incorrect in its statements about CARB's stance. Nowhere in the ISOR did CARB state that the current OBD system and sensors are not capable of detecting emissions malfunctions at the proposed low NOx levels, nor did CARB state that keeping the current monitor malfunction thresholds would hinder implementation of the technologies needed to meet the proposed low NOx targets. Instead, CARB staff had indicated in the ISOR that manufacturers have expressed concern about not knowing with certainty what impact the lower standards have on OBD system detection capability. Because of this uncertainty, manufacturers requested interim relief in the OBD monitor thresholds, which CARB agreed to. Further, CARB has specifically stated in the ISOR that "staff has not fully evaluated the capability of OBD monitors to robustly detect failures at the lower emission levels" and that "after discussions with engine manufacturers and suppliers, staff have determined that a continuation of the same malfunction criteria previously adopted for engines certified to the existing Optional Low NOx Emission standards is appropriate until staff can evaluate the use of lower malfunction thresholds in a future OBD rulemaking update." (ISOR, Appendix F-A-1, p. 36). CARB's statement regarding the uncertainty of the OBD monitoring capabilities should not be interpreted to mean that CARB believes that OBD monitoring is not possible at the lower NOx levels. CARB even included a statement in the ISOR (ISOR pp. III-10 and III-11) indicating that "based on past experience, staff expects that the majority of monitors will already be capable of detecting faults at emission levels lower than the proposed thresholds with minimal revision as changes to improve the emission controls generally also improve the resilience of such controls to degradation." In fact, there are currently engines certified with monitors that are able to detect faults at emission levels significantly lower than the proposed thresholds. For example, General Motor has a 6.6-liter HD engine certified to a 0.12 g/bhr-hr NOx FEL without any deficiencies, meaning it fully meets all the OBD thresholds that are a function of that FEL and are more stringent than the thresholds in the Omnibus Regulation (Executive Order is available [here](#)).<sup>75</sup>

Further, the commenter misinterpreted CARB's statement in the ISOR regarding reducing the benefits of the proposed emission standards. The sentence was intended to state that CARB's proposed interim OBD monitor malfunction threshold would allow the component to deteriorate even further (and thus result

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<sup>75</sup> Executive Order A-006-2279-1

[https://ww2.arb.ca.gov/sites/default/files/classic/msprog/onroad/cert/mdehdhvdv/2021/gm\\_hdoe\\_a0062279r1\\_6d6\\_0d12.pdf](https://ww2.arb.ca.gov/sites/default/files/classic/msprog/onroad/cert/mdehdhvdv/2021/gm_hdoe_a0062279r1_6d6_0d12.pdf) - accessed 7/24/2021).

in more emissions) before a malfunction is detected compared to a more stringent monitoring threshold based on the current OBD requirement that sets the malfunction threshold as a multiplier of, or addition to, the emission standard. Keeping the malfunction threshold at current levels (e.g., an absolute level based on a multiplier applied to dirtier emission standards) would reduce the potential emission benefits of having lower NO<sub>x</sub> standards by not effecting repairs at lower emission levels than current thresholds. CARB intended the statement to support the need to lower the OBD monitor malfunction thresholds at a later date. The statement the commenter cited was immediately followed by the sentence “Accordingly, it will be imperative that these thresholds are monitored and, if needed, adjusted to ensure the benefits of the proposed standards are protected,” which further supports CARB’s intent.

Moreover, the commenter’s assertion that the proposed low NO<sub>x</sub> emission standards are invalid and infeasible because the OBD thresholds for these standards are infeasible is false, as have been proven many times with previously adopted lower emission standards. This argument implies that emission standards should not be set until there are OBD requirements in place, which is not consistent with past regulatory developments. There were HD emission standards with PEMS-based in-use compliance requirements that engines have been able to meet before OBD requirements were even adopted and OBD systems were implemented (e.g., essentially all HD engines certified before the 2010 MY).

For responses to comments related to PEMS and 3B-MAW, please refer the Agency Responses to Comments A.(b)vii.4 and A.(b)iv.1, respectively.

- (a)ix.4. Comment: SwRI has suggested that partial-volume OBD monitoring strategies might be deployed for configurations similar to the Stage 3 system. However, CARB OBD-certification staff have refused to approve partial monitoring strategies when proposed previously by some OEMs. CARB will need to clarify whether there has been a change of policy to account for the advent of systems such as those used on the Stage 3 engine. (EMA, Daimler, Navistar, Volvo)

Agency Response: No changes were made in response to this comment. For diesel engines, the OBD Regulations require monitoring of all the NO<sub>x</sub> converting catalysts in the system; however, each catalyst in a series configuration that converts NO<sub>x</sub> may be monitored either individually or in combination with others. Based on CARB’s experience with diesel OBD systems, solutions have been developed per these provisions to monitor the SCR catalysts in multiple catalyst systems. To date, there have always been viable solutions for full volume monitoring on diesels such that partial volume monitoring (i.e., monitoring of a portion of the catalyst system instead of the entire system) did not have to be accommodated as the only viable solution. CARB staff anticipates that the solutions to meet the low NO<sub>x</sub> standards will

have sufficient sensors (e.g., NOx sensors upstream and downstream of each portion of the catalyst volume) to monitor all the separate catalyst volumes in the system. However, for engines certified to the proposed low NOx standards, CARB staff may entertain future amendments to the regulations to allow partial volume monitoring if it is determined that this is the only feasible monitoring strategy available.

- (a)ix.5. Comment: Even if the NOx and PM thresholds are maintained at today's absolute levels, manufacturers will be left with too little time to develop monitoring strategies for the host of the new envisioned low-NOx emissions control devices and sensors, or to modify existing strategies to cope with the new technologies and control strategies.... Therefore, to release a certified product for the 2024 MY, a manufacturer must develop new systems, new sensors, new controls and actuators, and develop robust and complete OBD diagnostics, all by mid-2022, just one year following OAL approval of the Omnibus Regulations. As already noted, that is a wholly inadequate leadtime period. Consequently, and for the myriad other reasons discussed above, CARB should abandon the 2024MY requirements, and should focus instead on working with EPA to develop more carefully considered 2027 MY standards, which would allow for the necessary and legally mandated lead-time for the development and implementation of the complex low-NOx emission technologies at issue. (EMA, Daimler, Navistar, Volvo)

Agency Response: No changes were made in response to this comment. CARB staff believes the commenter is referring to abandoning the proposed 2024 MY emission standards. The rationale for the adopted 2024 standards are presented in Appendix F of the ISOR and the Agency Responses to Comments A.(a)i.1 and A.(a)ii.1.

If the commenter is referring to abandoning the proposed OBD requirements applicable starting with the 2024 MY, then CARB is confused about why the commenter would propose this. CARB's OBD proposal would relax the OBD monitor malfunction thresholds required for the emission threshold monitors for engines certified to the lower NOx and PM standards. Without the proposed thresholds, manufacturers would be required to meet the more stringent thresholds currently contained in the OBD Regulations. Further, since the OBD thresholds would be kept at the same levels and manufacturers are anticipated to largely use the same emission controls for the 2024 MY as those used to meet the current 0.2 g/bhp/hr standard, it is expected that manufacturers would not have to change (or would only need slight changes or additions to) their existing OBD monitors to meet the proposed OBD thresholds in 2024. For example, the EGR cooler bypass capability (which is one of the possible technologies that manufacturers will need in 2024) is already on some HD diesel engines and are currently monitored by the OBD systems using sensors that are already on the engine. The only emission control component or system not on current engines that was described in the ISOR as a possible addition to meet

the 2024 emission standards is heated urea dosing. CARB staff believes a monitor for this doser will not be difficult to implement because a heated urea doser is only required by the HD OBD Regulation to be monitored for proper function and not for exceeding an emission threshold. Additionally, monitoring strategies of various types of heaters have already been implemented (e.g., glow plug heaters, exhaust gas sensor heaters, DEF tank heaters) and could be transferred to heated urea dosers.

- (a)ix.6. Comment: CARB's OBD-related proposals also could create disincentives for manufacturers seeking to certify their engines to lower FELs between now and 2024. In that regard, the alternate NOx and PM OBD thresholds proposed in 13 CCR §§ 1968.2(e) and 1971.1(f) are only available to 2024 MY and subsequent engines (and 2023 MY engines for manufacturers choosing to certify all of their engines to the full HD Low-NOx program a year early). That would require a manufacturer attempting to certify an engine to a lower NOx FEL prior to the 2024 MY to meet a more stringent OBD threshold than would be required in the 2024 MY. EMA recommends that the alternate NOx and PM thresholds be applied to all engines certified to FELs lower than the current NOx and PM standards starting with MY 2022. (EMA, Daimler, Navistar, Volvo)
- (a)ix.7. Comment: Engines certified to FELs lower than current standards could be subject to more stringent OBD thresholds than engines certified to MY 2024 and later standards. Cummins recommends CARB allow use of the proposed alternate OBD thresholds starting MY 2022 for engines certified to FELs lower than current standards. (Cummins)
- (a)ix.8. Comment: [T]he alternate NOx OBD thresholds proposed in 13 CCR §§ 1968.2(e) and 1971.1(f) are only available to engines certified to NOx standards/FELs of 0.10 g/bhp-hr or lower. That would result in manufacturers certifying engines to NOx FELs above 0.10 g/bhp-hr, but lower than the current 0.20 g/bhp-hr standard, being subject to more stringent NOx OBD thresholds than manufacturers certifying to 0.10 g/bhp-hr or lower. Requiring more stringent OBD thresholds for engines certified to less stringent emission standards is not logical. EMA recommends that the same alternate NOx OBD thresholds be applied for all engines certified below the current 0.20 g/bhp-hr NOx standard. (EMA, Daimler, Navistar, Volvo)

Agency Response to Comments (a)ix.6 through (a)ix.8: No changes were made in response to these comments because CARB staff disagrees with the commenters' recommendations. CARB's OBD proposal was intended to do two things: (1) copy over the current relaxed OBD malfunction thresholds for 2015-2023 MY engines certified to the Optional Low NOx standards (engines that voluntarily certify at 0.10, 0.05 or 0.02 g/bhp-hr of NOx) from section 1956.8 to section 1971.1, and (2) propose similar relaxed alternate malfunction criteria for the new proposed 2024 and subsequent MY emission standards. However,

CARB's proposal did include alternate malfunction thresholds applicable to 2022 and 2023 MY engines, but manufacturers would need to meet certain conditions to be able to apply these alternate thresholds. Specifically, CARB proposed to relax OBD monitor malfunction thresholds for engines that meet at least the 0.10 g/bhp-hr NO<sub>x</sub> standard in addition to all other 2024 MY requirements (3B-MAW method, LLC standards, lower PM standards, etc.). In order to be eligible for the relaxed OBD thresholds, manufacturers must demonstrate at least a 50 percent reduction of tailpipe emissions for 2022-2023 MYs and meet all 2024 MY requirements. CARB staff believes that certifying engines to FTP/RMC FELs between 0.1 and 0.2 g/bhp-hr NO<sub>x</sub> would not require any significant hardware changes and can be accomplished with minimal calibration changes. The relaxed OBD thresholds are meant to apply to engine and aftertreatment system architectures that would meet all of the more stringent 2024+ MY requirements. Therefore, the relaxed OBD monitor malfunction thresholds are not warranted for the engines about which the commenter is concerned.

- (a)ix.9. Comment: Moreover, any new control hardware and control strategies would require compliance with CARB's extensive HD OBD Regulations. CARB has not explained how manufacturers might comply with the rigorous requirements of its numerous HD OBD requirements when certifying such a highly complex system. Additionally, SwRI's adaptation of long-term "trims" in the SCR controller is not allowed under the current OBD demonstration program. The controller would still be "learning" on the cycles where detection of a failed part and malfunction indicator light (MIL) illumination is required. If the OBD Regulations were modified to allow long-term trim functions, the considerable time it would take, perhaps 40 hours or more, to stabilize emissions through the learning process between OBD monitor demonstration tests would be prohibitive. (EMA, Daimler, Navistar, Volvo)

Agency Response: No changes were made in response to this comment. CARB has already proposed relaxations to the OBD monitor thresholds to accommodate engines certified to the lower NO<sub>x</sub> and PM standards, and proposed further changes to other OBD requirements tied to the emission standards as part of the 15-Day Notice Amendments to address these engines. CARB is not aware of any other requirement in the OBD Regulation that would cause issues with manufacturers trying to certify their new systems and would therefore necessitate changes. Concerning the comment that adaptation of long-term trims in the SCR controller is not allowed under the current OBD demonstration program, CARB is unaware of any such restrictions in the OBD Regulations. The HD OBD Regulation currently allows for up to two preconditioning cycles during demonstration testing if the manufacturer can show that the cycles are needed to stabilize emissions.

- (a)ix.10. Comment: In addition, CDA presents complex challenges for OBD strategies and calibration. Threshold diagnostic determination becomes very difficult, since multiple valves individually or in concert may experience either partial

or complete failures. In such a case, separate failure modes would require separate diagnostic validation for each failure mode permutation. The OBD challenges would not be limited to diagnostics of the CDA system itself. CDA can significantly alter the required strategies and calibrations of multiple system diagnostics. For example, CDA greatly complicates the ability to diagnose misfire, a detection issue that already is among the more challenging under the HD OBD Regulations. (EMA, Daimler, Navistar, Volvo)

Agency Response: No changes were made in response to this comment. Based on CARB's experience with CDA systems, CARB is not aware of any issues with the diagnosis of CDA failures or their impact on monitoring other diagnostics. The HD OBD Regulation currently does have provisions to allow the disablement of a diagnostic if the failure of another monitored component or system would impact diagnostic robustness.

It should be noted that the use of CDA technology would not be needed to comply with the emissions standards until the 2027 and subsequent MY engines. This will allow adequate time for CARB to investigate changes during a future OBD rulemaking update should it be determined that new CDA systems on future HD vehicles create new issues for OBD diagnostics that are problematic.

- (a)ix.11. Comment: CARB proposed to maintain the OBD thresholds at their current levels — e.g. 2 times the existing NO<sub>x</sub> standard, and an additive 0.020 g/bhp-hr to their existing PM standard, for final OBD thresholds of 0.40 g/bhp-hr for NO<sub>x</sub>; and 0.030 g/bhp-hr for PM. However, the current in-use emissions standards also are tied to the certification cycle emissions standards — e.g. 1.5 times the FTP NO<sub>x</sub>-threshold is the current NTE/In-Use emissions testing threshold. Today, that approach for correlating test-cell standards to in-use testing standards leads to an in-use NTE standard of 0.30 g/bhp-hr NTE NO<sub>x</sub>, with a 0.15 g/bhp-hr additive measurement allowance, for an aggregate in-use NO<sub>x</sub> limit of 0.45 g/bhp-hr. The corresponding result, with respect to today's standards, is an effective OBD NO<sub>x</sub> threshold of 0.40 g/bhp-hr, at which failed components must be detected and diagnosed. That currently leaves a small gap (0.05 g/bhp-hr) between the two emission values, where a component is required to be diagnosed, before a vehicle equipped with such a component could fail the PEMS-assessed in-use NTE standards. (EMA, Daimler, Navistar, Volvo)

Agency Response: No changes were made in response to this comment. The OBD thresholds specified in the OBD Regulations are not required to be linked to the noncompliance thresholds used for HDIUC testing – these are two separate requirements/programs that are not inherently linked to each other. The PEMS limits and OBD thresholds were not designed to ensure this 0.05 g/bhp-hr gap existed - they were independently set as stringently as possible based on what was determined to be feasible at the time. To maximize the benefits of the respective programs, the thresholds for the OBD program should be set at the

lowest, feasible and cost-effective values for the OBD program, and similarly the in-use compliance threshold for the NTE should be set at the lowest, feasible and cost-effective limits for the NTE program. Based on the commenter's rationale above, there should not even be emission standards in the place before OBD requirements are in place, which is obviously not appropriate. OBD thresholds have never been set to detect malfunctions at the emission standard, and yet, previous emission standards have been clearly shown to be feasible since manufacturers succeeded in meeting them.

- (a)ix.12. Comment: It is important for CARB to consider fully all of the impacts that the Omnibus Regulations will have on the HD OBD requirements, and all of the necessary OBD revisions that should be included in the relevant OBD Regulations (e.g., sections 1971.1, 1971.5). This will help promote implementation of revised HD OBD Regulations in the future that do not frustrate the implementation of the Omnibus Regulations. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff made changes in response to this comment. CARB staff reviewed the OBD Regulation to determine if there are any other proposed revisions needed to accommodate the proposed lower standards in the Omnibus Regulation. CARB staff determined that several sections in the OBD Regulation (title 13, CCR, sections 1968.2, 1971.1, and 1971.5) would need revisions. Specifically, sections 1968.2 and 1971.1 (the OBD II Regulation and HD OBD Regulation, respectively) prescribe NOx and PM malfunction criteria and "test-out" criteria (i.e., criteria that manufacturers would need to meet in order to be exempt from the monitoring requirements) that are based on the emission standards to which the vehicle/engine is certified to. Section 1971.5 (the HD OBD enforcement regulation) also sets criteria based on the NOx standard to determine OBD nonconformance for deficient emission threshold monitors. Therefore, CARB staff proposed changes to these regulations as part of the 30-Day changes notice to keep these criteria around the current levels (i.e., to use a NOx emission standard of 0.20 g/bhp-hr and a PM standard of 0.01 g/bhp-hr when determining these criteria).

- (a)ix.13. Comment: When determining what OBD thresholds are achievable for the proposed low NOx and PM standards, CARB and industry may determine that the state of the art for monitoring key components such as catalytic converters, particulate filters, aftertreatment system sensors, or EGR components will require intrusive monitors, which will temporarily increase emissions. In order to prevent the current OBD provisions from making the proposed standards even more stringent and infeasible, the applicable standards will need to be adjusted to reflect these temporary increases or the OBD thresholds maintained at levels high enough to not require intrusive monitoring. (EMA, Daimler, Navistar, Volvo)

Agency Response: No changes were made in response to this comment. The HD OBD Regulation currently contains provisions to address intrusive

diagnostics (section 1971.1(d)(3.1.4)). CARB staff will continue to use the provisions to determine if intrusive diagnostics are appropriate or not. It is important to keep in mind that intrusive diagnostics can be counter-productive and have to be carefully implemented to avoid undermining the benefits of the OBD system. However, CARB will keep in mind the potential usage of intrusive diagnostics for new emission control systems or components when determining the appropriate OBD thresholds for the proposed low NOx and PM standards in a future rulemaking. Further, based on CARB's past experience with intrusive diagnostic usage, CARB staff believes it will be feasible to meet lower OBD thresholds with monitoring strategies that do not require intrusive actions for many of these key components.

- (a)ix.14. Comment: The OBD threshold staying constant is an important element for the significantly extended emissions warranty. However, development is ongoing with software, specifically on vehicle health management. Furthermore, with the Real Emissions Assessment Logging (REAL) OBD implementation phase-in starting in MY2022, the aftertreatment system and tailpipe emissions can be monitored in real-time, which will provide more data to understand the emissions level beyond the current FUL. Therefore, when improved OBD technology becomes available in the future and there is improved understanding of the systems and components with the extended FUL requirements to support an OBD threshold tightening, CARB should consider tightening the OBD threshold. If and when CARB considers tightening the OED threshold, CARB should fully evaluate cost implications and economic impacts of the OBD extension. (MEMA)

Agency Response: No changes were made in response to this comment. Concerning the REAL data, as was discussed in the 2018 ISOR for the OBD rulemaking update, the REAL data is primarily intended to be used to screen populations of vehicles for additional testing, identify the conditions in-use where vehicles are not performing as expected with regard to emissions control, and generally better inform CARB's inventory, regulatory, and certification programs. Though the data may be used by CARB staff to determine if certain revisions to the OBD Regulation is warranted, CARB staff does not anticipate the data will be used to directly support tightening of the OBD thresholds. Nevertheless, CARB staff does intend to revisit the OBD Regulations in the future to assess tightening of the OBD thresholds based on other data and information. Further, as has been done with all previous rulemaking updates of the OBD Regulations, CARB staff will fully evaluate the costs and economic impacts if CARB staff determines that changes are needed to the thresholds.

#### **(a)x. Optional 50-State-Directed Engine Standards**

- (a)x.1. Comment: MEMA strongly encourages CARB to set a standard for an optional 50-state program for MYs 2024-2026 that is more stringent than 0.1

g/bhp-hr... MEMA urges CARB set an FTP standard of at least 0.08 g/bhp-hr for its optional 50-state program for MYs 2024-2026.

[A] slightly more stringent standard than the proposed 0.1 gram could encourage initiating the best in-class technologies in 2024 to work toward the 2027 goal of 0.02. (MEMA)

- (a)x.2. Comment: Jacobs supports an optional 50-state program...However, Jacobs has concerns with the proposed standard of 0.1 g/bhp-hr for the FTP, but could support a slightly more stringent standard such as 0.08 g/bhp-hr or a standard that promotes initiating new technology adoption. Jacobs proposes an LLC standard of 0.25 g/bhp-hr. Setting the standards at 0.1 g/bhp-hr for the FTP as well as the LLC standard of 0.30 g/bhp-hr for MYs 2024 - 2026 could mitigate technology momentum Jacobs had targeted moving toward a 0.02 g/bhp-hr NOx standard in MY2027. If vehicle manufacturers are to meet the 0.02 g/bhp-hr in 2027, they need to start deploying the best available technologies in 2024 to work toward the 2027 standard. An optional 50-state program that sets a standard at 0.08 g/bhp-hr for the FTP as well as the LLC standard of 0.25 g/bhp-hr for MYs 2024-2026 would provide momentum to begin payback of many years of R&D investments and commercialize a more robust technology portfolio going into MY2027. Development of these technologies has required substantial lead-time, major economic resources, and product planning. Even a few years delay in the deployment timeline has significant ramification for Jacobs' return on investment. Further, the selection of 0.1 g/bhp-hr target for an alternative pathway does not align with data-driven results from the SwRI Low NOx Demonstration program. As a result, Jacobs feels that it is critical that CARB adjusts the standards in the optional 50-state program to be more stringent. (JVS)
- (a)x.3. Comment: MECA supports a nationwide technology advancing standard for HD engines, like the voluntary 50-state approach being proposed. However, based on our members' testing, we believe an optional 50-state limit of 0.1 g/bhp-hr in 2024 could be set lower... Technology screening from stage 1 of the SwRI program showed that several pathways, based on traditional aftertreatment with calibration and modest thermal management, achieved NOx emissions down to the 0.05 g/bhp-hr level. (MECA)
- (a)x.4. Comment: SCAQMD staff is particularly concerned about the proposed... "50 State-Directed Engine Standard Option" which are not stringent enough to help the South Coast Air Basin to meet the 2023 and 2031 ozone attainment goals.... However, as the ISOR highlighted, the proposed optional "50-State Directed" NOx level of 0.10 g/bhp-hr is already achieved by today's engines. Staff is concerned that the proposed flexibility might instead significantly delay commercialization of critical low-NOx enabling technologies such as CDA for achieving the more aggressive 2027 or later NOx standard of 0.02 g/bhp-hr. While South Coast AQMD recognizes

CARB's response on South Coast AQMD's previous comments on adopting the proposed amendment three years early, for the reasons listed in this comment letter, staff continues to urge CARB to adopt the most stringent standards for 2024-2026 that encourages critical low-NOx technology advancement and to ensure future attainment goals can be met. (SCAQMD)

Agency Response to Comments (a)x.1 through (a)x.4: Rather than making the optional 50-state standards more stringent as recommended by the commenters, CARB staff instead eliminated the 50-state-directed engine standard option from the Proposed Amendments in the 30-Day Notice of Public Availability of Modified Text. At the hearing, the Board's direction in its Resolution 20-23 to CARB staff was to either strengthen the optional 50-state-directed engine emission standards or to remove it completely.

To determine whether to strengthen or eliminate these standards, CARB staff reviewed and analyzed all the oral and written comments from the public comment period. Many commenters noted that the technology to meet a more stringent (0.05 g/bhp-hr NOx) standard is already available, and thus, the 50-state 0.10 g/bhp-hr NOx standard option provided an unneeded concession to industry. Also, the optional 50-state standard would be unnecessary because two manufacturers, Cummins and PACCAR, plan to have products in California for 2024 that can comply with the primary 2024 MY 0.05 g/bhp-hr NOx standard. In addition, the primary 2024 MY NOx standard may be adopted by states that fall under section 177 of the Clean Air Act (CAA), resulting in potentially a large percentage of national low NOx HD vehicles and subsequent California emission benefits from out-of-state trucks. Commenters noted that California should instead adopt a more stringent primary NOx standard that section 177 states can consider adopting. Thus, CARB staff's conclusion following the Board's direction was to eliminate the proposed 50-state optional standards from this rulemaking action.

- (a)x.5. Comment: To eliminate regulatory uncertainty, we believe the 0.1 g/bhp-hr 50-state option in the proposal could be removed. (Cummins)
- (a)x.6. Comment: We ask that CARB remove the option for manufacturers to certify to a less stringent 50-state 0.1 g/bhp-hr standard. Importantly, the technology for meeting a 0.05 g/bhp-hr standard is already available. So, this option simply provides a concession to industry where one is not needed. (Earthjustice, LACETBC)
- (a)x.7. Comment: The voluntary 50-state program allowing for higher emitting trucks (0.1 g/bhp-hr) to be sold in California is unnecessary and should be eliminated from the proposal. Nationwide adoption of cleaner emissions technology is important, but the research shows clearly that manufacturers can apply the technology needed to meet the 2024-2026 standards (0.05 g/bhp-hr) nationwide. Moreover, they already have ample flexibility and

incentive within both the federal and California emissions programs to promote such deployment, and state adoption of California's standards under section 177 of the CAA will further spur such progress, diminishing any justification for this voluntary program. Elimination of this voluntary option ensures that near-term progress on diesel emissions control is maximized, as envisioned by the technology-forcing requirements of the CAA. (UCS)

- (a)x.8. Comment: [T]he so-called "50-state standard" equally exasperates the competitive balance by asking engine manufacturers to decide whether they want to disadvantage only their California customers or their entire national clientele. We oppose CARB's proposed approach for a "50-state standard" because it pits manufacturer against manufacturer, creates economic disparities outside of California, and lacks analysis of potential impacts.

As discussed above, a manufacturer's election to meet California standards by pursuing a 50-state standard could have a range of economic impacts extending to businesses and communities located outside the state as well in areas meeting federal air quality standards. However, the ISOR dismisses analysis of these impacts by assuming no manufacturer will make this election.<sup>76</sup> Simply dismissing this potential compliance strategy does not alleviate the need to analyze its economic and environmental impacts, including identifying those extraterritorial impacts that will result from the state's actions. (CTA/ATA)

- (a)x.9. Comment: The "50-state standard" circumvents CAA Requirements. This approach tramples on the state rights protections which have been crafted by Congress under section 177 of the CAA. Congress has defined California's path for establishing a state-specific standard and has defined how other states may elect to opt-in to a California standard. The proposed "50-state standard" circumvents these rights and instead leaves this decision to be determined by how a particular manufacturer will comply with the proposed California standards. Also, Congress has prohibited the creation of standards which create a "third vehicle." This proposal directly conflicts with Congress' intent to limit the number of different vehicles or engines required to be manufactured and sold throughout the United States. (CTA/ATA)
- (a)x.10. Comment: We oppose the 50-state option, because it ensures neither uniformity of standards nor a level playing field. (ATA)
- (a)x.11. Comment: We are also concerned about the signal that inclusion of a voluntary 0.1 g/bhp-hr 50-state NOx standard potentially sends... regarding any final targets the U.S. EPA might adopt under the -- its Cleaner Trucks Initiative (CTI). The adoption of a 0.1 g/bhp-hr national standard would ironically undermine the urgent NOx reduction needs from trucking and for which original -- the original petitioners of the South Coast and Central Valley

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<sup>76</sup> CARB, Staff Report: ISOR, pp. III-6 & IX-79.

air districts requested the U.S. EPA's assistance in order to meet their SIP requirements. Given that SwRI's research indicates that with recalibration of 2014 engines, it's possible to achieve 0.05 g/bhp-hr, we recommend either tightening the emissions target or eliminating that voluntary standard. (CEERT)

- (a)x.12. Comment: The Board should direct staff to remove the 50-state option, allowing manufacturers to certify to a weaker national standard. I appreciate staff's intent to cut emissions from out-of-state vehicles, however, this option is problematic for several reasons.

First, the emission level was shown to be easily met using traditional control approaches. A core purpose of the Omnibus Rule is to develop advanced emission reduction technology, which this weaker standard fails to accomplish.

Further, staff noted that it was unlikely manufacturers would certify to the 50-state standard. Consequently, this option risks signaling that California is comfortable with a weak and national standard without seeing any actual reductions.

Lastly, staff's analysis showed convincingly that more stringent standards are feasible and cost effective. California cannot afford to settle for weak standards, nor can the states following this rulemaking. (NRDC)

- (a)x.13. Comment: We submitted a comment letter with other advocates requesting the removal of the ... 50-state certification standard, which we recognize [is] well intended in effect, but [does] not ensure aggressive compliance with low NOx technology throughout all phases of the rule. (LCJA)
- (a)x.14. Comment: This Omnibus Rule is a vital complement to reduce and zero-out pollution from Heavy-duty vehicles. I urge the Board to vote yes on the rule and direct staff to remove the 50-state option. (NRDC)

Agency Response to Comments (a)x.5 through (a)x.14: As recommended by these commenters, CARB staff eliminated the 50-state-directed engine standard option from the Proposed Amendments in the 30-Day Notice of Public Availability of Modified Text. This was the result of the Board's direction in its Resolution 20-23 to CARB staff to either strengthen the optional 50-state-directed engine emission standards or to remove it completely. CARB staff reviewed and analyzed all the stakeholder comments from the public comment period and determined that most comments supported the elimination of the proposed 50-state optional standards. Thus, the 50-state-directed engine standard option was removed from the Proposed Amendments, and comments related to the economic impacts and CAA conflicts of the optional 50-state-directed standard are no longer relevant.

- (a)x.15. Comment: On the national compliance option, we know that the Board has identified a very real challenge involved with out-of-state trucking, and responded with this option. We don't argue with the effort to address out-of-state trucks at all, but we do believe that the proposed level of the national option far exceeds what is technologically feasible in 2024 and 2027, and should be carefully considered. (ALA)
- (a)x.16. Comment: The staff proposal includes an optional, 50-state compliance path for manufacturers that may choose to certify to a less stringent California NOx standard (0.1 g/bhp-hr) between 2024 and 2026. While we support CARB's ongoing efforts toward a standard that brings cleaner trucks into California as soon as possible and sets the stage for a strong national standard, we urge the Board to ensure flexibility options do not interfere with the achievement of a 90 percent reduction in California, or with the establishment of a national rule based on the well-documented technological feasibility of standards well below 0.1 g/bhp-hr that informs CARB staff proposal.

We also encourage CARB to work closely with other states to help them opt into the California standards. (ALA)

- (a)x.17. Comment: A loophole in the Regulation exists. Unless the manufacturers have a 0.05 or 0.02 g/bhp-hr NOx engine there is little incentive for them to develop and sell one in California because they can opt for a national approach of 0.1 g/bhp-hr NOx. Vehicle miles traveled from out-of-state trucks in California is very high, so CARB could get an in-state air quality benefit from the Regulation if these trucks are cleaned up. (LNC, AFS)

Agency Response to Comments (a)x.15 through (a)x.17: No change was made in response to these comments. At the hearing, the Board's direction in its Resolution 20-23 to CARB staff was to either strengthen the optional 50-state-directed engine emission standards or to remove it completely. After its analysis, CARB staff eliminated the 50-state-directed engine standard option from the Proposed Amendments in the 30-Day Notice of Public Availability of Modified Text.

Regarding out-of-state vehicles, the primary 2024 MY 0.05 g/bhp-hr NOx standard may be adopted by states that fall under section 177 of the CAA, resulting in potentially a large percentage of national low NOx HD vehicles and subsequent California emission benefits from out-of-state trucks. Once the Omnibus Regulation is finalized, CARB staff will provide support to section 177 states to aid in quickly adopting California's low-NOx standards. In addition, CARB staff will continue to support U.S. EPA's CTI rulemaking to establish California's low NOx 2027 MY standards on a national basis.

- (a)x.18. Comment: CARB has additionally proposed that manufacturers participating in the Optional 50-State-Directed Engine Emission Standards for Diesel (I.11.B)(5.5.4) or Otto-cycle engines (I.10.B)(3.3.4) must “forgo any credits generated from the U.S.-directed production volume.” The meaning and application of the “forgo credits” provisions are unclear.... CARB should not attempt to govern future rights and obligations in connection with regulatory programs that have yet to be established.

Ford believes that CARB should allow manufacturers participating in the voluntary 50-state program to continue to calculate their ABT compliance obligations and status based on 50-state volumes. This would allow for clear continuity of CARB program and a given manufacturer’s credit bank in the event of a future harmonized program. If such a harmonized program emerges, the details of credit usage from the Optional 50-State-Directed Engine Emission Standards program can be sorted out at that time, consistent with environmental protection objectives and principles of fairness. If such a harmonized program is not implemented by 2027 MY, CARB can require affected manufacturers to convert their credit bank to a CA-ABT based bank in the manner proposed for 2022 MY. This would have the additional benefit of allowing manufacturers participating in the voluntary 50-state program to continue generating reports based on their existing 50-state volume methodology which is also substantially aligned with the 50-state methodology required for CA Phase 2 HD GHG ABT reporting. (Ford)

- (a)x.19. Comment: One additional suggestion Ford would like to make is related to the optional 50-state directed engine emission standards. As proposed, the program would not allow a manufacturer to certify any engines to standards or FELs higher than the optional 50-state standards (e.g. 0.10 g/hp-hr NOx). Ford requests that CARB consider removing this restriction and replacing it with a new requirement prohibiting a manufacturer participating in the optional 50 state program from carrying a negative credit balance in any averaging set for the model years in which they are certifying to the optional 50 state standards. This revision will ensure fleet emissions performance as good or better than described in the ISOR while providing flexibility for manufacturers with varied engine offerings and product development cadences. (Ford)

Agency Response to Comments (a)x.18 through (a)x.19: No change was made in response to the comments. At the hearing, the Board’s direction to CARB staff was to either strengthen the optional 50-state-directed engine emission standards or to remove it completely. After reviewing the received written and oral public comments, CARB staff’s analysis concluded that eliminating the 50-state-directed engine standard option from the Proposed Amendments would best fulfill the Board’s intention and direction. Since the optional 50-state-directed standards are removed, the commenters’ suggested modifications to the credits program and for the upper limit of the FEL are no longer applicable.

- (a)x.20. Comment: [W]e also recognize that the federal standard to be established in the CTI could be influenced by this 50-state optional standard. Therefore, AESI believes that the inclusion of this relatively weak 50-state option in 2024 reinforces the need to set the most stringent technologically feasible standards in MY 2027. (AESI)
- (a)x.21. Comment: The optional 50-state-directed standards for MY 2024-2026 represents a rational approach for CARB to try to obtain air quality benefits as early as possible until U.S. EPA begins implementing the CTI (most likely) beginning with MY 2027 engines. However, we also recognize that the federal standard to be established in the CTI could be influenced by this 50-state optional standard. Therefore, MECA believes that the inclusion of this relatively weak 50-state option in 2024 reinforces the need to set the most stringent technologically feasible standards in MY 2027. (MECA)

Agency Response to Comments (a)x.20 and (a)x.21: No change was made in response to the comments. At the hearing, the Board's direction to CARB staff was to either strengthen the optional 50-state-directed engine emission standards or to remove it completely. After reviewing the received written and oral public comments, CARB staff's analysis concluded that eliminating the 50-state-directed engine standard option from the Proposed Amendments would best fulfill the Board's intention and direction. The optional standards, therefore, would not influence U.S. EPA's CTI rulemaking efforts for national 2027 MY low-NOx standards.

#### **(a)xi. Transit Bus Diesel Engines**

- (a)xi.1. Comment: These efforts underscore our Association's commitment to fulfilling the goals of the Innovative Clean Transit (ICT) Regulation, but also our unwavering belief that – to be successful – its implementation will require an “all hands on deck” approach from the industry and sustained investment by the state.

It is against this backdrop that we regrettably write to you today to express our concerns with the “HD Engine and Vehicle Omnibus Regulation and Associated Amendments” now before you. This Regulation is designed to reduce emissions from internal combustion engines – itself, a reasonable objective – but will have the practical impact of driving Cummins, the dominant manufacturer of diesel transit bus engines, out of the California market for diesel transit bus engines, beginning in 2024. This seismic shift in the technologies available for purchase by California's transit agencies, spurred by the regulation and communicated to California's transit agencies by Cummins last week, would have profound impacts on transit operations, forcing transit agencies to forego necessary capital replacements, operate diesel buses beyond their useful life, or accelerate diesel bus purchases.

Additionally, it would invalidate hard fought for – and sensible – provisions included in the ICT Regulation at the urging of our Association and through multilateral negotiations with environmental groups. (California Transit)

- (a)xi.2. Comment: If the HD Omnibus Regulation is allowed to proceed, as currently drafted, a transit agency, operating diesel buses, would technically still be able to submit a request for an exemption from the zero-emission bus purchase mandate, but they would be unable to proceed with the purchase of a diesel bus or diesel bus engine, beginning in 2024. This reality, and the impracticality of such an agency purchasing a compressed natural gas bus or engine, negates the history and intent behind the creation of the exemption process and eliminates the practical benefit of the exemption to transit agencies operating diesel buses. (California Transit)
- (a)xi.3. Comment: Finally, while the HD Omnibus Regulation doesn't itself rescind CARB's commitment to conducting a comprehensive review of zero-emission bus technology before the ICT Regulation's purchase mandate goes into effect, it would render the process an idle exercise. For clarity, consider that should the comprehensive review find that the performance of [zero-emission bus] ZEB technology is inadequate, the cost of the technology is too high to be practical, or that transit agencies lack incentive funding to effect the transition without compromising transit service, CARB could not relax or refine the ICT's Regulation in a manner that provides relief to transit agencies operating diesel buses. (California Transit)
- (a)xi.4. Comment: As an Association, we believe the clearest way to address the unintended consequences of the HD Omnibus Regulation is to strike the references to urban buses from the HD Omnibus Regulation entirely or to otherwise shield diesel engines and hybrid powertrains from the new emission standards being promulgated for MY 2024 and beyond. These proposed amendments to the regulation would keep Cummins in the California market for diesel transit bus engines, honor the timelines for transition to zero-emission bus technologies agreed to in the ICT Regulation, and ensure that transit agencies operating diesel buses are able to take full advantage of the flexibility provisions written into the ICT Regulation. In elevating this request to you, I will note that we have had productive conversations with your staff regarding our concerns and hope you will provide direction to them to accept our proposed amendments or to find a solution, through discussion with us, equally acceptable to the transit industry. (California Transit)
- (a)xi.5. Comment: I'm urging you to today to simply honor the ICT's timelines and to direct staff to amend the Omnibus Regulation to narrowly exempt diesel engines used in transit from the emissions standards set to go into effect in 2024. This would recognize that a zero-emission bus rule is already in place and that transit agencies are developing plans to comply with it. In fact, some

are even intending to comply with it early. We believe firmly that a narrow exemption is the cleanest way of ensuring that the Omnibus Regulation doesn't compromise the ICT. However, if that is not acceptable, we are ready to engage on other options, for example, authorizing the Executive Officer to approve the purchase of diesel transit bus engines in 2024 that meet the relevant U.S. EPA standards. (California Transit, YSTA)

- (a)xi.6. Comment: While there were a variety of technological and practical limitations to ZEV deployments that require some near-term reliance on Internal Combustion Engines (ICE) funding availability remains a key barrier to our transition. If ARB has resources it could couple with an exemption, it would certainly help transit agencies buy the cleanest technologies available. (California Transit)
- (a)xi.7. Comment: If this regulation is adopted without some type of regulatory relief, an exemption for public transit operators, many California transit agencies will be forced to take drastic negative actions that have the opposite effect this proposed regulation intends.

One of the largest engine manufacturers in the world has indicated they would leave California and no longer provide diesel engines for transit buses beginning 2024 without some type of relief. And therefore, we would be forced to maintain and operate diesel-powered buses well beyond their intended useful life during our transition to zero emissions.

Instead of spawning invasion, this Regulation is forcing one manufacturer to leave the California transit bus market altogether. (MST)

- (a)xi.8. Comment: Without a clear understanding of the financial effect this Regulation will have on our bus procurements included in our zero-emissions transition plan, it is troubling for me and others, to say the least. We seek regulatory relief. We need an exemption. We need a bridge to zero emissions. Projections show that our local economies will not return to pre-pandemic levels beyond 2024 or by 2024. Funding levels for transit agencies are going to be affected. Now is certainly not the time to impose regulations that negatively affect our citizens, our communities, and our ongoing plans to transition to zero emissions. Please give us the relief that we seek. We request this respectfully. (MST)
- (a)xi.9. Comment: We're requesting that CARB allow transit agencies to follow the timelines for transitioning to ZEVs, included in the ICT Regulations as mentioned before.... [We] ask that you do recognize the modest relief we're seeking in an exemption for this Regulation for transit agencies. And this would allow us to follow the transition scheduled outline in the ICT while maintaining the flexibility options contemplated by that regulation. (SRT)

- (a)xi.10. Comment: If the current regulation is implemented as proposed, the only certified California [engine manufacturer] will not be available. We'll have to either advance our projects earlier than in the cycle or more likely to continue to operate them throughout the five-years longer than their useful life.

In closing, I'm asking for your consideration to (inaudible) and the proposed regulations (inaudible) options, but my agency would like us to make the case for ICT compliance without unforeseen (inaudible) operational impact. (YSTA)

Agency Response to Comments (a)xi.1 through (a)xi.10: The Board was sympathetic to the transit agencies' difficulty as described by the comments, and therefore the Board directed CARB staff to offer compliance flexibility to transit agencies to resolve the issue. The transit agencies are concerned with the ability to purchase diesel-fueled buses in the future because the only manufacturer of diesel-fueled urban bus engines recently expressed its intent to no longer produce diesel urban bus engines in California, starting in 2024. The announcement created an obstacle for transit agencies, which are allowed by the ICT Regulation in coming years to continue purchasing some diesel-fueled buses. In addition, the same manufacturer recently expressed its intent to substantially increase the prices of its MY 2022 and 2023 diesel-fueled urban bus engines. The announcement of a significant price increase comes at the same time when COVID-19 has taken a particularly large financial toll on transit agencies caused by low ridership that has resulted in service cuts, affecting vulnerable groups in the greatest need of transit services. Without providing additional compliance flexibility, transit agencies would need to further reduce services and jeopardize their ability to financially support their transition to meet future ICT requirements.

Table IV.A.(a)xi.1-10.1 summarizes the estimated statewide numbers of delivered diesel and diesel hybrid buses in California.<sup>77</sup> The relatively small and decreasing numbers of delivered diesel and diesel hybrid buses, in addition to the unique circumstances of the transit agencies as discussed above, support the need for providing compliance flexibility to transit agencies.

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<sup>77</sup> Estimated diesel bus numbers and CNG bus costs, California Air Resources Board, April 16, 2021.

**Table IV.A.(a)xi.1-10.1 Estimated statewide numbers of diesel and diesel hybrid buses to be delivered in California**

<b>Bus types</b>	<b>Fuel/ Propulsion</b>	<b>2022</b>	<b>2023</b>	<b>2024</b>	<b>2025</b>	<b>2026</b>	<b>2027</b>	<b>2028</b>
standard	diesel	293	289	281	243	243	194	171
standard	diesel hybrid	42	42	36	36	36	25	25
motorcoaches + articulated	diesel	59	58	58	58	58	33	33
motorcoaches + articulated	diesel hybrid	3	3	3	3	3	2	2
<b>Total</b>		<b>397</b>	<b>392</b>	<b>378</b>	<b>340</b>	<b>340</b>	<b>254</b>	<b>231</b>

As directed by the Board in its Resolution 20-23, as part of the 30-Day changes, CARB staff developed a procedure for the Executive Officer to provide flexibility to transit agencies experiencing difficulty in complying with applicable requirements as a result of the Omnibus Regulation. In the proposed process in new subsection 1956.8(a)(2)(F), transit agencies will be eligible to purchase diesel buses meeting federal rather than California certification requirements under certain conditions for 2022 and subsequent model diesel-fueled HD engines used in urban buses.

The buses powered by such engines would be exempted from California Phase 2 GHG vehicle standards and California vehicle emissions warranty requirements. The exemption would not affect GHG emissions benefits from transit fleets or the California Phase 2 GHG program because bus manufacturers are currently subject to meeting similar federal Phase 2 GHG requirements. In addition, qualifying California transit fleets are already going above and beyond Phase 2 GHG requirements by transitioning to zero-emission buses under the ICT Regulation, and this exemption process would not diminish transit fleets' obligations under the ICT Regulation.

According to EMFAC2017, the exemption to meeting California emission warranty requirements would not affect the criteria emission benefits because transit buses are assumed to be well maintained and thus the emission deterioration is negligible.<sup>78</sup> To be eligible, transit agencies must seek incentive funding to accelerate their fleets' transition to ZEBs and reduce their diesel-fueled bus purchasing plans. If the transit agency has compressed natural gas (CNG) buses in its fleet, the transit agency must consider expanding the number of CARB compliant CNG-fueled buses in their fleet or explain why it is cost prohibitive to do so. If the transit agency is in compliance with the reporting and purchasing requirements of the ICT Regulation, and it is unable to add more CNG-fueled buses to its fleet, then it may obtain from CARB's Executive Officer an exemption to obtain federally certified diesel buses, called "exempt" buses in

<sup>78</sup> EMFAC2017 Volume III – Technical Documentation V1.0.2, California Air Resources Board, July 20, 2018. <https://ww3.arb.ca.gov/msei/downloads/emfac2017-volume-iii-technical-documentation.pdf>

the Regulation. With an exemption, a transit agency may purchase, rent, or lease exempt buses, contract with bus service providers to operate exempt buses, or re-power buses with diesel engines that are federally certified. The proposal would revoke a previously granted exemption request if any of the requirements, conditions or criteria warranting that exemption request were not met after the exemption request is granted. A transit agency could request a hearing to review the revocation of a previously granted exemption request. CARB staff engaged with affected stakeholders and received support from California Transit Association that the proposed exemption procedure adequately addresses their concerns.<sup>79</sup>

#### **(a)xii. Optional Low NOx Standards**

- (a)xii.1. Comment: CARB stated in the ISOR that most of today's Otto-cycle heavy-duty engines were already certified much below the lowest Optional Low NOx Standards (OLNS) of 0.02 g/bhp-hr. Thus, staff believes that it is technically feasible and cost-effective to further improve current technology and ensure the emissions reduction are realized over all duty-cycles by adopting the lower OLNS of 0.01 g/bhp-hr starting in as early as 2022 instead of proposed 2027 phase-in date. At the same time, CARB should properly recognize the air quality benefits that's already achieved by engines that certified to OLNS since 2016 by considering a retroactive credit provision to allow OEMs to bank and transfer those credits. (SCAQMD)
- (a)xii.2. Comment: Additionally, given recent advancements in HD truck technologies, the Valley Air District believes that it is technologically-feasible and cost-effective to further improve current technology and ensure the emissions reduction are realized by adopting a lower OLNS of 0.01 g/bhp-hr starting in as early as 2022, instead of the proposed 2027 phase-in date. This would encourage continued development of lower-emitting truck technologies by providing a mechanism for certifying and recognizing the additional emissions reductions available through these technologies. (SJVAPCD)

Agency Response to Comments (a)xii.1 and (a)xii.2: SCAQMD and SJVAPCD recommend that CARB consider establishing optional low NOx standards of 0.01 g/bhp-hr starting as early as MY 2022. As described in the 30-Day Notice of Proposed Modifications, CARB staff agrees that it is technically feasible and cost-effective to further improve emissions from current engines certified to the optional low NOx standard of 0.02 g/bhp-hr beginning with MY 2022. CARB staff believes engines that are likely to achieve this level of optional NOx standard in the 2022 to 2023 timeframe would be SI stoichiometric engines similar to those currently certified to the optional low NOx standard of 0.02 g/bhp-hr. Further improvements in aftertreatment systems, including catalyst formulations, air-fuel

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<sup>79</sup> "RE: CARB wants to solicit CTA's input on the potential 15-Day reg language (2012.02.02 version) for the HDV Omnibus (Low NOx) regulation," Michael Pimentel, California Transit Association, email communication with Yachun Chow, February 22, 2021.

ratio controls, and other engine calibration strategies could potentially reduce emissions further to achieve NOx certification levels of 0.01 g/bhp-hr. In response to the above comments, CARB staff included a new optional low NOx standard of 0.01 g/bhp-hr as measured on the FTP and RMC for 2022 and 2023 MY HD engines.

As with the previous optional low NOx standard, the 0.01 g/bhp-hr NOx optional standard is excluded from participation in the ABT to avoid double counting emission benefits. This is because the current optional low NOx standard of 0.02 g/bhp-hr has already been recognized for air quality benefits in California incentive programs, where optional low NOx standard certification is required to participate, and emission benefit reductions are calculated as part of program cost-effectiveness. Thus, including vehicles equipped with optional low NOx standard certified engines in the ABT program would result in double counting the emission benefits, where benefits are first utilized in the certification process and in the incentive programs. Similarly, allowing early compliance multipliers for optional low NOx standard would also double count the emission benefits associated with optional low NOx standard by magnifying its emission benefits by a factor and thus have not been included as part of the Proposed Amendments.

## **(b) Comments Related to HD In-Use Test Procedure Amendments**

### **(b)i. General Comments on the HD In-Use Test Procedure Amendments**

- (b)i.1. Comment: Perhaps most disconcerting of all, over and above the numerous serious concerns discussed above, is the lack of technical rigor and scientifically-based judgment that CARB has put into the development and “validation” of the 3B-MAW protocol as a credible means for assessing in-use emissions compliance. More specifically, CARB has not made any demonstration of any kind that:
- i. The proposed emissions “bin” definitions and boundaries reasonably and consistently segregate similar emissions characteristics in a manner that appropriately reflects the varying operating conditions of the engine and vehicle;
  - ii. The moving average window approach is superior to binning data without windowing, and that 300 seconds is the appropriate duration for a measurement window;
  - iii. There is a direct scalable relationship (i.e., 1.5x) between the emissions sorted into each bin, and the underlying test-cell standards (as CARB has linked them), which are based on different certification cycles;
  - iv. Day-to-day emissions levels from a single in-use test article tested over the same route produce reasonably repeatable 3B-MAW results;

- v. Day-to-day emissions levels from a single in-use test article run over highly variable test routes produce similar 3B-MAW results in each bin --- a minimum expectation for a tool that should be able to discern compliant vehicles from non-compliant vehicles;
- vi. SwRI's "Stage 3" prototype engine, when installed in a variety of vehicles and operated over a variety of duty cycles, is capable of meeting the proposed 3B-MAW in-use standards on a consistent basis;
- vii. The 3B-MAW protocol can reliably take into consideration the transient operating characteristics of an engine over a given route segment that lead to variations in core SCR temperature, and therefore is reflective of tailpipe emissions levels;
- viii. The proposed 3B-MAW in-use standards are achievable over the allowable range of ambient conditions for a valid in-use test using the Stage 3 technology set; and
- ix. There are alternative technology options different from the Stage 3 prototype that are capable of meeting the 3B-MAW standards, in the event that the Stage 3 technologies (including CDA) cannot withstand the rigors of HD in-use applications, or cannot be packaged for installation in HD vehicles. (EMA, Daimler, Navistar, Volvo)

(b)i.2. Comment: In the end, CARB has based the feasibility of the entire 3B-MAW program on a single test-cell evaluation<sup>80</sup> of a single technology set, when tested over a single test route (CARB "Southern Route"), and using a seemingly arbitrary "1.5 times" multiplier as a link to the test-cell certification-cycle emissions performance of that technology. CARB has not presented any data demonstrating the appropriateness of the bin definitions through any parametric study, nor through a comparison against alternative criteria and methods to set bin boundaries. Nor has CARB presented any assessment of why a 300 second window is optimum or even appropriate for the 3B-MAW approach, let alone how overlapping windows are superior as a compliance methodology to simply binning second-by-second results. And, as highlighted above, CARB has conducted no in-use testing whatsoever of its new in-use testing protocol. Given CARB's unreasonable lack of due diligence in this regard, manufacturers would be left to face insurmountable technical challenges to achieve extremely low in-use emissions levels, over a brand new and utterly undemonstrated in-use testing protocol using technologies never before deployed in a HD vehicle. For all of the foregoing reasons,

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<sup>80</sup> Significantly, the calibration for that feasibility test was modified after the first test run to mitigate NOx breakthroughs that were occurring, thereby improving the reported emissions results over the cycle.

therefore, the proposed 3B-MAW protocol and standards are, in effect, arbitrary, unreasonable, and invalid. (EMA, Daimler, Navistar, Volvo)

Agency Response to Comments (b)i.1 and (b)i.2: CARB staff did not make changes to the Proposed Amendments based on this comment. CARB staff has broken down the Agency Responses to address the list of points provided in Comment A.(b)i.1 that also addresses statements in Comment A.(b)i.2, as discussed below:

- i. The 3B-MAW bins were developed rigorously and logically, and they reasonably and consistently segregate similar emissions characteristics in an appropriate manner that is far superior to today's NTE method. The bin boundaries were determined with the help of SwRI during the LLC development, as presented in their Stage 2 Report. Development of the 3B-MAW was vetted with the project's technical working group, in which EMA and their members participated. The 3B-MAW was discussed, along with numerous in-use topics such as revisions to HDIUT/HDIUC programs, vehicle and engine family failure criteria, and reporting, during a workgroup meeting on April 20, 2020. Development of the 3B-MAW is also described in depth in section III of the ISOR. The idle bin is intended to capture events of idling and extremely low load operation. The idle bin is defined to include windows with average percent load equal to six percent or less. The low load bin is intended to capture operation similar to operation found during the development of the LLC by SwRI. The low load bin includes windows greater than 6 percent and equal to or less than the twenty percent average engine load. The medium/high load bin is designed to capture higher load operation found in the FTP and the RMC-SET cycles. The medium/high bin includes windows of average percent load greater than 20 percent, operation that cover engine percent load higher than the average percent load of the FTP cycle. This bin cut point is intended to provide more operation margin for thermal management control of the aftertreatment system by allowing a significant portion of the lower loaded events of the FTP into the low load bin that has a much higher standard (four times the FTP standard for 2024-2026 MY engines). Although the bins could have been defined differently, CARB staff is confident they are reasonable and will serve the purpose of ensuring engines and aftertreatment systems are designed and calibrated to control emissions during idle, low-load and medium/high load.
- ii. Windowing data is an effective method already implemented in the Euro VI In-Service Conformity testing.<sup>81</sup> The 3B-MAW approach allows emissions to be tied with history and operation on a fixed length of 300 seconds instead of Euro VI windows, which have fixed engine work

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<sup>81</sup> Commission Regulation (EU) NO582/2011. Article 12. ANNEX II Conformity of in-service engines or vehicles

that allows different time lengths to make up a window. SwRI evaluated work-based window and exponential based window metrics.<sup>82</sup> After consulting with industry and regulatory agencies, 300 second windows size showed a balance between smoothness of averaging a significant amount of emissions data and the necessary responsiveness manufacturers need to design to provide thermal management for effective emission control. The SwRI Stage 3 engine demonstrated the effectiveness of meeting the 3B-MAW requirements for 2027 and subsequent MY engines. For 2024 through 2026 MY engines, CARB staff made the following modifications to the 3B-MAW method to reduce the compliance burden:

- Eliminating the inclusion of cold-start emissions;
  - Increasing the LLC standard to 4 times the FTP standard (for 2027 and subsequent MY engines it is 2.5 times the FTP standard); and
  - Requiring that the average load of engine operation for the test day be at or above 10 percent engine maximum power (eliminated for 2027 and subsequent MY engines).
- iii. The commenter discusses the use of the conformity factor (1.5x) which is not intended to be scaled with the standards. The conformity factor provides an allowance for the errors of the instruments used to measure emissions and the variability of day-to-day field testing. Therefore, the conformity factor is not intended to be “[A] direct scalable relationship (i.e., 1.5x) between the emissions sorted into each bin and the underlying test-cell standards...” Further, the conformity factor has been increased to 2.0 for 2024 through 2029 MY engines to provide an added compliance margin as manufacturers transition to develop improved emission control systems and engine calibrations as the NOx standard becomes more stringent and the useful life requirements are extended.
- iv. Day-to-day testing has inherent variability from weather, time of day, pay-load, driver, route, and other factors. In-use testing does not seek the rigorous repeatability of engine dynamometer testing. Instead, in-use testing seeks to determine the emissions performance of engines under real world conditions and to be a reasonable test of whether the engine and aftertreatment system is designed and calibrated correctly so as to perform in real-world conditions. It should also be noted that in-use testing does account for such variability by providing a conformity factor that provides up to 100 percent margin against the standards. Engines

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<sup>82</sup> Sharp, Christopher. “Heavy-Duty Engine Low-Load Emission Control Calibration, Low Load Test Cycle Development, and Evaluation of Engine Broadcast Torque and Fueling Accuracy During Low-Load Operation,” Low NOx Demonstration Program – Stage 2,” Southwest Research Institute, SwRI Project No. 03.22496, Final Report. May 6, 2020.  
<https://www.arb.ca.gov/lists/com-attach/1-hdomnibus2020-VDdXMFihU2IAWQlw.pdf>

exceeding the emissions thresholds provide evidence of exceeding emission limits and would be deemed non-compliant.

- v. Similar emissions amongst bins are not indicative of a problem with the test methodology. Also, CARB staff would not expect to always have similar emissions over different tests due to the variability of real-world testing. It is most important the tested engines consistently operate at values less than the emissions threshold when analyzed with the 3B-MAW procedure. The 3B-MAW has a clear distinction between compliant and non-compliant engines. Sum-over-sum (SOS) emissions less than the in-use thresholds for each pollutant and each bin are required for a pass test result. Failure to comply with the emission thresholds provides evidence of exceeding emissions limits, and the vehicle would be deemed non-compliant.
- vi. The Stage 3 prototype engine has proven feasibility of low NO<sub>x</sub> emission rates over a number of cycles including LLC, FTP, RMC, and CARB's Southern Route Replay as discussed in the Agency Response to Comment A.(a)iv.2. Robust calibration and design are required to fulfill controlled emissions over a wide range of duty cycles. The failure to maintain Low NO<sub>x</sub> emissions outside of the certification cycles would be regarded as tailoring to only the certification cycles and could be viewed as a defeat device in real world operation. In addition, CARB staff does not believe it is necessary for CARB to demonstrate that the Stage 3 prototype engine meets the standard in a "variety of vehicles," as the commenter implies. CARB and SwRI have demonstrated the overall broad technical feasibility of the standard. It is appropriate for each manufacturer to do detailed design and calibration for each engine/vehicle they manufacture.
- vii. The Stage 3 prototype engine has proven the feasibility of low NO<sub>x</sub> emission rates over a number of cycles including LLC, FTP, RMC, and CARB's Southern Route Replay as discussed in the Agency Response to Comment A.(a)iv.2. The FTP, LLC, and Southern Route exhibit significant transient operating characteristics that lead to variations in SCR temperatures. As demonstrated in the Stage 3 program, the Stage 3 prototype system achieved 99.2 percent conversion efficiency over the composite FTP cycle and 99.7 percent over the LLC cycle. Similarly, data collected over the Southern Route Replay cycle were analyzed using 3B-MAW methodology and the Stage 3 prototype engine (with thermally aged catalyst) was able to meet the in-use thresholds for the three bins (idle, low load, and medium to high load bins). These results demonstrate the flexibility and capability of the Stage 3 prototype engine-aftertreatment system and the model-based ammonia control strategy in controlling NO<sub>x</sub> emissions over transient operations. Thus, the commenter's statement that CARB did not demonstrate that the 3B-

MAW protocol can provide reliable results on routes that exhibit transient engine operating characteristics that lead to variations in SCR temperature is incorrect.

- viii. The Stage 3 prototype has improved ability to quickly control emissions from a cold-start when compared to current products. The quicker response, thermal management, and improved aftertreatment efficiency will make the Stage 3 prototype perform over a wide range of adverse ambient conditions. Manufacturers can design similar features into their future engine offerings to meet the standards.
  - ix. CARB staff believes that the commenter intended to point out that more than one technology option should be available to meet the Low NOx standards. NREL identified three possible configurations to meet the Low NOx standards. NREL surveyed industry for the incremental increase in cost to produce engines with the Low NOx technology and manufacturers responded. At that time responses did not indicate the inability to provide engines that will meet the Omnibus Regulation Low NOx standards.
- (b)i.3. Comment: CARB's proposed unilateral amendment of the HDIUT program is manifestly unfair and would impose unreasonable risks of recall liability on manufacturers. The HDIUT program (codified at 40 CFR Part 86, Subpart T, §§86.1901-86.1935) is a program that resulted from a negotiated settlement of litigation that EMA filed in 2001 challenging CARB's and EPA's authority to require that manufacturers test previously-sold non-new vehicles no longer in the manufacturers' possession and control. (See 70 FR at 34597). CARB's unilateral move to create a strict liability HDIUT program — with automatic recall liability for any "failed" Phase 1 testing — is contrary to the foundational agreements and terms that created the HDIUT program, and will result in an unfair and unacceptable divergence between the federal HDIUT program and the revised program that CARB seeks to implement. CARB's unilateral imposition of new and unwarranted in-use compliance risks and liabilities is yet another aspect of CARB's Omnibus Regulations that likely will fracture the market for HDOH products, with several manufacturers being forced to exit California. (EMA)

Agency Response: No change was made in response to this comment. CARB disagrees with the commenter's assertion that the amendments to the HDIUT program EMA's contentions are "contrary to the foundational agreements and terms that created the HDIUT program" which "resulted from a negotiated settlement of litigation." In fact, that agreement expressly specified that none of its terms would limit or modify the authority accorded to CARB under California law, or the federal CAA. The agreement therefore does not restrict CARB's authority to promulgate subsequent regulations needed to fulfill CARB's mission

to reduce sources of vehicular emissions that harm the health and welfare of Californians.

To the extent that the amendments to the HDIUT program will result in a divergence between California and federal programs, such divergence is consistent with the federal CAA. The CAA authorizes the United States Environmental Protection Agency (EPA) to establish emission standards and other emission related requirements for new motor vehicles and new motor vehicle engines, and generally prohibits states and their local governments from adopting or enforcing separate emission standards and other emission related requirements for new motor vehicles or new motor vehicle engines. However, California is the only state that is authorized, in the first instance, to adopt and enforce its own new motor vehicle and new motor vehicle engine emission standards and other emission related requirements, provided that it obtains a waiver of preemption from section 209(a) of the CAA from the Administrator of the EPA.

Engine family compliance or non-compliance determination after Phase 1 testing does pose liability to industry. Phase 2 testing applies to root cause testing required by the manufacturer if requested by the administrator (CARB or U.S. EPA). Phase 2 testing is not required if the root cause of the non-compliance can already be determined based off the ten Phase 1 engines tested. The proposed language provides an expedited method for determining non-compliance and corrective action to be taken quickly to limit excess emissions to the environment.

CARB staff expects that U.S. EPA will promulgate their CTI regulation that will largely align with the Omnibus Regulation. U.S. EPA staff has been involved in the SwRI Stage 1 through 3 working groups over the past several years and have been an active participant. Overall, although some manufacturers may temporarily exit the California market for 2024 through 2026 MY engines, CARB staff does not agree the market will be “fractured.”

- (b)i.4. Comment: While there can be short-term engine-operation effects on emissions, EMA disagrees that windows of data add value to the assessment of in-use emissions, especially when the proposed protocol makes no distinction whatsoever regarding the characteristics of engine-operating history. Two windows can have mirror-image time traces (engine speed, torque, etc.), one with rising SCR temperature, the other with falling SCR temperature, which can certainly yield very different emissions results. Yet the 3B-MAW protocol would bin those windows identically and hold them to the same standard. Consequently, while CARB’s premise is that engine operating history is important, CARB’s protocol does nothing to account for the particular details of that operating history. (EMA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. The history of operation is an important

element to emissions evaluation. The windows are segregated by the average engine percent load. The constant 300 second averaging period applies equal weight to operation before and after an emissions event through the moving average procedure, where invalid operation does not disrupt the window and binning procedures. Bins would be similar to the current certification cycles, which are comprised of many types of operation including idle, low speed events, high speed events, accelerating event, decelerating events, high load, and low load. The binning structure takes the average percent load and categorizes windows into bins. A detailed explanation of the binning methodology is provided in the Agency Response to Comments A.(b)i.1 and A.(b)i.2. The sum-over-sum by bin calculation and evaluation method allows for the averaging of the various types of emissions with similar operation by bin. CARB staff disagrees with the commenter's assertion the binning structure should be modified to give greater emphasis to operating history. Instead, the structure of the bins is intended to require manufacturers to keep emissions well-controlled under idle, low-load, and medium/high load operation, regardless of the operating history. Indeed, that is one of the main purposes of the 3B-MAW requirements.

- (b)i.5. Comment: The proposed 3B-MAW protocol is nowhere near the level of development appropriate to be a core component of any final emissions-control regulation. The 3B-MAW protocols and compliance criteria are in their early stages of development and are far from being sufficiently validated. Consequently, that in-use methodology needs to be thoroughly evaluated to demonstrate its suitability and feasibility as a robust and effective in-use emissions-performance metric. (EMA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. The 3B-MAW was developed with input from the engine manufacturers, PEMS manufacturers and U.S. EPA. The 3B-MAW methodology has also proven to be feasible by being applied to the SwRI Stage 3 demonstration engine over a replay of the "CARB Southern Route." The 3B-MAW also avoids the shortcomings of the current in-use methods as described in ISOR-II.C.3.1 The MAW which the 3B-MAW is based on is already implemented for the EURO VI In-Service Conformity testing. A detailed explanation of the binning methodology is provided in the Agency Response to Comment A.(b)i.1 and A.(b)i.2.

- (b)i.6. Comment: Moreover, if the in-use 3B-MAW standards are intended to be technology-forcing, CARB has made absolutely no demonstration of a proposed technology set or emissions control strategy capable of complying with each of those in-use 3B-MAW standards. On the other hand, if CARB did *not* intend for the 3B-MAW standards to be technology-forcing, such that a technology set and calibration strategy capable of complying with the underlying test-cell certification-standards also should be inherently capable of complying with the new in-use standards, CARB has not made that demonstration either. The bottom line is that CARB still has a very significant

amount of work left to do to develop and validate the 3B-MAW in-use protocol, establish technically feasible and cost-effective in-use standards, and make a compelling demonstration of that necessary work. (EMA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. The 3B-MAW methodology is not technology forcing and is similar to the current NTE emission test method. Like the NTE, the 3B-MAW methodology is designed to enforce the emission standards for vehicle operating conditions similar to the current certification cycles. This is done by binning exhaust emissions windows based on the percent engine load and then averaging the emissions data based on a sum-over-sum algorithm approach. Further, SwRI has demonstrated that the 3B-MAW methodology is feasible by applying the methodology to the Stage 3 engine.<sup>83</sup> Therefore, CARB has met the statutory requirements for demonstrating feasibility. Similar to current requirements, engine manufacturers are required to make engines and components robust to control emissions to the standards for their useful life. Specifically designing and calibrating engines to only control emissions during certification cycles and excess emissions during off-cycle is considered a defeat device and to be non-compliant.

- (b)i.7. Comment: While CARB has presented little if any data in the rulemaking record to justify its 3B-MAW proposal, EMA and its members have devoted significant amounts of time and money to exploring the strengths and weaknesses of MAW-based emissions binning tools and other potential in-use protocols. Unfortunately, notwithstanding EMA's and WVU's extensive efforts (which are detailed in WVU's Report, see Exhibit "G"), EMA has not been able to identify a suitably robust in-use emissions-data assessment protocol. EMA is continuing its investigations. And while those investigations have not yet identified a well-suited in-use testing protocol, they have made one thing abundantly clear: CARB's proposed 3B-MAW protocol is not a reasonable regulatory framework for assessing in-use emissions compliance. (EMA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. The 3B-MAW methodology is based on Euro VI In-Service Conformity testing analysis methods that have been in use since 2013. The 3B-MAW provides greater allowances than the European method that is already in use by implementing the binning method. The binning method allows operation to be evaluated with appropriate emission standards at the high/medium load, low load and idle bins. This prevents idle or low load bin operation from being compared against the more stringent high/medium load bin where high efficiency emissions control at higher average engine loads is feasible. As mentioned in the Agency Response to Comment A.(b)i.5, the 3B-

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<sup>83</sup> Sharp, Christopher. Further Development and Validation of Technologies to Lower Oxides of Nitrogen Emissions from Heavy-Duty Vehicles. Low NOx Demonstration Program Stage 3. Final Report. SwRI@ Project Number 03.23379

MAW methodology was developed with input from regulatory groups and industry, including the commenter, EMA. The 3B-MAW was validated using the Stage 3 engine as described in the Agency Response to Comments A.(b)i.6.

- (b)i.8. Comment: CARB’s proposed “concatenating” of data across key-off/key-on cycles will result in an unrepresentative binning of dissimilar data, which will yield wide spreads in the binned results. (EMA, Daimler, Navistar, Volvo)
- (b)i.9. Comment: Another area of concern with the 3B-MAW approach, relates to CARB’s proposal that data gaps stemming from, for example, key-off events, should be concatenated. That is, data points that are part of a particular operating segment of the vehicle’s application, even if there is a cessation of data-generation due to a vehicle coming to a stop, should be stitched together. Stitching data gaps together, however, is directly at odds with the supposed importance of windowing. CARB’s approach (again) simply does not make sense. No reasoned analysis would lump those disparate emissions data together in that way. Accordingly, CARB should not deploy concatenation techniques. Alternatively, CARB should include PEMS calibration events and key-off/key-on events among the sources of invalid data for which a concatenated window greater than 600s in duration may be voided.<sup>84</sup> The Regulation should also be clear that any events for which concatenated data would create windows greater than 600 seconds in duration would apply when such events occur *in combination*. (EMA)

Agency Response to Comments (b)i.8 and (b)i.9: Based on these comments, CARB staff changed the Proposed Amendments by including PEMS calibration and key-off/key-on events as criteria for data invalidation. The 3B-MAW in-use method was developed to capture real world operation lacking in the NTE method. However, it is important that manufacturers design aftertreatment systems that can control emissions effectively by accounting for short key-off or engines that employ an engine stop/start system during engine idle periods. Operation before and after an engine start/stops requires surveillance and control due to potential higher emissions occurring after a pause in engine operation. Thus, it is important to concatenate these events to include them into the emission analysis. However, CARB staff has limited the inclusion of concatenated data up to 600 seconds as the commenter suggested. This provides a reasonable design target manufacturers’ will need to use in developing their emission control systems. The term “disparate emissions data” is irrelevant in this case where the in-use method is looking to capture valid real-

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<sup>84</sup> In those instances where CARB does permit concatenated windows greater than 600s to be voided, CARB would require a “detailed explanation” as to why the windows were voided in each case. That should not be necessary. The objective criteria that allow for the invalidation of a window due to excessive window length are clearly spelled out in the proposed regulatory text. Accordingly, invalidating a window would be based on a completely objective assessment; there is nothing subjective about the “decision” to invalidate windows on the basis of those spelled-out criteria. The requirement to provide a written explanation for invalidated windows should be eliminated.

world operation, and the binning method ensures windowed data is segregated similarly by the average percent load over a 300 second window of operation.

- (b)i.10. Comment: While CARB also has specified several other conditions under which an in-use test should be invalidated,<sup>85</sup> CARB has failed to identify two key conditions for which a test should be declared invalid. The first condition is if a regeneration event occurs during some portion of the in-use test. In an April 20, 2020 Omnibus Low-NOx work group meeting, CARB staff noted that that they were following [European Union] EU regulatory practices that do not provide any special consideration for a test which happens to include a regeneration event. That is not accurate. The European In-Service Conformity Regulations do, in fact, permit a manufacturer to void a test that includes a regeneration event. EU VI Regulation 582/2011 (introduced in the amendment EC 2016/1718) specifies:

*4.6.10. If the particle exhaust after-treatment system undergoes a non-continuous regeneration event during the trip or an OBD class A or B malfunction occurs during the test, the manufacturer can request the trip to be voided....”*

Utilizing test data that includes a regeneration event to assess for compliance with the in-use standard is in direct conflict with the basic concepts of the test-cell certification procedures that involve development of infrequent regeneration adjustment factors (“IRAFs”). Those adjustment factors are used to accommodate the fact that regeneration emissions are characteristically different and generally higher than under normal operation. It is therefore inappropriate to consider an in-use test that includes regeneration as a valid test.

The second condition under which an in-use test should be invalidated is when the malfunction indicator lamp is illuminated during any portion of the test. Under no circumstances, even in the event of passing test results, should CARB consider a test with any period of MIL-ON time to be a valid test. (EMA)

- (b)i.11. Comment: In-use testing analysis includes data even when regeneration occurs, MIL is illuminated, or coolant temperature is low after a shutdown period. Cummins recommends CARB consider invalidating tests or data when these conditions occur. (Cummins)

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<sup>85</sup> CARB has incorrectly required that a test be voided if it fails to meet “a minimum valid window requirement of 3 hours of non-idle operation” (Emphasis added.) That requirement is inconsistent with the in-use test provisions of §86.1910, which require a minimum of 3 hours of non-idle operation. CARB should amend this proposed requirement to be consistent with the already-codified and well-established in-use testing requirements.

Agency Response to comments b(i).10 and (b)i.11: CARB staff made changes to the Proposed Amendments based on these comments as described further below. After further discussions with stakeholders, CARB staff agreed to provide additional provisions to the in-use testing methods. CARB staff included manual active regeneration, automatic active regeneration, and low coolant temperature events as criteria for data invalidation. In addition, CARB staff will be evaluating other methods to evaluate how regeneration emissions that are much higher than non-regeneration events should be accounted for during in-use testing for 2027 and subsequent MY engines. Any such changes, if needed, would go through the required public review process and presentation to the Board in a separate rulemaking, most likely one planned for soon after U.S. EPA's expected CTI rulemaking.

CARB staff did not change the Proposed Amendments related to this MIL-ON comment. This is because the flexibility for manufacturers to deal with MIL-ON events during in-use testing currently exists in the test procedures under 86.1910.A.b and will continue to be available for 2024 and subsequent MY engines.

- (b)i.12. Comment: Just as important, CARB has made no effort whatsoever to demonstrate the feasibility of any technology package to meet the new moving average windows-based in-use test procedures and standards (the so-called "3B-MAW" protocol and standards) that would come into force in the 2024 MY. Those 3B-MAW procedures, discussed at greater length later in these comments, introduce a completely new method to assess in-use emissions, over a broader range of operating and ambient conditions, and with associated standards at a fraction of where they are today, while (without justification) prohibiting the use of any PEMS measurement-accuracy adjustment factors (adjustment factors that are, by themselves, double the 2024 in-use compliance limits CARB proposes to set). There have been no test cell evaluations of the Stage 1B/2 prototype engine's ability to comply with the 3B-MAW standards, let alone any rigorous in-use in-vehicle compliance demonstration testing of the Stage 1B/2 prototype operated over the multitude of conditions encountered by HD tractors and trucks in-use. CARB's apparent effort to skip over the need to present an actual "in-use" feasibility demonstration regarding such sweeping new changes to "in-use" standards starting in 2024 amounts to another fundamental shortcoming of the pending rulemaking effort. (EMA)

Agency Response: CARB staff did make changes to the Proposed Amendments based on this comment. The 3B-MAW methodology has been demonstrated at SwRI using the Stage 3 engine as discussed in the Agency Response to Comments A.(a)iv.2 and A.(b)i.5. During SwRI's Stage 1 and 2 testing under the Low NOx demonstration project, the 3B-MAW in-use test method was not developed, and thus could not be evaluated at that time. It should be noted that the MAW is not a new method and has been used in Europe for in-use testing for

many years (see Agency Response to Comment A.(b)i.7). The MAW method in Europe implements a conformity factor and does not include an in-use measurement accuracy margin used in today's NTE-based HDIUT program. As explained in Agency Response to Comments A.(b)viii.1 through A.(b)viii.6, CARB staff believes the conformity factor is sufficient for the 3B-MAW method.

CARB staff disagrees with the comments regarding prohibiting of the in-use PEMS measurement accuracy adjustment factors. As described in the Agency Response to Comment A.(b)ii.2, CARB staff conducted an analysis of the uncertainty in measurements. The estimated uncertainty in calculating an emissions rate is less than the 50 percent, thus the conformity factor already provides allowance for PEMS accuracy/uncertainty margins.

As described in section II C.3.1 of the Staff Report, an assessment of the current HDIUT program using the NTE methodology shows that the vast majority of operating conditions are not evaluated and go unchecked for in-use compliance. CARB staff evaluated modifying the exclusion in the NTE to increase the data percentage for compliance determination but concluded such modifications could never overcome the fundamental shortcomings of the NTE method. Significant gains in percent of test time and NOx emissions for evaluations when a European MAW methodology was used on the HDIUT data set versus the NTE method. In-use emissions from European HD engines are better controlled over the span of operating speeds when compared to the United States products.<sup>86</sup> The improvement in emissions control performance in the low and medium speed operations is likely due to the differences in the in-use requirements in Europe that require control over a broader range of operations when compared to the current NTE-based HDIUT program in the United States. Based on the comparison of the NTE, modified NTE, and Euro VI MAW, CARB staff concluded that modifying the NTE would be insufficient. Instead, a MAW type approach would be superior for developing a future in-use method capable of capturing most of the test time and most of the NOx emissions during real-world testing.

CARB staff understands that manufacturers will have to make changes to their engine and aftertreatment systems to meet the Proposed Amendments and needing to meet the lower NOx emissions standards, the new LLC and new in-use testing requirements. To help manufacturers in the early transitions to the more stringent requirements, CARB staff has increased the conformity factor from 1.5 to 2.0 for 2024 to 2029 MY engines, providing an additional 50 percent margin above the emission standards. In addition, this change provides an added compliance margin as manufacturers transition to develop improved emission control systems and engine calibrations as the NOx standard becomes more stringent and the useful life requirements are extended. In addition, CARB staff

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<sup>86</sup> "Analysis of HDV in-use NOx emissions performance and compliance protocols," F. Posada, H. Badshah, A. Isenstadt, R. Muncrief, The International Council on Clean Transportation, CARB Low NOx Workshop, September 26, 2019.

added additional compliance provisions for 2024 through 2026 MY engines, as discussed in Agency Response to Comments A.(b)i.1 and A.(b)i.2.

- (b)i.13. Comment: It also is important to consider that the “Stage 3” technology set that serves as the basis for CARB’s purported feasibility demonstration offers little or no improvement to NOx emissions levels when operating over periods of sustained engine load, the types of operation that should be included in the proposed medium/high-load bin of CARB’s 3B-MAW protocol (discussed, infra). CARB proposes to set a new 90%-lower NOx standard associated with that type of already-optimized operation. Specifically, CARB is proposing to use the RMC-SET steady-state certification cycle and to apply a 1.5x conformity factor to the “medium/high” bin in-use limits based on a NOx standard set at 10% of today’s limits. There is no reason to expect that the level of emissions under those already-optimal conditions will be significantly improved, which again undermines the feasibility of CARB’s proposal. (EMA)

Agency Response: CARB staff did make changes to the Proposed Amendments based on this comment. It is true that well designed aftertreatment on today’s diesel engines do perform at high efficiency at specific operating points of the test cycle, similar to the demonstrated Stage 3 engine. However, the Stage 3 engine was designed to maintain high efficiency control over a broad range of engine operation. The Stage 3 engine demonstrated effective RMC-SET emissions control with the aftertreatment system aged out to the current 435,000 mile useful life.<sup>87</sup> The results showed an improvement from 0.14 g/bhp-hr during engine baseline testing to 0.015 g/bhp-hr for the final demonstration with adjusted calibration to account for aging. Recent “Stage 3 Rework-435k” results from SwRI on the Stage 3 engine emissions have shown to be lower emitting at 0.020, 0.029, and 0.018 g/bhp-hr on the composite FTP, LLC, and RMC-2021 cycles for an aged engine with IRAF values applied.<sup>88</sup> This testing demonstrates the feasibility of reducing the NOx emission standards by 90 percent in this limited demonstration. Manufacturers will have over five years to further develop engine and aftertreatment emission controls to meet the 2027 and subsequent MY NOx standards. As mentioned in Agency Response to Comment A.(b)i.12, CARB staff adjusted the conformity margin for 2024 through 2029 MY engines in response to this and other comments to provide manufacturers additional time to further learn and refine their emission control systems.

#### **(b)ii. In-Use Idle Bin**

- (b)ii.1. Comment: Other defects inherent in CARB’s binning proposal become evident when CARB’s new LLC certification test is processed according to

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<sup>87</sup> Sharp, Christopher. Further Development and Validation of Technologies to Lower Oxides of Nitrogen Emissions from Heavy-Duty Vehicles. Low NOx Demonstration Program Stage 3. Final Report. SwRI® Project Number 03.23379

<sup>88</sup> Sharp, Christopher. Stage 3 and Beyond Continuing Low NOx Efforts. WCX Digital Summit, April 13-15, 2021

the 3B-MAW in-use protocol. A significant number of windows, especially those including long periods of idle followed by a high-load “return to service” period of operation, end-up in the medium/high-load bin. Consequently, the portions of the LLC most vulnerable to NOx “breakthroughs” would have to comply with the in-use standard linked to the more stringent FTP/RMC-SET standards, not the higher LLC standard. (EMA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. The windows are binned according to the percent average load and reflect the engine operation during that window of operation. It is common for windows accumulated over transient operations to have a mixture of different operating modes. For example, FTP cycle is a mixture of idle, transient operation, “return to service,” and high load operating modes. Similarly, LLC is comprised of the same types of operating modes, but the average load of the windows is significantly less. Manufacturers will need to design their emission control system to adequately respond to provide sufficient transient emission control as the average load of an engine is changing for each window. Proper engine calibration and design should eliminate or greatly reduce “breakthrough” events. The frequency and severity of breakthrough events to cause sum-over-sum emissions in specific bins to fail is unacceptable and would result in a non-compliant vehicle test. Also see Agency Response to Comments A.(b)x.9 through A.(b)x.12.

- (b)ii.2. Comment: CARB also has failed to explain or justify: (i) why a bin of “idle” emissions should include tractive power emissions up to 6% of an engine’s normalized CO<sub>2</sub> rate, while also having an extremely aggressive NO<sub>x</sub> standard targeting low-idle conditions; (ii) why the low-power bin should have a 6% CO<sub>2</sub> rate as its low-range boundary, when 6% is the average power (not low-range limit) of CARB’s proposed low-load cycle; and (iii) why CARB has selected a 20% CO<sub>2</sub> rate as the boundary marker for the medium/high-power bin, when that value seems extremely low. Just as important, CARB has provided no data demonstrating that its 3B-MAW approach is reasonable or feasible when the proposed uniform in-use emissions-compliance factor of 1.5 (1.5 times the relevant idle, LLC or FTP standard) is applied to the average emission rates in the idle, low, and medium/high bins. (EMA)
- (b)ii.3. Comment: No PEMS measurement allowance is specified for in-use compliance testing. CARB and industry should work together to determine data-driven measurement allowances given the new data analysis techniques, expanded operating ranges and conditions, and lower emissions thresholds associated with the new in-use protocol. (Cummins)
- (b)ii.4. Comment: No PEMS measurement allowance is specified for in-use compliance testing. CARB and industry should work together to determine data-driven measurement allowances given the new data analysis

techniques, expanded operating ranges and conditions, and lower emissions thresholds associated with the new in-use protocol. (Cummins)

- (b)ii.5. Comment: CARB's notion that the in-use measurement accuracy margin can simply be brushed aside is not based on any data or evidence, and runs counter to longstanding scientific research, understanding and practice. As a result, the current additive PEMS NO<sub>x</sub>-measurement adjustment factor (0.15 g/bhp-hr) must be retained, as should the measurement allowances for the other emissions constituents as well. Once that necessary concession to the realities of in-use PEMS-based testing is made, it becomes clear that CARB's proposal, in effect to set the in-use NO<sub>x</sub> standards significantly below the measurement capabilities of current PEMS (and five times lower than the current NO<sub>x</sub> measurement allowance), is fundamentally infeasible. Promulgating emissions standards that are far below the limits of detection for state-of-the-art emissions measurement equipment is neither workable nor reasonable. CARB's 3B-MAW proposal is therefore fundamentally unsound and invalid on this basis as well. (EMA)

Agency Response to Comments (b)ii.2 through (b)ii.5: CARB staff made changes to the Proposed Amendments based on this comment, as detailed below. The binning structure for windows is based on the average percent load of the FTP cycle, LLC, and Idle testing average percent loads as noted in the ISOR (ISOR pp. III-38 and III-39).

As described in the Agency Response to Comments A.(b)i.1 and A.(b)i.2, the bin boundaries for idling were selected based expected engine idle load of approximately 5 to 6 percent, operations that supports typical loads such as running the vehicle cab AC and other systems. This cut off between the idle and low load bins was to separate the majority of idle operation in the idle bin and to account for more low engine load operation at low vehicle speeds in the low load bin. The LLC is comprised of long idle events with periodic transitional engine load events to evaluate the emission control systems during transient operations. Thus, some windows that will show up in the low load bin, and to a lesser extent in the medium/high load bin, should have some amount of idle operation in them. The low load and medium/high load bin boundary is based on the analysis conducted for the LLC development by SwRI. Over six hundred vehicles were analyzed from NREL's Fleet DNA database and an additional hundred vehicles on-road tested at College of Engineering – Center for Environmental Research and Technology to develop the LLC. In the analysis, operation was broken down in to microtrips defined as the time elapsed from when the vehicle starts moving to the next stop. Data was grouped into windows where a window consists of 10 microtrips. There were 1.25 million windows generated in the full data set, and there were 250,000 windows were in the low load region. The 95th percentile of this region is located at about 22 percent average load, and it also occurs at the 20th percentile of the overall distribution. The LLC bin's upper limit was set near this point and it was decided with consultation with SwRI, U.S. EPA and the

technical workgroup that an average window load at 20 percent would be a good boundary between were LLC driven control is shifted towards FTP cycle control. The RMC cycle average load is much higher but also shares the same emission standards as the FTP so a third boundary condition was not needed. Consequently, the medium/high load bin included windows with average engine percent load of greater the 20 percent that accounts for the higher load conditions of the FTP and RMC test cycles.

The 1.5 conformity factor for compliance is currently used in Europe for compliance with EURO VI In-Service Conformity testing using the MAW method. The 50 percent compliance margin is greater than the 39 percent instrument measurement error estimated by CARB staff. CARB staff based the estimation on the root-mean-squared (RMS) error analysis.<sup>89</sup> The NOx emissions uncertainty is a combination of the combined RMS uncertainty of the measurements required to calculate the brake specific emissions for NOx: CO2 analyzer, exhaust flow meter accuracy, and NOx analyzer. The accuracy of each the elements in the RMS analysis assumed to be 10 percent. The combined RMS accuracy was estimated to be 17 percent. Time alignment and final drift uncertainty were added to the combined RMS accuracy at 3 percent and 19 percent respectively. The final uncertainty of the NOx emissions was estimated to be 39 percent. The total uncertainty is less than the conformity factor. Thus, there is no need for an additive PEMS accuracy margin.

However, in response to this comment and other comments, CARB staff has increased the conformity factor to 2.0, which would provide an additional compliance margin of 50 percent (totaling 100 percent) for the 2024 through the 2029 MY engines. Please also see Agency Response to Comment A.(b)i.12.

- (b)ii.6. Comment: The inclusion of the up-to-6% CO2 rate in the idle bin has the net impact of increasing the stringency of the proposed “Clean Idle” standards CARB has set the NOx limit for what they call the “idle bin” at 1.5 times the idle standard (without any allowance for measurement accuracy). On top of that, CARB has not assessed the feasibility of complying with an appropriate in-use idle standard at ambient temperatures as low as -7C(<20°F), the threshold CARB has set for compliance. Consequently, either the stringency of the standards for the in-use idle bin need to be greatly reduced, or the binning structure needs to be rethought to eliminate these unintended consequences. (EMA)

Agency Response: CARB staff made changes to the Proposed Amendments based on this comment, as described below. CARB staff redefined percent CO2 rate to average percent load. Engine idle operation depending on a baseline load or rpm generally ranges between 5 to 6 average percent engine load at idle. This is effectively the bottom limit to the average percent load because engine-off

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<sup>89</sup> Gieschaskiel et al. 2018. Framework for the assessment of PEMS (Portable Measurement Systems) uncertainty. Environmental Research. <https://doi.org/10.1016/j.envres.2018.06.012>

operation has been added as a criterion for invalid data to 3B-MAW method. Therefore, the range of the idle bin does not increase stringency of the idle standards.

For response to comments related to measurement accuracy please see Agency Response to Comment A.(b)ii.2 that describes the uncertainty analysis. The commenters request for additional margin for in-use idle bin compliance is not supported by the SwRI's Stage 3 test data used to evaluate the 3B-MAW method on that engine. Figure 138, on Page 157, of the Stage 3 report shows that the margin of compliance for the idle bin is greater than the low load and the medium/high load bins.<sup>90</sup> The margin for compliance was over nine times the emission results. Thus, providing additional margin for the idle bin would not be warranted.

CARB staff has also extended cold temperature coolant data invalidity exclusions between 2024 to 2026 to provide additional lead time for further developing emissions control during cold starts and cold ambient conditions. In addition, CARB staff made modifications to the conformity factor from 1.5 to 2.0 for 2024 to 2029 MY engines. Please also see Agency Response to Comment A.(b)i.12.

### **(b)iii. In-Use Idle Test**

- (b)iii.1. Comment: As mentioned, CARB also has introduced a new test procedure to measure “in-use” idle NOx emissions. That in-use test, however, does not specify a minimum ambient temperature, nor any limit on the duration of the idle period. Those conditions make control of idle-NOx emissions more challenging than under the current test procedure, used since the 2008 MY. CARB intends to certify engines according to the current idle-test procedure, and it is likely that the current procedure is the basis for any feasibility work that CARB may have done to evaluate the proposed 10 and 5 g/hr low-NOx idle standards. Yet at the same time, CARB is proposing to add a new “in-use” idle test procedure without making any demonstration of the feasibility of compliance to the new in-use idle test. CARB should not require demonstration to the new low-NOx standards using the new more challenging “in-use” idle emissions test procedure. Otherwise, and in effect, CARB would be implementing three protocols against which idle-NOx emissions will be evaluated: the current test-cell test; the “idle bin” protocol (which will be one of the three components of the 3B-MAW procedure); and the in-use idle test. There is no justification or need for three means (two of which are unverified) to assess the same emissions condition. (EMA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on these comments. CARB staff added the in-use idle test to

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<sup>90</sup> Sharp, Christopher. “Further Development and Validation of Technologies to Lower Oxides of Nitrogen Emissions from Heavy-Duty Vehicles, Low NOx Demonstration Program – Stage 3,” Southwest Research Institute, ARB Contract 16MSC010, SwRI® Project Number 03.23379, [Final Report](#), April 16, 2021.

verify the current idle certification tests results with similar procedures on vehicle mounted engines. The temperatures for the stand-alone in-use idle test are conditions similar to the test cell between 68 to 86 degrees Fahrenheit (°F). The test procedure specifies a minimum of 30 minutes in each mode to a minimum total of one hour. The main purpose of the new in-use idle test is to check compliance with the idle emission standards as described in the Agency Response to Comment A.(a)viii.1, and it is necessary for that purpose. For practical reasons and to ensure that manufacturers are controlling extended idle emissions beyond just 1 hour of operation, the in-use test duration may exceed 1 hour. The purpose for the in-use idle testing provisions is to determine an engine family's compliance with the optional NOx idle emission standard used to demonstrate control of extended idle emissions. The 3B-MAW testing may not capture extended idling that occurs during rest periods. Idle bin operation in 3B-MAW is most likely going to be made up of short idling periods that occurs in traffic or at delivery locations and can include vehicle creep operations. It is also important to note the stand-alone in-use idle test is not required by the manufacturers for the HDIUT program. This in-use compliance testing will be conducted by CARB staff.

**(b)iv. 3B-MAW**

- (b)iii.1. Comment: Given the fact that the prototype Stage 3 engine, even with multiple recalibrations in a well-controlled test cell environment, has not demonstrated compliance with CARB's proposed stringent low-NOx standards, CARB, at the very least, will need to provide and implement significant "in-use" compliance margins or allowances during the first years of production of any new low-NOx engines. There is precedent for such necessary in-use compliance allowances in the light-duty GHG Regulations and in the HDOH fully-phased-in 2007 standards (effectively, the 2010 MY standards). In those cases (and as clearly pertains here) where significant compliance margins are necessary, the new significantly more stringent emission standards are applied for all certification testing, including DF and IRAF testing, but, for the first model years following the implementation of the new stringent standards and certification protocols, all selective enforcement audits and compliance tests of engines in or from the field are provided an additional compliance allowance before being declared non-compliant. CARB's Omnibus Low NOx Regulations clearly constitute a "significant standards change and implementation of new protocols." More specifically, with 90% and 50% lower NOx and PM standards, respectively, coupled with the introduction of the LLC certification cycle and the 3B-MAW in-use protocol, additional compliance margins are clearly warranted, for example, for the 2024 and 2025 model years, and then for the 2027 and 2028 model years. Without such necessary in-use compliance margins or allowances, the anticipated and likely absence of CARB-compliant HDOH engines and vehicles starting in advance of the 2024 MY low-NOx standards will become inevitable. (EMA)

Agency Response: CARB staff changed the Proposed Amendments based on this comment, as described further below. CARB staff understands that manufacturers will have to make changes to their engine and aftertreatment systems to meet the adopted lower NOx emissions standards, the new LLC and new in-use testing requirements. To help manufacturers in the early transitions to the more stringent requirements, CARB staff increased the conformity factor from 1.5 to 2.0 for 2024 to 2029 MY engines, providing an additional 50 percent margin above the emission standards.

- (b)iii.2. Comment: CARB envisions that the 3B-MAW protocol will assess emissions performance for all or almost all of a HD engine's operation over its entire shift-day. Indeed, that expectation is one of CARB's primary objectives in implementing a new in-use protocol, given the relatively limited coverage of in-use operations provided by the current NTE method. Despite CARB's intent, a similar risk exists still with the 3B-MAW protocol. A day's testing may very well capture 99% of the vehicle's operating time, yet, depending on the duty cycle, any single "bin" still may have a minimal amount of in-use emissions data stored for assessment. Consequently, EMA recommends that CARB include a minimum data requirement for each bin, expressed as a number of windows, or total operating time, or a similar metric. More analysis is needed regarding this issue, but perhaps 30 minutes of data (real data, ignoring the over-counting of individual seconds of data that results from overlapping 1 Hertz (Hz) windows) would be a good place to start the additional necessary analysis. (EMA)

Agency Response: CARB staff has changed the Proposed Amendments based on this comment. CARB staff has changed the valid test requirements to a minimum of 2,400 valid windows in each of the bins (idle, low, and medium/high) instead of 3 hours non-idle operation requirement of the NTE methods. This provides a minimum of 40 minutes of valid engine operation to be used in evaluating compliance in each of the three bins. Clarifying language was added to indicate additional testing will be required until the minimum required windows per bin is achieved. In addition, if the 2,400 valid windows are achieved for the low load and the medium high/load bins, but not the idle bin, then the manufacturers may request the fleet to idle their engines at the end of the shift-day for a minimum of 40 minutes to a maximum of 60 minutes to satisfy the minimum valid window requirement for the idle bin.

- (b)iii.3. Comment: Provisions are needed to address unknowns associated with the all-new in-use compliance protocol. Another concern is the potential for unforeseen challenges related to the proposed new MAW-based in-use compliance protocol. This protocol segregates real-world emissions data into three bins ("3B-MAW", or in the case of Otto engines, a single bin or "B-MAW") and applies an in-use limit to each bin based on a 1.5x conformity factor, or multiplier, of a corresponding certification standard. CARB and

manufacturers have no experience implementing such an approach, especially at the low in-use NOx thresholds in the proposal. Given the already-compressed product development schedules discussed above and little time for further evaluation of the 3B-MAW/B-MAW method itself or validating compliance to it, CARB should provide for addressing unknowns associated with it. For example, CARB should consider initially allowing additional "guard rails" such as higher conformity factors and/or additional data exclusions to cover unique duty cycles or other unanticipated issues. (Cummins)

Agency Response: CARB staff changed the Proposed Amendments based on this comment, as described further below. CARB staff discussed the challenges with the current NTE method and the benefits of using the Euro VI In-Service Conformity testing method in the Agency Response to Comment A.(b)ii.2. Further, CARB staff discusses the feasibility of the 3B-MAW in the Agency Response to Comments A.(b)i.1 and A.(b)i.2. Compliance margin and conformity factor changes for MY 2024 through 2029 are discussed in the 30-Day Notice Amendments and in the Agency Response to Comments A.(b)i.10, A.(b)i.11., and A.(b)ii.2. These changes will give the manufacturers time to develop and implement equipment technology needed to meet the adopted standards.

#### **(b)v. 3B-MAW Fuel Specification**

- (b)v.1. Comment: CARB has proposed as part of the Omnibus Regulation that manufacturers' "maintenance instructions may not prohibit the use of commercially available diesel and biofuel blends that meet California's fuel specifications in title 4, CCR, § 4148." Critical fuel properties for engine hardware may vary depending on the specific hardware components used. The fuel properties required under [American Society for Testing and Materials] ASTM D6751 (B100), ASTM D7467 9B6-B20), and ASTM D975 (B0-B5), as well as properties not specified in those standards, can have a broad range of impacts on fuel-injection system durability and performance. Malfunction of critical engine hardware due to fuel quality also may lead to significant emissions-performance issues. As hardware challenges are unique to the OEM, the OEM should have the sole discretion to designate compatible fuels with their products. CARB should eliminate this provision prohibiting an OEM's specification of allowable fuels.

There also is clear evidence that engine emissions control can be directly impacted by fuel properties, not simply from the longer-term poisoning effects of fuel contaminants. The fuel requirements CARB has proposed leave very little "margin for error" from those types of fluctuations in emissions.

CARB's Omnibus Regulation would no longer permit candidate vehicle rejection on that basis. A manufacturer would have to allow a candidate vehicle to be tested, provided it had been operated on any "commercially

available” fuel in California. That would include all commercially available diesel and biofuel blends that meet California’s fuel specifications detailed in Title 4, CCR, § 4148 (which could include fuels up to B100). That is inconsistent with EPA’s guidance regarding vehicle-rejection criteria for in-use testing, and is unacceptable for engine manufacturers seeking to ensure long-term emissions control by limiting the allowable fuel types that may be used. It also is inconsistent with the goals of the Omnibus Regulations, where CARB is implementing 90% reductions in the applicable NOx standards, with significantly extended FUL periods. CARB’s proposed elimination of manufacturers’ ability to specify the allowable fuels for their products to ensure long-term emissions control is not only a significant impediment to manufacturers’ ability to comply with the proposed stringent low-NOx requirements, it is environmentally detrimental. CARB should retain the current criteria for rejecting candidate vehicles from HDIUT as they pertain to fuels. (EMA)

- (b)v.2. Comment: Starting MY 2024, manufacturers may not prohibit the use of commercially available diesel and biofuel blends that meet California’s fuel specifications. To ensure performance of their products as designed, manufacturers should be allowed to continue specifying allowable fuels in their maintenance instructions as well as rejecting unacceptable fuels for purposes of in-use compliance testing. (Cummins)
- (b)v.3. Comment: Lastly, there was a stakeholder suggestion that CARB revise its proposal to allow the engine manufacturers to prohibit the use of commercially available fuels for purposes of in-use testing. We believe this suggestion misses the point. NBB does not believe the use of commercially available fuels will be an issue with biodiesel blends or renewable hydrocarbon diesel blends. However, for the in-use testing provisions of the HD Omnibus Regulation, we believe it would be more appropriate to require the use of certification grade test fuel, rather than commercially available fuel. This is because CARB would get a more accurate and reliable assessment of engine/aftertreatment performance if that testing were conducted using certification grade fuel rather than the fuel the vehicles are actually using at the time. This testing is meant to be a confirmative evaluation of the engine and vehicle hardware, not of comparative differences that may exist between the various fuels approved by CARB. Utilizing the certification fuel would remove one source of potential variation for the in-use results and provide a more accurate representation of the vehicle performance over time. We recommend ARB consider that change in the final version of the Regulation. (NBB)

Agency Response to Comments (b)v.1 through (b)v.3: CARB staff did not make changes to the Proposed Amendments in response to these comments. Current HDIUT test procedures allow for the use of commercial fuels available at fuel

stations that meet ASTM D975 fuel specifications.<sup>91</sup> However, manufacturers are allowed to use certification fuel for the actual HDIUT testing,<sup>92</sup> and CARB staff is not changing that provision. CARB staff does not agree with NBB's desire to require certification fuel for the actual HDIUT testing because such testing is intended to reflect real-world emissions so real-world fuels are fair game.

The fuel specification changes in the Proposed Amendments modify section 86.010-38, and can be found in ISOR Appendix F-B-1: Purpose and Rationale for Proposed Amendments to the Diesel Test Procedures. Current analysis of commercially available biodiesel fuels does not indicate any concerns with fuel contaminants that would harm or degrade the engine's emission control systems (also see Agency Response to Comment A.(I)iv.5.) The fuel specification amendment is necessary to ensure that manufacturers do not prohibit the use of CARB-approved commercial fuels via a statement in the manufacturer's maintenance instructions in the owner's manual or deny warranty based on the use of such fuels. Manufacturers are required to furnish to the purchaser of each new motor vehicle or motor vehicle engine written instructions for the proper maintenance and use of the vehicle or engine.

The Proposed Amendments prohibit manufacturers from specifying in their maintenance instructions that commercially available diesel and biofuel blends that meet California's fuel specifications in title 4, CCR, section 4148 for 2024 and subsequent may not be used in their engines. The Amendments in subparagraph 86.1910.A.2.2(ii) and 86.1910.A.2.3.(ii) allow manufacturers to use commercially available biodiesel fuels within the fuel tank or drain and fill fuel tanks with commercially available biodiesel or fuels meeting the requirements of ASTM D 9745 for 2024 and subsequent MY engine.<sup>93</sup> The Proposed Amendments are needed to avoid manufacturers putting restrictions in their maintenance instructions that are unlikely to be followed (for example restrictions prohibiting the use of common legal fuels in California) and then pointing to those restrictions as a way to reject vehicles from HDIUT testing.

Manufacturers need to be calibrating and engineering their products to be compliant on all legal commercially available fuels, and any such fuels are fair game for use in HDIUT and HDIUC programs. These changes to the fuel requirements will differ from the current practices for the California and federal HDIUT in-use testing starting with the 2024 MY engines. However, CARB staff believes U.S. EPA will make similar adjustments to their HDIUT requirements in the CTI rulemaking, likely applicable starting with 2027 MY engines.

#### **(b)vi. 3B-MAW and OBD Integration**

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<sup>91</sup> Appendix B-1 Proposed Second 15-Day Modifications to the Diesel Test Procedures. 86.1910.A.2.2(i)

<sup>92</sup> Appendix B-1 Proposed Second 15-Day Modifications to the Diesel Test Procedures. 86.1910.A.2.3(ii)

<sup>93</sup> Appendix B-1 Proposed Second 15-Day Modifications to the Diesel Test Procedures.

- (b)vi.1. Comment: CARB proposed that a family “failure” determination could be made on two bases. First, the family would not pass if “there are three [or more] exceedances of the same bin and same pollutant,” and second, the family would not pass if “the arithmetic mean of the sum-over-sum emissions from the 10 vehicle tests is greater than the in-use thresholds for any pollutant in any bin.” When a participant in the web meeting questioned the extremely restrictive nature of the latter condition for engine family failure, especially where one or two vehicles may have a compromised SCR system (due to fuel contamination, etc.), CARB staff responded that they would anticipate that a compliant OBD system would catch such failures and would have screened-out any such vehicle from the test program.

That response from CARB is inaccurate. Consider the following hypothetical test results from ten vehicles tested to satisfy an in-use test order...

In the case of this hypothetical example, 8 out of 10 vehicles comfortably pass the proposed 0.030 g/bhp-hr “Bin 3” NOx standard. In fact, they meet the underlying FTP/RMC-SET test cell standard without application of the 1.5x conformity factor applied for in-use. Just two vehicles (vehicles 3 and 5 in this example) exceed the in-use standard, but at levels of just 20% of the proposed OBD threshold for NOx. Those vehicles are far from triggering an OBD MIL, so they presumably would not be excluded from an in-use test order. (This would be true even if it were technically possible to reduce the OBD NOx thresholds to 0.10 g/bhp-hr.) This example demonstrates that CARB’s restrictive pass/fail criteria are overly punitive. Consequently, the proposed secondary pass/fail criteria should be eliminated from consideration. (EMA)

Agency Response: CARB staff did not make changes to the Proposed Amendments based on this comment. Current OBD systems are designed to detect engines that emit well above the emission standards. CARB staff recognizes that current OBD systems may not presently have the capability to accurately measure NOx emissions at the levels corresponding to the more stringent NOx emission standards, and the Proposed Amendments therefore keep OBD malfunction emission thresholds at today’s levels. However, the commenter’s logic suggesting that OBD systems must detect malfunctions that cause emissions to exceed certification standards is incorrect. OBD systems are required to illuminate malfunction indicator lights (MILs) if they detect NOx emissions exceed 0.4 g NOx/bhp-hr. The OBD emission threshold is based on current technical feasibility, not an accommodation for the HDIUT program. OBD systems can use NOx sensors to determine overall expected performance of the emission control system, but cannot illuminate a MIL unless the malfunction emission threshold is exceeded. Even in current HDIUT testing conducted by CARB, engine families have failed testing and corrective action has ensued without any of the engines tested having an OBD MIL illuminated. Accordingly, in-use testing does not require or rely upon OBD malfunction thresholds being

set at the emissions standards to flag test vehicles for exclusion. CARB staff is not initiating any changes in this regard.

The HDIUT program needs to be effective at evaluating emission compliance of an engine family as it is operated in the field under diverse driving cycles. HDIUT changes are introducing large averaging windows of 5 minutes (300 seconds) and include a conformity factor that provides a significant compliance margin above the standard. The pass/fail criteria are fair, just, and not overly punitive.

The Amendments to HDIUT for determining engine family compliance use two evaluation methods. Under the first method, if three or more engines are emitting on average above the HDIUT compliance threshold (minimum of 150 percent above the emission standard) for the same pollutant and same bin (idle, low load or medium/high bin), then the engine family being tested would fail the standard over a portion of the test cycle, requiring the manufacturer to pursue corrective action. Three engines failing for the same pollutant and emissions bin would be indicative of a systematic problem requiring quick corrective action by the manufacturer to prevent excess emissions.

In the second method, ten engines would need to be tested and the average sum-over-sum emission of those ten engines for the same bin and pollutant would be evaluated with the HDIUT compliance threshold. This second method would evaluate how an engine family, on average, is complying with the HDIUT threshold. Even if one or two of the ten engines tested caused the engine family to fail the HDIUT emissions threshold, it would be important that the manufacturer take corrective action to address why some of the engines have significant emission control failures. For example, consider nine of the engines emit in-use at or below the NO<sub>x</sub> in-use threshold level of 0.030 g/bhp-hr for the medium-/high-load bin (Bin 3) and one engine emits at an average emission rate of 1.88 g/bhp-hr, based on PEMS in-use test data<sup>94</sup>. The nine engines would pass the in-use threshold of 0.030 g/bhp-hr for Bin 3 while the one engine emitting at 1.88 g/bhp-hr would fail and emit about 7 times higher than the total of the nine engines that passed the in-use threshold. Thus, both methods to determine compliance are needed to meet California's air quality commitments and to protect impacted disadvantaged communities that have more than their fair share of trucks operating in their communities.

- (b)vi.2. Comment: Another very significant issue (discussed further below) is that CARB has failed to explain how the comprehensive HD OBD requirements will be amended to cover the new 3B-MAW standards. For example, CARB has not demonstrated that all of the OBD-related requisite standards,

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<sup>94</sup> Arvind Thiruvengadam, Marc C. Besch, Berk Demirgok, Saroj Pradhan, Filiz Kazan, Beti Selimi, Rasik Pondicherry, Allen Duffy, Jordan Leatherman, Chakradhar Reddy, Cem Baki, Jason England, Aaron Leasor, Daniel K. Carder. "In-Use Emissions and Chassis Dynamometer Emissions Rates of Heavy-Duty Diesel and Alternative Fueled Vehicles Operating in Southern California," 30th CRC Real World Emissions Workshop, Presentation, March 8-11, 2021.

sensors, software, post-processing protocols, and similar elements needed to comply with the 3B-MAW requirements will be in place by the 2024 MY. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make changes to the Proposed Amendments based on this comment. The 3B-MAW does not require any new types or new specifications for sensors used in OBD systems above and beyond the current sensors used on current technology engines. The HDIUT change that relates to the OBD system is the requirement to download OBD emissions data before, during and after the testing. The OBD data collected for HDIUT is supplemental and not a factor for determining compliance. Also, please see Agency Response to Comment A.(b)vi.1.

**(b)vii. General Comments on the Use of PEMS**

(b)vii.1. Comment: CARB has proposed other changes to the requirements associated with the HDIUT program as well. Those changes are not reasonable. The recruiting, planning and execution of in-use PEMS tests on customer-owned vehicles — tests conducted in the midst of customer operations — are complex and challenging tasks. CARB’s proposed changes will bring additional complexity and delays to the program, with little benefit. Some of the proposed changes are simply impossible to fulfill given the normal routines of setting up and executing the requirements of the program.

CARB has decided to more deeply engage in, and require CARB approvals for, numerous aspects of manufacturers’ in-use test planning. To that end, CARB has introduced a long list of newly required information over and above that which is required by EPA (see e.g., CARB’s proposed modifications to §86.1920(h)). Much of the information that CARB requests 30 days in advance of a fleet-test includes items that will be unknown until the manufacturer’s test team arrives at the fleet-customers’ location. Current practice is to select customers who have at least six units from the specified engine family, and to make the final vehicle selection based on availability once the team arrives at the customer location. PEMS testing is disruptive to a customer’s operations and the test vehicles do not belong to the engine manufacturer, so the test team must be flexible in terms of vehicle selection and scheduling. Loads are being dispatched in real-time in a dynamic environment where the trucking company is trying to minimize down-time to meet its customers’ needs. Most fleets will not know the availability of specific units 30 days out. In some cases, fleets will not know vehicle availability as little as 24 hours out. Recruiting customers for PEMS testing is already extremely difficult. CARB’s new requirements will make it nearly impossible.

More specifically, 16 of the 30 newly-designated data elements CARB would require 30 days before commencement of in-use testing are simply unknowable in that timeframe. Indeed, the only practical data elements CARB

proposes to require that could reliably be provided in advance according to CARB's schedule are the engine family designation, engine displacement, and the date on which CARB selected the engine family for testing – all data elements that CARB dictated to the manufacturer when issuing the test order in the first place. (EMA)

Agency Response: CARB staff made changes to the Proposed Amendments' HDIUT preapproval procedures based on the comment. The current structure of 40 CFR Subpart T requires engine manufacturers to test based on request from the U.S. EPA and CARB. The list of parameters required for the test plan pre-approval process are presented in the Diesel Test Procedures in section 86.1920.B.3. CARB staff understands there are elements that may not be known and can vary until they have access to the test vehicle such as expected date, expected test time, expected duration, number of shift days, test route, weather, history of OBD/MIL illuminating events, history of owner actions for OBD/MIL illumination, OBD MIL codes experienced after accepting for in-use testing, percent of operation at highway speeds, percent operation on surface streets, percent operation idling, and trailer type. CARB staff has made changes to the Omnibus Regulation in the 30-Day Notice Amendments to address these elements that are difficult to know in advance. CARB staff understands some parameters may not be known exactly at the time of the test plan submission, especially in the Test Day category items. The manufacturer may use forecasted information as necessary and indicate when a parameter is forecasted.

For reasons described in ISOR I.B.3.2 and ISOR II.C.3.1, testing over routes and conditions likely to provide zero valid data for analysis and in-use compliance has been an ongoing practice in the HDIUT program. Such practices are an advantage to the manufacturers because those useless test results on engines are an automatic pass for the manufacturer and also provide a pathway to truncate the HDIUT testing obligations to only five engines. The current HDIUT program instructs the manufacturer to seek out test engines that would likely experience engine operation conducive to generating valid NTE test data, but 17 percent of the engines tested under the manufacturer-run HDIUT program between 2016 and 2019 passed by default, indicating the spirit of the program instructions are not being implemented. Because of this behavior and the fact that CARB staff noticed that very few engine families tested have failed the HDIUT program despite EWIR rates, owner complaints, and roadside emissions measurements suggesting potential issues, CARB staff pursued doing in-house HDIUT testing. Over five years of running this program (currently being formalized in this rulemaking as the HDIUC program), CARB has completed testing 19 engine families of which 17 have been determined noncompliant with the HDIUT program. Amendments are needed to ensure manufacturers are taking the proper steps in procuring and testing engines and to prevent gaming of the HDIUT program. Thus, CARB staff oversight of the procurement and testing under the HDIUT program is needed, and this is why the Proposed Amendments

require CARB staff approvals for numerous aspects of manufacturers' in-use test planning.

- (b)vii.2. Comment: There are still other complications raised by CARB's new proposed in-use testing requirements, including the requirement to include a cold-start. Conducting PEMS tests is very different from conducting test-cell tests.

When conducting in-use testing with PEMS, each test is similar to a test-cell installation and commissioning exercise. With that tremendous complexity, plus the dependency on new controller connections for each PEMS test, it often takes a number of attempts to get all of the systems working reliably. Re-initialization of data communication is often necessary because of engine shutdowns and the reliance on engine control module data (again, not necessary in the test cell environment). Those J1939 communication initializations often cause issues during PEMS testing. What all this means is that there is a high risk, under the requirements CARB has proposed, of a test being declared invalid due to equipment malfunction during a cold-start. The consequence of that outcome is that testing would have to be rescheduled for another day, with the very real possibility that the customer would not be able to accommodate the extended request during the course of the test team's travel itinerary. That also can damage the good will that helped in recruiting the fleet customer and vehicle in the first place. CARB should eliminate the requirement that each in-use test include a cold-start in order to be counted as a valid test. (EMA)

Agency Response: CARB staff made changes to the Proposed Amendments based on this comment. CARB staff understands there could be difficulties in performing cold starts during in-use testing. CARB staff therefore added clarifying language that allow manufacturers to indicate circumstances related to weather or logistics that prevent meeting the cold-start requirements. Manufacturers would be required to include documentation as to why meeting the cold-start requirements were infeasible in their HDIUT report to CARB. CARB staff has added language indicating that CARB's Executive Officer would approve requests to waive cold-start testing if the manufacturer provides a justification and makes the request at the test plan pre-approval submission. In assessing the request, the Executive Officer would rely on information provided by the manufacturer and on the use of good engineering judgement.

- (b)vii.3. Comment: No PEMS measurement allowance is specified for in-use compliance testing. CARB and industry should work together to determine data-driven measurement allowances given the new data analysis techniques, expanded operating ranges and conditions, and lower emissions thresholds associated with the new in-use protocol. (Cummins)

Agency Response: CARB staff did not make changes to the Proposed Amendments based on this comment. As described in the Agency Response to Comment A.(b)ii.2, the 1.5 conformity factor for compliance is already being used in Europe using a similar MAW method for compliance with EURO VI In-Service Conformity testing. The 50 percent compliance margin the 1.5 conformity factor affords is greater than the PEMS measurement error. CARB staff has also increased the conformity factor to 2.0, which will provide a 100 percent compliance margin for 2024 through 2029 MY engines to reduce the manufacturers' risk of noncompliance during the transition of meeting more stringent NOx standards.

- (b)vii.4. Comment: CARB has not demonstrated – and in fact cannot demonstrate — that the PEMS that CARB would rely on to implement and enforce its 3B-MAW in-use testing program are capable of measuring and “binning” NOx emissions at the near-zero levels that CARB’s Omnibus Regulation would require. The undisputed facts are that current PEMS are not capable of measuring and sorting NOx emissions at levels as low as 0.030 g/bhp-hr, the low-NOx levels at which CARB proposes to set the medium/high range bin of the in-use 3B-MAW standards. To the contrary, the regulatory-capable NOx-detection and measurement range of current PEMS is at a level (approximately 0.20 Grams Per Kilowatt-Hour (g/kW-hr), or 0.15 g/bhp-hr) that is roughly an order of magnitude higher than the in-use NOx limits that CARB’s regulations envision. Indeed, CARB’s proposed in-use 3B-MAW low-NOx standards are close to the measurement “drift” of PEMS’ NOx-detection instruments. CARB has no data and there are no data whatsoever in the rulemaking record that contradict the well-established facts regarding the NOx-measurement capabilities of current or even future PEMS. In that regard, and most telling, CARB has not conducted any PEMS-based in-use testing of any HDOH vehicle to try to establish the feasibility of its 3B-MAW proposal. Consequently, it is clear that the PEMS-based 3B-MAW in-use testing protocols and standards that CARB is proposing are infeasible and unenforceable, as detailed further below. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make changes to the Proposed Amendments based on this comment. The PEMS accuracy margin was developed with PEMS technology nearly two decades ago. The technology in PEMS has made huge strides in stability that decreases the uncertainty (drift) of PEMS measurements. CARB staff already has a PEMS equipped with a more sensitive NOx detector capable of measuring emissions at Low NOx levels that was obtained from a major PEMS industry manufacturer. The constraints of the Low NOx emissions standards place practical limits on maximum concentrations allowable while still being able to remain in overall compliance. This practical concentration ceiling allows a PEMS measuring Low NOx calibrated engines to focus on a narrower and lower concentration range than was required for the pre-NOx aftertreatment engines driving the initial PEMS designs which can act to ease certain measurement challenges. CARB staff has developed environmental

and vibrational protection chambers to greatly reduce the impacts to the stability of PEMS system. Similar drift mitigation strategies to minimize temperature deviation around the PEMS, eliminate solar heating loads, and shield the PEMS from vibration have also been adopted in manufacturer field campaigns, including mounting PEMS units in the climate-controlled environment of the passenger space and using auxiliary cushioning between the PEMS and the vehicle. The additional new 3B-MAW test methods using CO2 emissions measurements for load/work calculations instead of engine broadcast load estimates dramatically increases the accuracy of the calculations at lower engine loads. This is due to using more accurate CO2 analyzers or fuel injection quantity to directly measure the denominator metric and not relying on inaccurate engine broadcast load estimates when engine load is less than 20 percent.

The commenter's statement that "current PEMS are not capable of measuring and sorting NOx emissions at levels as low as 0.030 g/bhp-hr, the low-NOx levels at which CARB proposes to set the medium/high range bin of the in-use 3B-MAW standards" is not true. On the contrary, a PEMS manufacturer testified at the August 27<sup>th</sup>, 2020 Board Hearing that their laboratory equipment is capable today of measuring 0.02 g/bhp-hr NOx engines and that as they have for each previous emissions standard they "continue to innovate our PEMS products with the goal of ultimately demonstrating real-world engine emissions compliance at these proposed low NOx levels."

[\[https://ww3.arb.ca.gov/board/mt/2020/mt082720.pdf\]](https://ww3.arb.ca.gov/board/mt/2020/mt082720.pdf), see page 285 et seq]

As described in the Agency Response to Comments A.(b)ii.2 and A.(b)vii.3, the conformity factor includes and exceeds the margin needed for PEMS instrument uncertainty. The 3B-MAW method was developed based on Euro VI in-use testing methods and has been used for many years (please see Agency Response to Comment A.(b)i.7). In the development of the 3B-MAW method, the U.S. EPA, EMA and EMA member technical staff were provided many opportunities to discuss and critique the method and provide input during SwRI's technical workgroup meetings. Also, please see Agency Response to Comments A.(b)i.1 and A.(b)i.2. on other testing done using the 3B-MAW method on the Low NOx Stage 3 engine.

- (b)vii.5. Comment: [T]here is no justification (or even rationale) for CARB's proposal to eliminate the current in-use NOx measurement allowance. PEMS simply cannot measure what CARB would require them to measure without including the necessary measurement allowance. It makes no sense, therefore, for CARB to eliminate an in-use measurement allowance for NOx when the need for that allowance is far greater at the low-NOx in-use levels that CARB is proposing. The available data completely refute CARB's unfounded position. Moreover, the UC-Riverside paper also points out that the measurement "drift" that is permitted under the relevant federal and CARB specifications for emissions-measurement equipment (see 40 CFR 1065.550) would equate to a 0.0008 g/bhp-hr drift limit at the low NOx levels that CARB is targeting, a

drift limit that would be difficult even for laboratory grade instruments to meet, let alone PEMS, which as noted above, have drift levels that are roughly equivalent to the proposed 0.030 g/bhp-hr in-use standard. While there may be some limited avenues for marginally improving the accuracy of NOx measurements with PEMS, they all involve drawbacks and concessions. Any small accuracy improvements would still be compromised by all of the confounding real-world practical issues associated with in-use testing, such as time alignment, fuel and exhaust-flow estimates, the influences of the high ambient temperatures and high humidity conditions common in the California climate, as well as condensation impacts and even system-freezing during the occasional tests run at ambient temperatures as low as -7 Degrees Celsius (°C). (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff made changes to the Proposed Amendments based on this comment. As described in the Agency Response to Comments A.(b)ii.2 through A.(b)ii.6, the 1.5 conformity factor for compliance is currently used in Europe for compliance with EURO VI In-Service Conformity testing using the MAW method. The 50 percent compliance margin is greater than the 39 percent instrument measurement error estimated by CARB staff. CARB staff based the estimation on the RMS error analysis.<sup>95</sup> The NOx emissions uncertainty is a combination of the combined RMS uncertainty of the measurements required to calculate the brake specific emissions for NOx: CO2 analyzer, exhaust flow meter accuracy, and NOx analyzer. The accuracy of each of the elements in the RMS analysis assumed to be 10 percent. The combined RMS accuracy was estimated to be 17 percent. Time alignment and final drift uncertainty were added to the combined RMS accuracy at 3 percent and 19 percent respectively. The final uncertainty of the NOx emissions was estimated to be 39 percent. The total uncertainty is less than the conformity factor. Thus, the need for an additive PEMS accuracy margin is unnecessary. However, to provide manufacturers more compliance flexibility during the introduction of more stringent NOx standards, CARB staff has proposed to increase the HDIUT conformity factor from 1.5 to 2 for the 2024 through 2029 MY engines. This will provide manufacturers with a significant compliance margin of 100 percent of the certification emission standards.

As described in the Agency Response to Comments A.(b)viii.1 through (b)viii.6, in the development of the PEMS accuracy margin in 2009, the study identified three of the largest factors contributing to error, accuracy of PEMS analyzer compared to the laboratory equipment, environmental effects causing errors, and PEMS interfacing with engines.<sup>96</sup> These issues have been addressed in the past

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<sup>95</sup> Gieschaskiel, Barouch, M. Clairotte, V. Valverde-Morales, P. Bonnel, Z. Kregar, V. Franco, Pa. Dilara, "Framework for the assessment of PEMS (Portable Measurement Systems) uncertainty." Environmental Research, Vol. 166, 2018, Pages 251-260, ISSN 0013-9351, <https://doi.org/10.1016/j.envres.2018.06.012>

<sup>96</sup> Sharp, C., Feist, M., Laroo, C., and Spears, M. "Determination of PEMS Measurement Allowances for Gaseous Emissions Regulated Under the Heavy-Duty In-Use Testing Program Part 3-Results and Validation," SAE Int. J. Fuels Lubr. 2(1):407-421, 2009, <https://doi.org/10.4271/2009-01-0938>.

decade since the study. In the past decade the analyzers accuracy compared to laboratory analyzers have increased dramatically. Environmental enclosures, climate control enclosures, and vibrational dampeners have been implemented to decrease variability from the environment. The 3B-MAW method has improved its accuracy by decoupling from the engine control unit (ECU) broadcast engine load and instead using independent from the ECU CO<sub>2</sub> measurements by the PEMS. The 3B-MAW data workup procedure is assembled from 300 second windows and then summed across all valid windows of a given CO<sub>2</sub>-based load bin. The 3B-MAW method's extensive averaging of windows reduces the compliance determination susceptibility to certain forms of measurement noise compared to the NTE's much shorter (down to 30 second) windows that are digitally counted for pass/fail fraction, not averaged together. For all of these reasons as well as the error analysis described earlier, CARB staff disagrees with the commenter and believes the removal of the PEMS accuracy margin associated with the NTE method is justified.

As described in the Agency Response to Comment A.(b)xii.1, the ability to run tests to -7°C is currently in practice in Europe, feasible, and an important component to ozone and PM emission control. The CARB and manufacturer testing practices of stabilizing the ambient temperature around the PEMS for drift stability are the same actions one would take to prevent freezing or overheating on low or high temperature test days. This concern appears resolvable with good testing practice and not a preclusion of testing under these conditions.

CARB staff do not find the commenter's assertion of confounding effects compelling as these effects are equally operative today and must be handled to avoid a proportionally large effect on testing of current engines, thus unrelated to tightening the emissions standard or typical tailpipe concentration.

- (b)vii.6. Comment: [T]he PEMS market is an extremely limited one, with PEMS manufacturers only able to make a business case for selling a single model to satisfy the emissions-measurement requirements associated with all relevant business sectors. Creating a unique PEMS model with slightly improved low-level NO<sub>x</sub> measurement accuracy (likely at the expense of accuracy when recording NO<sub>x</sub> emission "breakthroughs"), to be sold only to those few engine manufacturers that might elect to run the risks of staying in the California HD truck market, would not present a compelling business case to PEMS manufacturers. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff made changes to the Proposed Amendments based on this comment. Low NO<sub>x</sub> PEMS units have been contracted for CARB staff for the HDIUC program. Minor changes are necessary to focus in on the accuracy to the lower NO<sub>x</sub> ppm values. CARB staff agrees focusing on lower emission concentrations decreases the dynamic range of the gas analyzer.

Based on this comment, in the 30-Day changes, CARB staff provided provisions for emissions above the instrument range in the Diesel Test Procedures in 1065.935.B.1.1. If emissions exceed the range of the instrument, a value twice the maximum of the range will be used for the data analysis.

Technology currently exists to measure Low NOx emissions with PEMS. Costs were estimated for calculations of emissions data for the 3B-MAW method. CARB staff analyzed the macroeconomic impacts of the total Regulation are estimated to have a negligible impact on the industry.

Contrary to the commenter's speculation on potential business strategies of instrument suppliers, a PEMS manufacturer testified at the August 27<sup>th</sup>, 2020 Board Hearing that their laboratory equipment is capable today of measuring 0.02 g/bhp-hr NOx engines and that as they have for each previous emissions standard they "continue to innovate our PEMS products with the goal of ultimately demonstrating real-world engine emissions compliance at these proposed low NOx levels."<sup>97</sup> The PEMS manufacturer testimony shows clear intent to engage this market, contrary to the commenter's speculation.

CARB staff disagrees with the commenter's speculation that the market for 0.02 g/bhp-hr capable PEMS will be so narrow as to preclude participation by instrument makers. CARB staff notes two engine manufacturers are on public record four years ahead of time with their plans to bring 2024 MY compliant engines to California, with others remaining in an undeclared public stance. CARB staff also notes that 14 states and the District of Columbia joined California in the Multi-State Medium and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding which mentions their need of Low NOx engines,<sup>98</sup> and several states are in the process of adopting CARB HD programs via the CAA section 177 process. States having held public meetings or being bound by their law to adopt CARB standards when they appear already include New Jersey,<sup>99</sup> New York,<sup>100</sup> Oregon,<sup>101</sup> Washington,<sup>102</sup> and Massachusetts<sup>103</sup> with others earlier in their respective processes. U.S. EPA has been cooperatively collaborating with CARB on the SwRI Low NOx demonstrations and other technical work jointly underpinning these standards and their own HD engine standards in development. Taken together the above observations are consistent with an expectation of both Low NOx engines and the market call for instrumentation to measure them.

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<sup>97</sup> Board Hearing Transcript. <https://ww3.arb.ca.gov/board/mt/2020/mt082720.pdf> page 285 et seq.

<sup>98</sup> Multi-State Medium- and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding. (<https://www.nescaum.org/documents/multistate-truck-zev-governors-mou-20200714.pdf> - accessed 7/28/2021).

<sup>99</sup> <https://www.nj.gov/dep/workgroups/docs/njpact-air-co2-20200910-low-nox.pdf>

<sup>100</sup> [https://www.dec.ny.gov/docs/air\\_pdf/hdvwebinar021721.pdf](https://www.dec.ny.gov/docs/air_pdf/hdvwebinar021721.pdf)

<sup>101</sup> [https://www.oregon.gov/deq/EQCdocs/05202021\\_ItemD\\_CleanTrucks.pdf](https://www.oregon.gov/deq/EQCdocs/05202021_ItemD_CleanTrucks.pdf)

<sup>102</sup> <https://ecology.wa.gov/Air-Climate/Climate-change/Greenhouse-gases/Reducing-greenhouse-gases/ZEV>

<sup>103</sup> <https://www.mass.gov/doc/presentation-from-april-2021-stakeholder-meetings-mhd-vehicles/download>

(b)vii.7. Comment: CARB's notion that the in-use measurement accuracy margin can simply be brushed aside is not based on any data or evidence, and runs counter to longstanding scientific research, understanding and practice. As a result, the current additive PEMS NO<sub>x</sub>-measurement adjustment factor (0.15 g/bhp-hr) must be retained, as should the measurement allowances for the other emissions constituents as well. Once that necessary concession to the realities of in-use PEMS-based testing is made, it becomes clear that CARB's proposal, in effect to set the in-use NO<sub>x</sub> standards significantly below the measurement capabilities of current PEMS (and five times lower than the current NO<sub>x</sub> measurement allowance), is fundamentally infeasible. Promulgating emissions standards that are far below the limits of detection for state-of-the-art emissions measurement equipment is neither workable nor reasonable. CARB's 3B-MAW proposal is therefore fundamentally unsound and invalid on this basis as well. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make changes to the Proposed Amendments based on this comment. As described in the Agency Response to Comments A.(b)ii.2 through A.(b)ii.6, the 1.5 conformity factor for compliance is currently used in Europe for compliance with EURO VI In-Service Conformity testing using the MAW method. The 50 percent compliance margin is greater than the 39 percent instrument measurement error estimated by CARB staff. CARB staff based the estimation on the RMS error analysis.<sup>104</sup> NO<sub>x</sub> emissions uncertainty is a combination of the combined RMS uncertainty of the measurements required to calculate the brake specific emissions for NO<sub>x</sub>: CO<sub>2</sub> analyzer, exhaust flow meter accuracy, and NO<sub>x</sub> analyzer. The accuracy of each the elements in the RMS analysis assumed to be 10 percent. The combined RMS accuracy was estimated to be 17 percent. Time alignment and final drift uncertainty were added to the combined RMS accuracy at 3 percent and 19 percent respectively. The final uncertainty of the NO<sub>x</sub> emissions was estimated to be 39 percent. The total uncertainty is less than the conformity factor. Thus, the need for an additive PEMS accuracy margin is unnecessary.

As described in the Agency Response to Comments A.(b)viii.1 through (b)viii.6, in the development of the PEMS accuracy margin in 2009, the study identified three of the largest factors contributing to error, accuracy of PEMS analyzer compared to the laboratory equipment, environmental effects causing errors, and PEMS interfacing with engines.<sup>105</sup> These issues have been addressed in the past decade since the study. In the past decade, the analyzers accuracy compared to laboratory analyzers have increased dramatically. Environmental enclosures,

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<sup>104</sup> Gieschaskiel Barouch, M. Clairotte, V. Valverde-Morales, P. Bonnel, Z. Kregar, V. Franco, Pa. Dilaraet. "Framework for the assessment of PEMS (Portable Measurement Systems) uncertainty." Environmental Research. Vol. 166, 2018, Pages 251-260, ISSN 0013-9351, <https://doi.org/10.1016/j.envres.2018.06.012>

<sup>105</sup> Sharp, C., Feist, M., Laroo, C., and Spears, M., "Determination of PEMS Measurement Allowances for Gaseous Emissions Regulated Under the Heavy-Duty Diesel Engine In-Use Testing Program Part 3 – Results and Validation," SAE Int. J. Fuels Lubr. 2(1):407-421, 2009, <https://doi.org/10.4271/2009-01-0938>.

climate control enclosures, and vibrational dampeners have been implemented to decrease variability from the environment. The 3B-MAW method has improved its accuracy by decoupling from the ECU broadcast engine load to independent CO<sub>2</sub> measurements by the PEMS. The 3B-MAW also has shift day long averaging of all valid windows in each load bin, which reduces compliance determination susceptibility to certain types of measurement noise compared to the short (down to 30 seconds) NTE window pass/fail determinations. All of these reasons, as well as the error analysis described earlier, support the Proposed Amendments' removal of the PEMS accuracy margin associated with the NTE method.

- (b)vii.8. Comment: [I]n addition to the inability of currently available PEMS to accurately measure NO<sub>x</sub> at the levels of CARB's proposed stringent in-use standards. CARB is requiring that when conducting in-use testing, if the PEMS fails to meet the allowable "range" criteria in §1065.550 for 5% or more of the test intervals, the test engine would be deemed noncompliant unless compliance is nonetheless demonstrated. The problem with such a provision is that emission levels can be high during the period following a cold-start, likely in excess of the levels to which one would otherwise set the range of the PEMS (with an appropriate concentration calibration gas.) To avoid emissions measurements that exceed the range of the calibration gas, the PEMS would have to be calibrated to a higher range than might be sensible for enhancing accuracy at the very low NO<sub>x</sub> levels required under the Low-NO<sub>x</sub> Regulations, especially for emissions sorted into in the medium/high normalized CO<sub>2</sub> bin. That is exactly the type of unresolved in-use testing issue that can only be understood and addressed through the execution of a carefully controlled PEMS measurement-accuracy program, a program that is clearly needed to assess in a reasonable manner the feasibility of CARB's very strict proposed in-use standards. Without that PEMS evaluation program, CARB simply cannot demonstrate the feasibility of its 3B-MAW proposal. (EMA)

Agency Response: CARB staff did not make changes based on this comment. The emissions concentrations expected to be measured for NO<sub>x</sub> engines are approximately 5 ppm, and this range is technically feasible for PEMS. Even during cold-start, the tailpipe emission concentrations cannot in practice be arbitrarily high and still average out to a compliant result. The Low NO<sub>x</sub> standards effectively place a maximum concentration inversely related to the length of time before efficient emissions control is achieved. The breakthrough emissions that exceed the instrument range after emissions controls are active are indicative of gross pollution and noncompliance when the sum-over-sum emissions of the test exceed the in-use thresholds. The exact value of the emissions event is unnecessary as the excess emissions were already detected and twice the instrument range is substituted for the value as described in section 1065.935.B.1.1. The feasibility of PEMS at low ranges is possible, and

hence CARB staff believes it is unnecessary to dramatically increase the analyzer range.

Overall, with the new 3B-MAW measurement method, the use of a large conformity factor compliance margin and with the provisions for instrument range, CARB staff does not agree that a PEMS evaluation program is necessary. Instead, CARB staff believes it is already clear that the 3B-MAW method is feasible for determining in-use compliance.

**(b)viii. Use of PEMS Adjustment Factor and Conformity Factor**

- (b)viii.1. Comment: CARB has proposed to eliminate any PEMS measurement accuracy adjustment factor for any in-use emissions-compliance testing conducted on MY 2024 and later HDOH engines under the new proposed 3B-MAW protocol. In particular, CARB proposes to eliminate the current in-use measurement allowance for NO<sub>x</sub>, which is 0.15 g/bhp-hr. However, CARB has presented no study or evidence whatsoever demonstrating that the PEMS that will be used to conduct the 3B-MAW-based in-use testing no longer require a measurement allowance to account for the relative accuracy and variability of emissions measurements made with PEMS, as compared with emissions-certification tests conducted in emissions testing laboratories. Similarly, CARB has not produced any data supporting its seemingly arbitrary position that the very same measurement accuracy adjustment factors that CARB's current regulations apply during an NTE-based in-use compliance test, using PEMS, are somehow no longer necessary under the new 3B-MAW-based protocols for in-use emissions-compliance assessment, using PEMS. (EMA)
- (b)viii.2. Comment: CARB simply asserts that the corollary EU Regulations do not directly apply a measurement accuracy adjustment factor in the EU's MAW-based "In-Service Conformity" requirements. That argument is neither germane nor persuasive. (EMA)
- (b)viii.3. Comment: The current PEMS measurement-accuracy adjustment factor was determined in 2008 through an extensive series of tightly controlled laboratory and in-vehicle tests designed specifically for the assessment of PEMS measurement accuracy and variability. There have been no significant technological breakthroughs in PEMS equipment design or capabilities in the intervening years that would materially improve their emissions-measurement accuracy, including for NO<sub>x</sub>. (EMA)
- (b)viii.4. Comment: Continuous, accurate and reliable measurements of NO<sub>x</sub> emission at very low concentrations is a very difficult undertaking. Cao et al. (2016) showed that the measurement error of PEMS equipment increases sharply below 0.1 g/kW-hr (or 0.074 g/bhp-hr) from 15% to about 50% at 0.03 g/kW-hr (or 0.022 g/bhp-hr). It is acknowledged that a conformity factor is

introduced to account for the measurement uncertainties. However, variability in measured results related to real driving emissions route, operating conditions of the vehicle, and evaluation of the data still exists with the current equipment. Without additional supporting data on the accuracy of equipment, the conformity factor of 1.5 suggested in the proposed Amendment cannot be justified. Recommendation: Given the significant uncertainty in the measurement accuracy with the current PEMS equipment at very low NOx emissions, CARB should set a conformity factor higher than 1.5, until the PEMS accuracy is improved and confirmed. (WSPA)

- (b)viii.5. Comment: CARB’s proposed implementation of the 3B-MAW approach also includes the arbitrary establishment of an in-use multiplicative conformity factor of 1.5 that links each of the three bins to a unique test-cell standard. CARB has made no demonstration whatsoever that the uniform 1.5 conformity factor was derived from any analysis of the three separate bins of NOx data, or is based on any justifiable assessment of technical feasibility. CARB similarly has made no effort to evaluate the conformity factor and resultant in-use emissions standards against the capabilities of the proposed prototype engines and aftertreatment systems. Nor has CARB evaluated whether an additive rather than a multiplicative approach would be more appropriate. In that regard, and as discussed further below, the in-use conformity factor also needs to be assessed against the limits of detection of the instruments that will be used to assess in-use compliance. (EMA)
- (b)viii.6. Comment: CARB proposes to set the “In-Use Threshold” at “the value of the [dyno test-cycle based] emission standards multiplied by a conformity factor of 1.5 for each of the respective in-use bins: idle, low load, and medium/high load.” As just explained, that definition needs to be consistent with the definition applied today concerning NTE testing, which means it needs to include today’s allowed measurement accuracy margin. (EMA)

Agency Response to Comments (b)viii.1 through (b)viii.6: Based on these comments, CARB staff made revisions to the Proposed Amendments, as discussed further below.

Under the current HDIUT program, there is a conformity factor of 1.5 and an additional accuracy margin of 0.15 g/bhp-hr for NOx. CARB staff proposes to eliminate the PEMS accuracy margin as part of the Proposed Amendments to the HDIUT program. The current HDIUT program utilizes the NTE method to determine in-use compliance, and this method allows for the determination on non-compliance on as little as 30 seconds of emissions data. Such an evaluation requires accurate measurements of emissions, exhaust flow and other parameters used in determining emissions compliance on such a short time window. During the early development of the HDIUT program over a decade ago, it was determined that an additional accuracy margin was needed because

PEMS were new, and it was agreed by U.S. EPA and CARB that an additional compliance margin was warranted to prevent false failures of an engine family.

In the development of revisions to the HDIUT program under the Omnibus Regulation, CARB staff evaluated the NTE method and compared it with an in-use program utilizing the MAW method developed for Europe's EURO VI In-Service Conformity testing. A comparison of these two methods is discussed in Table II-1 on page II-13 of the ISOR and demonstrates why CARB staff decided to use a similar MAW method for HDIUT testing under the Proposed Amendments. CARB staff consulted with EU technical staff who developed the MAW method to better understand this method and the compliance margin needed to account for PEMS measurement uncertainty. In 2011, the conformity factor for the EURO VI MAW method was determined from empirical testing. It was observed most engine's emissions performed within 1.5 conformity factor.<sup>106</sup> More recently, an uncertainty analysis study for determining PEMS measurement uncertainty for the EU regulation was published.<sup>107</sup> Using the RMS method used in this study for the In Service Conformity program, the combined RMS uncertainty in the measurement of NOx analyzer (10 percent), CO2 analyzer (10 percent), and exhaust flow meter (10 percent) was calculated to a combined 17.32 percent uncertainty. Also included was the estimated uncertainty from time alignment (3 percent) and analyzer drift (18.8 percent). The combined uncertainty for all the PEMS measurement parameters used to determine compliance was 39.12 percent. It should be noted that this uncertainty on the PEMS system is based on the PEMS used during the study and does not account for any improvements implemented since that time. Based on their uncertainty analysis, the EURO VI In-Service Conformity program implemented a 1.5 conformity factor for compliance that more than covers the less than 40 percent uncertainty of using PEMS, providing an additional 10 percent compliance margin.

CARB staff utilized a similar MAW approach used by the EURO VI In-Service Conformity program. However, instead of basing the windows on a unit of work, CARB staff in consultation with SwRI and workgroup members established the window on five minutes of engine operation (300 seconds) that go into the shift-long averages in each bin that are compared to the standard. Because the MAW method uses a significant fraction of the shift day engine operation for each bin (>2400 sec) as compared to the NTE method which assesses as little as 30 seconds, the accuracy of PEMS parameters used to calculate compliance are better suited for MAW than for the NTE method. Longer averaging times reduces

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<sup>106</sup> Bonnel P, Kubelt J, Provenza A. "Heavy-Duty Engines Conformity Testing Based on PEMS - Lessons Learned from the European Pilot Program," EUR 24921 EN. Luxembourg (Luxembourg): Publications Office of the European Union; 2011. JRC66031

<https://publications.jrc.ec.europa.eu/repository/handle/JRC66031>

<sup>107</sup> [Giechaskiel, Barouch, M. Clairotte, V. Valverde-Morales, P. Bonnel, Z. Kregar, V. Franco, P. Dilara,](https://doi.org/10.1016/j.envres.2018.06.012) Framework for the assessment of PEMS (Portable Emissions Measurement Systems) uncertainty." Environmental Research, Vol. 166, 2018, Pages 251-260, ISSN 0013-9351, <https://doi.org/10.1016/j.envres.2018.06.012>

the concerns with instrument measurement variability. Therefore, the MAW method does not require an additional accuracy margin above the provided conformity factor (see also Agency Response to Comments A.(b)viii.1. through A.(b)viii.6.). Thus, CARB staff disagrees with the commenter the in-use compliance program developed in Europe using a similar MAW approach is not germane or persuasive.

The commenter's statement that PEMS have not significantly improved since 2008 is not accurate. During the development of the HDIUT accuracy measurement program, there were few commercialized PEMS. At that time, the hardware to limit vibration, control environmental conditions, such as temperature, humidity, which have a material impact on the accuracy margin, were relatively crude. Since then, many improvements have been made to improve measurement accuracy and minimize the impact of environmental conditions. For example, CARB current PEMS procurement require precise control of temperature and humidity that the analyzer experiences during field testing when PEMS operate in the open environment. During the development of the accuracy margin, these two variables contributed significantly to the numeric value of the accuracy margin.

However, in response to this and similar comments, CARB staff has increased the conformity factor from 1.5 to 2 times the emission standard for the 2024 through 2029 MY to provide additional compliance margin as engine manufacturers introduce new technology engines meeting more stringent standards. This change provides a significant margin of 100 percent above the emission standards. Beginning with the 2030 MY, the conformity factor would be adjusted back to 1.5 that provides a 50 percent margin that includes both the variability of PEMS measurement and a compliance margin. In 2030, manufacturers would have three MYs of experience meeting the 0.020 g/bhp-hr NOx standard. In addition, it is likely that PEMS manufacturers will implement further improvements to their systems to reduce measurement variability further.

With regards to the commenter's comment that there has been no demonstration of the 3B-MAW method proposed by CARB, please see Agency Response to Comments A.(b)i.1, A.(b)i.2, and A.(b)x.5

#### **(b)ix. Otto-Cycle Engine In-Use Test Methodology**

- (b)ix.1. Comment: The proposed single bin 300 second moving average window (1B-MAW) for Otto-Cycle engines (86.1370 B-2 1.1) has not been supported by the same level of data and technical rigor as the 3B-MAW for Diesel engines. The workshops leading up to the proposed regulation included no substantial discussion of technical feasibility or unique considerations needed in order to apply the MAW methodology to Otto-Cycle engines at the 2024 MY or 2027 MY standard levels. As an example, Ford is concerned that high load component protection enrichment actions unique to spark ignition products

were not considered or evaluated when defining the 1B-MAW test procedures or setting the compliance limits. Ford requests that CARB reevaluate the 1B-MAW window methodology for Otto-Cycle engines. Ford recommends that CARB either revise the measurement “guard rails” and compliance limits to account for unique Otto-Cycle engine operating requirements or that CARB postpone the application of the MAW methodology until 2027 MY to allow for a more comprehensive evaluation of unique Otto Cycle engine operating characteristics. (Ford)

- (b)ix.2. Comment: Most of EMA’s comments to this point have been directed at CARB’s insufficient demonstration of the feasibility of the Low-NOx Regulations as applied to HDOH diesel engines. As part of the Low NOx Regulations, however, CARB also is proposing to set the same aggressive standards for Otto-cycle engines. Natural gas (NG) engines certified to NOx levels as low as 0.02 g/bhp-hr have been on the market for some years. The early phases of the SwRI research program included an FTP-based demonstration of NG-fueled HD engines. There has not, however, been any demonstration of those engines’ capability to conform to CARB’s new 3B-MAW in-use protocol and standards. And, more importantly, CARB has not made any feasibility demonstration whatsoever with respect to HDOH gasoline-fueled engines. CARB should take the time to perform a proper feasibility assessment for gasoline and NG-fueled engines prior to seeking approval of any new Omnibus Regulations. (EMA)
- (b)ix.3. Comment: Of importance, CARB staff focused their efforts solely on diesel engines for the in-use moving average window demonstration program, and did not provide consideration for test methodologies and procedures that are unique to gasoline engines.

[W]e request that CARB staff consider revisions to the data acceptance criteria described in the test procedures. As an example, CARB has excluded cold start operation until 2027 MY and has a minimum average power threshold. Criteria such as these were considered primarily for diesel engine technology without similar consideration for unique gasoline challenges.

There are inherent combustion differences between gasoline and diesel engines that must be, but were not, accounted for in CARB’s proposed in-use requirements. While gasoline engines easily maintain minimum aftertreatment temperatures for good conversion efficiency during low load operation, they must avoid damaging aftertreatment and engine componentry under aggressive and/or sustained high load operation. High temperature resistant components and materials have been implemented in modern gasoline HD engines to reduce this concern. However, there is still a need to utilize fuel enrichment under aggressive and/or sustained high load operation to protect engine and aftertreatment components.

We recommend that CARB and EPA work with industry to study and assess new HD gasoline in-use requirements. The EPA is currently undertaking a focused effort through a gasoline demonstration program as part of their HD Low NOx CTI regulatory development targeting a 2027 MY implementation. A coordinated effort could align with CARB's Phase 2 (2027 MY) step when in-use cold starts are included. Until necessary research is complete, the AAPC recommends CARB exclude these component protection events from the in-use moving average window test procedure. (AAPC)

Agency Response to Comments (b)ix.1 through (b)ix.3: Based on these comments, CARB staff made revisions to the Proposed Amendments, as discussed in the paragraphs below. The MAW method for heavy-duty Otto-cycle (HDO) engines was developed to be analyzed with the FTP standards. HDO engines are not subject to the idle, LLC and RMC standards because HDO engines do not have the same emissions control problems associated with HD diesel engines. As mentioned in Comment A.(b)ix.3, "gasoline engines easily maintain minimum aftertreatment temperatures for good conversion efficiency during low load operation." Thus, separate binning and certification cycles are unnecessary for HDO at idle or at lower loads, unlike their diesel counterparts. As the commenter pointed out in Comment A.(b)ix.2, SwRI under the Stage 1 Low NOx demonstration project was able to demonstrate compliance with the 0.020 g/bhp-hr- NOx emission levels with small minor modification of the catalyst system and with improved air/fuel calibration control (please see Agency Response to Comment A.(a)i.2).

However, in the 30-Day changes, CARB staff did propose amendments to the HDIUC testing of HDO engines to account for current challenges with sustained high engine loads. In order to deal with possible enrichment events during HDIUC testing, the Proposed Amendments would allow the manufacturers to exclude up to 5 percent of the data from the total test time with the highest emission levels if enrichment was activated during that time for 2024 through 2026 MY HDO engines. This exclusion would remove the highest emitting events of concern from the MAW evaluation process. Manufacturers would therefore have an extra 3 years to become more familiar with the MAW method and further refine future engines to account for sustained high engine loads in their designs. The more stringent requirements would begin with 2027 and subsequent MY engines.

U.S. EPA is also investigating enrichment for HDO engines for the CTI rulemaking. CARB staff is monitoring those changes and, if U.S. EPA adopts HDO requirements differing from CARB's, CARB staff will consider proposing alignment with their 2027 requirements as part of an upcoming rulemaking.

#### **(b)x. In-Use Emission Data Collection**

- (b)x.1. Comment: CARB’s NOx-binning approach will result in individual seconds of data appearing multiple times in each of the 3 bins. (EMA, Daimler, Navistar, Volvo)
- (b)x.2. Comment: CARB’s methodology will result in a sorting, in effect a “smearing,” of the same emission data points across all of the proposed bins. (EMA, Daimler, Navistar, Volvo)
- (b)x.3. Comment: CARB’s approach will disproportionately weight certain emission results over others (i.e., some data points will be included up to 300 times, while other points will not). (EMA, Daimler, Navistar, Volvo)
- (b)x.4. Comment: There is no discernable correlation among the data points that end up being binned together under CARB’s proposal – the data variability and spread do not yield any consistent trends or significant differences among the 3 bins of data, and so reveal no objective justification for the selected bin boundaries. (EMA, Daimler, Navistar, Volvo)
- (b)x.5. Comment: CARB’s proposed binning method results in randomly-binned data, and so is not suitable as a basis for separately regulating those randomly-binned data. (EMA, Daimler, Navistar, Volvo)
- (b)x.6. Comment: Another very important consequence of the overlapping window approach is that while some measured datapoints will be included in the data set of a particular bin up to 300 times, other points will be included only once, and other data points anywhere in between. That has the effect of variably weighting individual datapoints in the dataset as a whole, and especially within a given bin. The fact that some datapoints can have up to 300 times greater influence on the averaged bin emissions is fundamentally incongruous with a reasonable compliance assessment, especially since that varying weighting is driven solely by chance. (EMA)
- (b)x.7. Comment: By moving the proposed 300-second windows forward on a second-by-second basis, each measured one-second data point is included in up to 300 windows. Those windows are then sorted into one of the three bins. That means that single one-second data points end up being sorted as many as 300 times into some varying combination of the three bins. Consequently, under CARB’s approach, much of the in-use data, in effect, ends up being randomly sorted and “smeared” across two or even all three of the proposed bins. One consequence of that smearing of results is that the binned data will have limited, if any, correlation to any emissions standard that might applied to the “separate” bins, which undermines the reasonableness of applying separate regulatory standards to the arbitrarily-binned emissions data. (EMA)

Agency Response to Comments (b)x.1 through (b)x.7: CARB staff did not make any changes to the Proposed Amendments based on these comments.

As described in Agency Response to Comments A.(b)viii.1 through A.(b)viii.6 the use of a MAW method is not new and has been used for many years for in-use compliance in Europe. CARB staff disagrees with the characterization of the method as “arbitrarily-binned.” On the contrary, the use of MAW groups a set of consecutive engine and emissions data that evaluates how the emission control system maintains emission control under various transient operations. This is important for make sure manufacturers are controlling emissions on vehicles in the field and not just on certification test cycles. The 3B-MAW method allows differing compliance stringencies based on the area of operation within each bin. For example, the idle and low load bin compliance thresholds are much higher than the medium/high load bin threshold because it becomes more difficult to control thermal management at lower engine loads, and thus in the lower load bins (also see Agency Response to Comment A.(b)x.16).

The comments that some of the 1 Hz data could show up in multiple bins (“smearing data”) or weighted differently are not an issue because it is the operational characteristics of 300 seconds of data that determine the bin and not the 1 Hz event as it works its way through 300 windows. The work done over the window of operation dictates which bin it should be associated with and so the 1 Hz data contributes but does not drive the bin determination. During test events like at the end of a test or during an engine shutdown event that lasts longer than 600 seconds, the 1 Hz data that is introduced into windows toward the end of valid windowing events will not have the opportunity to be part of 300 windows. This limitation is not problematic as suggested by the commenter but instead is just an artifact of the MAW method. Whether 1 Hz data shows up in 300 windows or 1 window, it is the window that compliance is evaluated on based on the work generated over that window and the corresponding bin to evaluate compliance with the bin emission threshold.

Thus, CARB staff disagrees with the comments referring to the MAW as “smearing” the data. As described previously, the MAW method provides data processing and smooth transition of operation using the windowing method of highly variable and noisy 1 Hz data. If it was the case that each 1 Hz of data should stand alone and be binned based on engine power at that second, the randomness of binning emissions from one second to the next would be much more than the 3B-MAW method and would result in a higher likelihood of higher emissions in some of the bins for vehicles that have a lot of transient operation. Instead, 3B-MAW has the ability to provide smooth emission control transition and provides a rational, workable method that allows for similar operation to be binned together and averaged with other windows.

- (b)x.8. Comment: Despite EMA’s best efforts to find a workable NOx-binning protocol, it is clear that using normalized CO2-rate parameters alone (as CARB proposes) is not sufficient to yield a protocol for binning reasonably

correlated in-use NOx data in a manner that is suitable for applying separate regulatory in-use emission limits. (EMA)

- (b)x.9. Comment: Use of the FTP CO2 Family Certification Limit in the MAW in-use binning and emissions calculations as a surrogate for power leads to inaccuracies. More work is needed to determine a more accurate method. (Cummins)

Agency Response to Comments (b)x.8 and (b)x.9: CARB staff did not make changes to the Proposed Amendments based on these comments. The current HDIUT NTE method currently relies on engine broadcast torque information that is very inaccurate at lower engine loads. In SwRI's Low NOx Demonstration Stage 2 report, the torque error distribution versus percent of maximum torque is tabulated. The ECU reported torque (or broadcast torque) error is approximately 32 percent at engine loads of less than 20 percent engine maximum torque for the 50<sup>th</sup> percentile of measurements. The table notes the error of the 90<sup>th</sup> percentile of measurements could be as high as 75 percent or even 118 percent error in the same torque range.<sup>108</sup> The methods of using broadcast torque are insufficient for the goals of the proposed in-use program to monitor, analysis, and determine emissions compliance at lower loads, and so CO2 must be used. The use of CO2 to estimate the engine load depends on the error of the exhaust flow meter and the CO2 gas analyzer, as described in the Agency Response to Comments A.(b)ii.2 through A.(b)ii.6. The estimated error at 17 percent before time alignment and drift is accounted for is significantly less than the ECU broadcast range of between 32 and 118 percent. For the reasons above, using the measured CO2 emission value is proven necessary to estimate engine work and emission compliance with the 3B-MAW procedures.

The normalized CO2 emissions rate calculated for windows determines the average percent load of the engine over the window. The bin assignments are based on the percent average load of the engine and is compared to the corresponding certification cycles, as described in the ISOR on p. III-38 and 39 and in the Agency Response to Comments A.(b)i.1 and A.(b)i.2.

As mentioned in the ISOR on p. III-36 and 37, "During the industry workgroup development process for this rulemaking, some industry representatives voiced concerns that the NOx standard based on a CO2 metric would penalize more fuel-efficient engines. To address this, the Proposed Amendments would normalize emissions by the Family Certification Level (FCL)..." The FCL is based on the FTP cycle, so at loads near the FTP cycle there would not be any inaccuracies in calculating power. CARB staff acknowledges that there may be inaccuracies due to the engine efficiency not being at a fixed constant, but these

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<sup>108</sup> Sharp, Christopher. "Heavy-Duty Engine Low-Load Emission Control Calibration, LowLoad Test Cycle Development, and Evaluation of Engine Broadcast Torque and Fueling Accuracy During Low-Load Operation," Low NOx Demonstration Program – Stage 2, Southwest Research Institute, SwRI Project No. 03.22496, Final Report, May 6, 2020

are small. CARB staff estimated the errors to be between 1 and 5 percent when determining engine load between 5 percent and 30 percent of maximum engine load, respectively on an Urban Dynamometer Driving Schedule vehicle drive cycle.

- (b)x.10. Comment: The proposed 3B-MAW in-use testing method and standards do not sufficiently distinguish between modes of in-use engine operation, and so do not and cannot adequately separate in-use emissions into separate bins of idle, low-load, and medium-to-high load operations, as CARB asserts. To the contrary, and as demonstrated by the extensive analyses performed by West Virginia University (WVU), CARB's proposed 3B-MAW method simply spreads (or "smears") and comingles in-use emissions data across and among all of the three proposed bins. As WVU's work proves, the binned data under CARB's 3B-MAW method have no adequate correlation, trend lines, consistency, repeatability or reliability of results to support the establishment of separate regulatory standards for the three proposed bins. In fact, WVU's analyses clearly establish that CARB's proposed binning method is, in effect, arbitrary and unreasonable. (EMA, Daimler, Navistar, Volvo)
- (b)x.11. Comment: The three proposed MAW-based "bins" do not actually represent idle, low-load, and medium-to-high load operations, as CARB claims in the ISOR. (ISOR, p. ES-9.) Instead, they amount to a varying amalgam of all three bins when the binning methodology is actually applied. Moreover, in the end, the 3B-MAW protocol, with three separate in-use standards for each "separate" bin, in effect amounts to three essentially arbitrary chances to fail the 3B-MAW-based program. Such an in-use compliance-assessment protocol is inherently unreasonable. (EMA)
- (b)x.12. Comment: WVU's analysis demonstrates the degree to which the 3B-MAW approach randomly assigns data to the 3 "operational" bins. In the graph<sup>109</sup> from their report, WVU shows how often single data points fall into two or even three bins over the course of a test day, as assessed for the various vehicle categories included in WVU's 100-vehicle test program.<sup>110</sup> The percentage ranges shown for datapoints in one or more "bins" for a given vehicle category represent the range of individual test-day outcomes for all vehicles in the category. The chart that accompanies WVU's graph shows that, in the aggregate, more than 26% of the measured datapoints end up in two bins at the end of the accumulated test-days. That level of cross-binning of data demonstrates that the 3B-MAW protocol does not effectively sort emissions data according to the targeted binned engine-operating characteristics. (EMA)

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<sup>109</sup> The graph can be found on page 61 of EMA's comment letter which is linked here:

<https://www.arb.ca.gov/lists/com-attach/8-hdomnibus2020-1jACGvmafgDgEIXk.pdf>

<sup>110</sup> WVU's nomenclature often refers to the three bins this way: "Bin 1" is the idle bin, "Bin 2" is the low-load bin, and "Bin 3" is the medium/high-load bin.

- (b)x.13. Comment: WVU depicts this variable weighting phenomena in the figure ..., which indicates the number of times individual data points are used in each of the 3 bins after a shift-day of line-haul vehicle operation.<sup>111</sup> (To understand how to interpret the graph, consider Bin 2: approximately 40% of the datapoints are used 100 or fewer times, 85.4% are used less than 300 times, and 14.6% are used 300 times.) Again, there is no demonstration in the rulemaking record of why this is a fair and appropriate weighting of in-use emissions data. (EMA)

Agency Response to Comments (b)x.10 through (b)x.13: CARB staff did not make any changes to the Proposed Amendments based on these comments. As described in the section III.A.3 of the ISOR and the Agency Response to Comments A.(b)ii.2 through A.(b)ii.6, the bins are separated by the average percent load calculated per window, which is a reasonable and effective approach. The two cut points for the bins define the three bins in which the windows are placed, i.e., the idle, low load, and medium/high load bins. The average percent load of a window (300 seconds of engine operation) determines in which bin the window is placed. At the end of testing, each bin is evaluated for compliance. All the window emissions and the corresponding engine load data are summed for each bin and compared to the bin compliance threshold, which is based on the conformity factor times the corresponding certification cycle standard. For the idle, low load and medium/high load, the corresponding certification cycles is the idle, LLC and FTP, respectively.

It is important to understand that a window is a series of 300 seconds of operation that is connected, and the data have influence within each window and correspond to the window's emission performance. Thus, if a second of operation has influence on the window and as that second shifts and provides a different influence in subsequent other window, how is that second of operation not valued in its influence, whether it belongs to an idle bin or to a medium/high bin? The answer is that it does and should be considered as a window of valid emissions data is gathered, placed in the appropriate load bin and average with other windows in that bin. It is understood that some seconds of operation, like at the beginning or end of a test, will influence a lesser number of windows than other seconds of data, but they are still important to the windows they form.

As described in the Agency Response to Comments A.(b)x.1 through A.(b)x.7, CARB staff disagrees with the comments referring to the MAW as "smearing" the data. The MAW method provides data processing and local data to smooth the window operation of the highly variable and noisy 1 Hz data. One Hz data could not be binned without such smoothing because of the noise and the infinitesimally small engine load.

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<sup>111</sup> WVU figure can be found on page 62 of the EMA comments which are linked here: <https://www.arb.ca.gov/lists/com-attach/8-hdomnibus2020-1jACGvmafgDgEIXk.pdf>

The misrepresentation of datapoints occurs in cases such as at the end of the test and when large periods of invalid operation occur causing breaks and uneven sampling of the valid binned data. These events do not occur frequently during testing and have much less influence on results than the 1 Hz data that is represented in 300 windows. It is important to understand that HDIUT testing occurs over a shift day of approximately 8 hours and the majority of the data will have equal weighting and so the underweighted events will not have any significant impact on emission results.

- (b)x.14. Comment: CARB's proposed NOx-binning method is not supported by any actual in-use testing data whatsoever, and CARB has never even tried to assess its proposed binning method using any low-NOx HDOH vehicle in-use. (EMA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. Although it is true that CARB did not demonstrate emissions in the field, CARB staff disagrees that no data was generated to support the 3B-MAW. The 3B-MAW methodology has been demonstrated at SwRI using the Stage 3 engine as discussed in the Agency Response to Comments A.(a)iv.2 and A.(b)i.5. Additionally, the Stage 3 prototype engine has proven feasibility of low NOx emission rates over a number of cycles including LLC, FTP, RMC, and CARB's Southern Route Replay as discussed in the Agency Response to Comment A.(a)iv.2. It is also important to note that the 3B-MAW is very similar to the European in-use testing method that has been implemented successfully for years (see Agency Response to Comments A.(b)viii.1 through A.(b)viii.6).

- (b)x.15. Comment: Based on the results of WVU test data, much more time and effort need to be devoted to developing an emissions-data segregation methodology that is truly representative of actual vehicle and engine operating characteristics, that can accurately reflect the real emissions contribution of an in-use vehicle, and that can give OEM's a fair opportunity to comply with the highly stringent underlying in-use standards. The proposed 3B-MAW does not meet those necessary criteria. (EMA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. CARB staff believes the 3B-MAW in the Amendments is truly representative of actual vehicle and engine operating characteristics. CARB staff also believes 3B-MAW can accurately reflect the real emissions contribution of an in-use vehicle, and will give each OEM a fair opportunity to comply. The rationale for the 3B-MAW and extensive explanation regarding its development is included above and in section III.A. of the ISOR.

It is important to remember that CARB staff did not develop the 3B-MAW methodology to make the current production HD engine able to pass the HDIUT test. On the contrary, as described in section II.C.3 in the ISOR many studies

have shown current production diesel engines to have high NOx emissions at low-load and low exhaust temperature operations. The objective of the Omnibus Regulation is to assure optimal emission control under all modes of operations. The 3B-MAW method reasonably and fairly evaluates an engine's emission control performance over a sequencing of 300 seconds of data windows. This method allows for a fair metric that allow averaging of windows in a bin to determine compliance with an applicable standard. MAW methods are not new and a similar method is currently used in Europe for in-use compliance of HD engines (see Agency Response to Comments A.(b)viii.1 through A.(b)viii.6).

- (b)x.16. Comment: Instead of advancing 300-second windows on a second-by-second basis, CARB should be working with EPA and industry on the evaluation of a method that advances the in-use data sets on a window-by-window basis (i.e., a “tip-to-tail” window method), as opposed to a second-by-second basis. Additionally, evaluation of recording second-by-second data without applying averaging windows should be conducted, so that ultimately the most sensible and representative methodology could be applied. Further, some analysis has shown that the RMC-SET/FCL CO2 result is a more favorable normalization factor than the FTP/FCL for CO2, as CARB has proposed. CARB should evaluate the merits of both of those options, and perhaps other possible normalization schemes, through comprehensive parametric studies. CARB also should present that comparative evaluation to industry and other stakeholders for comment and follow-up protocol-development efforts. Since CARB is proceeding without that necessary thorough parametric evaluation, it is clear that the 3B-MAW protocol is not developed or validated enough to serve as the basis for an in-use regulation. (EMA)

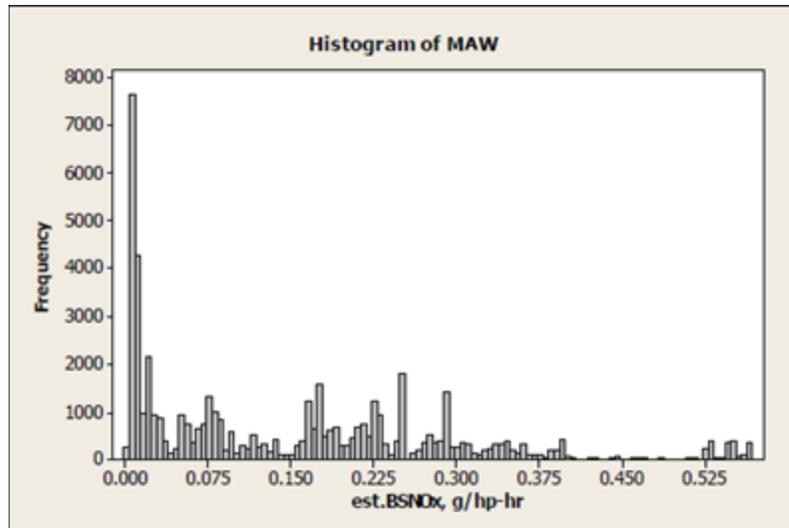
Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. As described in the Agency Response to Comments A.(b)x.1 through A.(b)x.7 and in section II.C.3 of the ISOR, the MAW methods adopted by Europe have been more successful at reducing real-world emissions than the NTE program. CARB staff observed the benefits of a continuous overlapping windows over discretized points because it provides averaging to provide noise filtering to the variability of 1 Hz data. CARB staff decided to propose a fixed time window of 300 seconds as opposed to the fixed window work method used in the EURO VI regulation to prevent the dramatic stretching of windows and unbalanced proportion when applied to the binning structure of the 3B-MAW. The local averaging and simple fixed window size with the 3B-MAW method provides a more balanced approach to determining compliance than relying on 1 Hz data analysis.

CARB staff rejected the tip-to-tail approach advocated by the commenter because the random cutting of emissions of windows may yield dramatically different results in a window's emission rate. For example, imagine a breakthrough emission event where there is a spike of high emissions, for

example due to a hard acceleration. In one extreme case, the breakthrough event could be completely included in just one window. On the other extreme, the emissions breakthrough could be evenly split between two windows. This could dramatically change the emissions recorded in a window. The MAW with continuous window generation is capable to capture the full spectrum of any breakthrough emissions event. Using a sum-over-sum approach after the windows are binned provides a smooth representation of the data. The tip-to-tail type of method would on the other hand not be representative of how engines operate and emit in use and would significantly complicate compliance determination, and provide no benefits.

Regarding the RMC CO<sub>2</sub> FCL, this parameter is not currently required to be measured for vocational HD diesel engines under the Phase 2 GHG standards. Selecting this method would require additional testing for engines that go into vocational vehicles. In addition, all engines are required to be designed to account for efficient operation (CO<sub>2</sub> emission control) under FTP type operation (ISOR on pp. III-36 and 37, Agency Response to Comments (b)x.7 and (b)x.8). Engines design for line-haul operation are optimized for operation under the high load areas of the RMC. Therefore, to have an effective way of determining the amount of work produced from all engines, it is appropriate to use the FTP CO<sub>2</sub> FCL emission results to determine engine work.

- (b)x.17. Comment: CARB has ignored the recommendations and admonitions of its designated technical experts, and is proceeding forward with a 3B-MAW method that is unsound, underdeveloped, untested and unreasonable. SwRI also highlighted what WVU's analyses have confirmed: the MAW-based method does not yield any clear trends in emissions behavior, and disproportionally weights brief spikes in NO<sub>x</sub> emissions (i.e., NO<sub>x</sub> "breakthrough events"). First, SwRI observed that the MAW-based approach "indicates no clear trend [in emissions] other than a high frequency of very low numbers, but the rest of the distribution is *scattered somewhat randomly* between 0.05 and 0.35 g/bhp-hr." (SwRI Report, ISOR Reference 191, p. 77.) (Emphasis added.) SwRI also noted that the MAW-based approach "provides little information about where emissions are coming from in terms of engine operating modes." (SwRI Report, ISOR Reference 191, p. 79.) SwRI depicted that overall randomness in the MAW-based emissions data as follows:



**FIGURE 86. HISTOGRAMS OF EST. BSNO<sub>x</sub> FROM MAW ANALYSIS**

Second, SwRI expressed its clear conclusion (again matching WVU's) that the MAW-based approach tends to overweight "return to service events after a long low-load period," and that CARB's approach "could result in an overemphasis of those relatively brief spikes in a Low NO<sub>x</sub> environment," with "a large number of windows being driven by a small number of breakthroughs." (SwRI Report, ISOR Reference 191, pp. 66, 69 and 74.)

SwRI also recommended that "careful consideration be given to balance the in-use metric design with the stringency for light-load duty cycles," and that "more effort is needed to examine these and other metrics, and the implications of each approach." (SwRI Report, ISOR Reference 191, pp. xiv, 75.). (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. SwRI has performed more recent investigations using the proposed 3B-MAW on the Stage 3 engine for CARB's Southern NTE Route. These newer results verify the validity and the robustness of the proposed 3B-MAW method. For further detail, please see the Agency Response to Comments A.(b)x.9 and A.(b)x.13.

CARB staff's response to comments related to "smearing" of data, trend lines, consistency and repeatability, reliability, transitional operation appearing in multiple bins, and bin to data correlation can be found in the Agency Response to Comments to A.(b)i.1 through A.(b)i.5. The goal of the new in-use method is to cover a larger portion of real world in-use test data.

Similar to the certification cycles, CARB staff acknowledges that the 3B-MAW will provide limited information about where emissions are coming from in terms of engine operating modes because windows and certification test cycles can be made up of a variety of operation modes. However, it is important to note that

the goal of an in-use testing method like 3B-MAW is primarily and most importantly to test whether a vehicle's emissions are adequately controlled in use, not to isolate "where emissions are coming from in terms of engine operating modes." Via CARB's OBD requirements, manufacturers are required to develop and utilize diagnostic tools far beyond the HDIUT to sense and diagnose emissions problems.

The analysis by WVU highlights the breakthroughs associated with return to service events being binned based on load. The WVU data presented highlights the concerns associated with real-world in-use emissions. Engine manufacturers will need to produce robust engine emission control strategies to prevent known "breakthrough" operation emission events that can have significant effects on air quality. As described in the Agency Response to Comments A.(b)x.9 to A.(b)x.13, the WVU study focuses on current technology known to lack controls in the low load regime and during transient operation, the very reason CARB staff proposed moving away from the current NTE test method to the 3B-MAW method.

#### **(b)xi. Sensor-Based Torque and NOx Measurements**

- (b)xi.1. Comment: CARB has ignored the recommendations and admonitions of its designated technical experts, and is proceeding forward with a 3B-MAW method that is unsound, underdeveloped, untested and unreasonable. Figures 6 and 67 from EMA comment document, confirm that the correlation between laboratory-based measurements of torque and NOx, and sensor-based measurements of torque and NOx, is not sufficiently linear or "tight" to support a regulatory-compliance program. The spread between the two types of measurement is simply too large. (EMA, Daimler, Navistar, Volvo)
- (b)xi.2. Comment: CARB has ignored the recommendations and admonitions of its designated technical experts, and is proceeding forward with a 3B-MAW method that is unsound, underdeveloped, untested and unreasonable. SwRI examined the torque-error issue in more detail and found that "at progressively lower engine loads, larger errors are observed, and an increasing trend towards a positive bias on the Engine Control Module (ECM) Torque can be seen across multiple engines." (SwRI Report, ISOR Reference 191, p.58.) As depicted below, at torque/load levels below 20% (one of CARB's proposed bin boundaries), the error ranges from -9% to +75%. Accordingly, SwRI concluded that broadcast torque (or torque-derived work) should not be used in any in-use compliance program. SwRI's conclusions regarding the magnitude of sensor-based torque measurement errors have clear adverse ramifications for CARB's proposed 3B-MAW approach. More specifically, SwRI made the following recommendation regarding CARB's proposed NOx-binning concepts:

It is understood that there is some consideration being given to a “binning” approach, wherein in-use emissions would be grouped into one or more load regimes. If this binning is based on a power metric, such as an average percent of maximum power over a measurement window, then those torque errors could result in the misclassification of measurement windows near a low-load bin. Therefore, even if torque and power are not used as a direct load metric, it is still recommended that improvements to ECM Torque accuracy would be useful under such a classification scheme. (SwRI Report, ISOR Reference 191, p. 58.)

**TABLE 13. DISTRIBUTION OF TORQUE ERRORS AT VARIOUS LOAD RANGES**

Percentile	Torque Error Distribution, % pt			
	Percent of Max Torque			
	< 10%	10-20%	20%-40%	40%+
10th	-26%	-9%	-2%	-3%
25th	8%	8%	4%	0%
<b>50th</b>	<b>31%</b>	<b>32%</b>	<b>11%</b>	<b>4%</b>
75th	71%	50%	22%	9%
90th	118%	75%	30%	14%

(EMA, Daimler, Navistar, Volvo)

Agency Response to Comments (b)xi.1 and (b)xi.2: CARB staff did not make any changes to the Proposed Amendments based on these comments.

CARB staff concurs with the commenter that ECM broadcast torque at low engine loads is problematic, and that is why the Proposed Amendments’ metric is not based on broadcast torque. SwRI’s recommendation, as pointed out by the commenter, suggests that engine manufacturers improve upon their estimation of torque at low load levels. That is part of the reason why the current NTE test method only looks at emission compliance above 30 percent engine torque and power. Thus, a new method for determining work was needed, such as in the 3B-MAW test method. The 3B-MAW method uses CO2 emissions and the equivalent worked performed under an FTP cycle in a test lab (FTP CO2 FCL). Determining the FTP CO2 FCL is currently required of all engines for Phase 2 GHG certification. The use of the FTP CO2 FCL and the averaging of five minutes’ worth of CO2 emissions to determine the work of a window provides for a reasonable accuracy of the work of a window to determine which bin the window belongs to and to determine compliance and hence overcomes the torque error problem to which the commenter refers. Thus, CARB staff disagrees that the 3B-MAW is unsound, underdeveloped, untested and unreasonable, and as mentioned in Agency Response to Comments A.(b)x.1 through A.(b)x.7, the

method was examined by SwRI's as a good metric for evaluating emissions in each bin with the corresponding certification emission test cycle standards.

- (b)xi.3. Comment: CARB has ignored the recommendations and admonitions of its designated technical experts, and is proceeding forward with a 3B-MAW method that is unsound, underdeveloped, untested and unreasonable SwRI also examined whether state-of-the-art NO<sub>x</sub> sensors are sufficiently accurate at low-NO<sub>x</sub> levels to support CARB's proposed in-use regulations. As depicted in Figures 72 and 73. from the SwRI Report, SwRI found that "substantial errors can be seen on the order of 10% to 20%, which errors grow larger at low overall NO<sub>x</sub> mass levels," and that "NO<sub>x</sub> sensor data at present are not yet at the same level of accuracy as some of the other EMC broadcast measurements, such as exhaust flow." (SwRI Report, ISOR Reference 191, p. 63.) (EMA, Daimler, Navistar, Volvo)
- (b)xi.4. Comment: In summing up its conclusions regarding CARB's MAW-based approach, SwRI highlighted the facts that NO<sub>x</sub> sensors will "require considerable improvement in application and accuracy to support in-use compliance measurements at Low NO<sub>x</sub> levels," and that "further investigation of the [in-use] metrics is needed, as well as to set a proper compliance threshold for whichever new metric is chosen." (SwRI Report, ISOR Reference 191, p. 88.) (EMA, Daimler, Navistar, Volvo)

Agency Response to Comments (b)xi.3 and (b)xi.4: CARB staff did not make any changes to the Proposed Amendments based on these comments.

Although SwRI did look at how engine NO<sub>x</sub> sensors could be used to evaluate in-use compliance, the 3B-MAW in-use test method proposed by CARB staff does not use on-board engine NO<sub>x</sub> sensors to determine compliance with in-use testing. Instead, in-use compliance is determined using PEMS emissions analyzers for determining criteria emission and CO<sub>2</sub> emission levels. These emissions are averaged over five minutes of engine operation in a window. All the windows emissions are then averaged within a bin to determine engine compliance. On-board NO<sub>x</sub> sensors are used to determine overall emission control performance used by the engine's OBD system but are not utilized for in-use compliance determination. Hence, the commenter's critique is not relevant to the Proposed Amendments for HDIUT. The commenters' suggestion that OBD NO<sub>x</sub> sensors are incapable of measuring down to the proposed standards is not correct, as proven by the SwRI Stage 3 engine demonstration of compliance using the 3B-MAW method proposed in the Omnibus Regulation (please see Agency Response to Comment A.(a)iv.2). Thus, overall, for the reasons explained above, the commenters' suggestion that the 3B-MAW method is unsound, underdeveloped, untested and unreasonable is incorrect.

## **(b)xii. In-Use Testing Temperature Requirements**

- (b)xii.1. Comment: CARB also has proposed to set the minimum ambient temperature at which compliance with the 3B-MAW in-use standards must be met at -7°C (<20 Degrees Fahrenheit (°F)). That very low ambient temperature threshold is problematic on multiple levels. First, CARB has based many of its efforts in this rulemaking on the sensitivity of NOx control technology to exhaust temperatures. Ambient temperatures on the level of -7°C will significantly reduce engine-exhaust temperatures below those under the well-controlled conditions of an emissions-testing laboratory, yet CARB has made no demonstration regarding the feasibility of compliance at such low ambient temperatures. The stability, accuracy, and function of PEMS is questionable at those very low ambient conditions as well. Moreover, ambient temperatures that low are very rare in any populated areas of California. Finally, and perhaps most importantly, no photochemical ozone-producing reactions occur at extreme ambient conditions down to -7°C, so CARB is imposing technology costs, CO2 control limitations, and compliance risks for no environmental benefit. CARB should increase that minimum ambient temperature criterion to +7°C, which aligns with the temperature below which photochemical smog formation rapidly diminishes. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make changes to the Proposed Amendments based on this comment. Regarding the environmental benefit at the low ambient temperature, the statement “no photochemical ozone-producing reactions occur at extreme ambient conditions down to -7°C” is not correct. In the wintertime, weaker sunlight and the less abundant water vapor in the atmosphere generally leads to lower levels of hydroxyl radicals that plays a key role in initiating and sustaining ozone-producing oxidation cycles.<sup>112</sup> However, significant ozone pollution events have been observed in the western U.S. in the winter at temperatures as low as -17°C where there were alternative hydroxyl radical sources such as the photolysis of formaldehyde (HCHO), coupled with snow coverage.<sup>113 114 115</sup> The principal effects of snow cover were to increase the amount of solar radiation available for photochemistry by reflecting sunlight back into the atmosphere and to prevent the sunlight from heating up the ground, which leads to less mixing and dilution of pollutants in the atmosphere.<sup>116</sup>

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<sup>112</sup> “High winter ozone pollution from carbonyl photolysis in an oil and gas basin,” Edwards, P., Brown, S., Roberts, J. et al., *Nature* 514, 351–354 (2014). <https://doi.org/10.1038/nature13767>

<sup>113</sup> “High winter ozone pollution from carbonyl photolysis in an oil and gas basin,” Edwards, P., Brown, S., Roberts, J. et al., *Nature* 514, 351–354 (2014). <https://doi.org/10.1038/nature13767>

<sup>114</sup> “Winter ozone formation and VOC incremental reactivities in the Upper Green River Basin of Wyoming,” William P.L. Carter and John H. Seinfeld, *Atmospheric Environment*, Volume 50, 2012, Pages 255-266, ISSN 1352-2310, <https://doi.org/10.1016/j.atmosenv.2011.12.025>  
<http://www.sciencedirect.com/science/article/pii/S1352231011012982>

<sup>115</sup> “Rapid photochemical production of ozone at high concentrations in a rural site during winter,” Schnell, R., Oltmans, S., Neely, R. et al, *Nature Geoscience* 2, 120–122 (2009). <https://doi.org/10.1038/ngeo415>

<sup>116</sup> “High winter ozone pollution from carbonyl photolysis in an oil and gas basin,” Edwards, P., Brown, S., Roberts, J. et al., *Nature* 514, 351–354 (2014). <https://doi.org/10.1038/nature13767>

Therefore, -7°C is not as extreme in terms of ozone formation, as the commenter claims.

Also, it should be noted that the benefits of NOx emission reductions are not limited to a reduction in ozone formation. Nitrate PM is produced through the oxidation of NOx. For example, nitrate is a major constituent of winter fine particulate matter (PM2.5) in the San Joaquin Valley, where the 24-hour PM2.5 violations typically occur during the winter months.<sup>117</sup> Therefore, we have to reduce NOx emissions, including under low-temperature conditions, to further control nitrate PM formation.

Engine manufacturers should be designing and developing controls of emissions beyond what is required under test cell conditions, including aftertreatment thermal management controls under cold ambient conditions. Manufacturers are already familiar with the real-world engine testing procedures in Europe under the Euro VI In-Service Conformity program where the MAW methods have been implemented since 2013.<sup>118</sup> The Euro VI In-Service Conformity program currently uses -7°C as the lowest ambient temperature for the test. As described in A.(b)ii.3, CARB staff has extended cold temperature coolant exclusions between 2024 to 2026 to provide additional lead time for developing quick responding emissions control for cold start and ambient cold conditions. With regards to concerns with how ambient conditions affect PEMS, please see Agency Response to Comment A.(b)vii.5. As an additional compliance margin, the conformity factor has been changed from 1.5 to 2.0 for 2024 to 2029 MY engines.

- (b)xii.2. Comment: For the 2024-2026 MY engines, CARB proposes that the in-use test data would not be valid during the period of time after engine-start and before the engine coolant reaches 158°F (70°C). CARB also should consider invalid any data collected at any time when the engine coolant is less than 158°F. It is possible, on cold days and after engine-off periods, that the coolant temperature can drop below the 158F (70°C) threshold, as evidenced by the actual test plot below. The in-use testing procedures need to account for that possibility. (EMA, Daimler, Navistar, Volvo)

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<sup>117</sup> "Seasonal modeling of PM2.5 in California's San Joaquin Valley," Chen, J., Lu, J., Avise, J. C., DaMassa, J. A., Kleeman, M. J., Kaduwela, A. P., Atmospheric Environment 2014, 92, 182-190.

<sup>118</sup> <https://dieselnet.com/standards/eu/hd.php>



Agency Response: CARB staff made changes to the Proposed Amendments in the 30-Day Notice based on this comment. CARB staff provided provisions for cold temperature operation in the Diesel Test Procedures in section 86.1370.B.6.2.6. The provision would exclude data where the temperature is less than 158°F and the engine coolant temperature is not stabilized within 3.6°F over a period of 5 minutes for 2024 through 2026 MY engines. The exemption for this operation was originally only during cold start at the beginning of a test, but CARB staff recognizes the need for additional lead time for industry to develop robust technologies for 2027 and subsequent MY engines and has thus changed this provision to allow for exempting emissions data under these conditions anytime during in-use testing.

- (b)xii.3. Comment: CARB has identified several factors that can invalidate an in-use test after it is completed. Invalidating a test puts considerable strain on the schedule for in-use testing, and can strain the OEM's relationship with a customer who has cooperated with the manufacturer in supporting the regulatory in-use testing program, if another day of testing is required or another vehicle must be identified for testing. Therefore, tests should only be invalidated where there is actual good cause to do so. One of the conditions under which CARB has proposed to invalidate a test is if the engine coolant temperature is more than 30°C (86°F). Such a requirement is overly restrictive, especially given the warmer climate conditions typical throughout much of California. For example, consider that requirement in the context of the typical in-use test scheduling process. Should a manufacturer cancel all in-use testing for the day because the engine's coolant temperature failed to drop below 30°C during the course of the evening? What judgment is the

in-use test team supposed to use to feel confident enough to start the engine and not witness the flow of warmer water resting in the engine block immediately increase to temperatures >30°C as that water flows past the temperature sensor? Any such outcome would, by CARB's proposal, render the scheduling, time, resources and inconvenience to the customer's operations for naught if the test were to be declared invalid as CARB proposes. If CARB decides to maintain the requirement not to start the engine before commencing the start of PEMS measurement despite the concerns raised above, CARB should remove the maximum coolant temperature criteria at engine-start, or at least increase it to 50°C to reduce the chances of this kind of wasteful outcome. It adds nothing to the credibility of the test data in terms of assessing compliance to in-use standards. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff made changes to the Proposed Amendments in the 30-Day Notice based on this comment. CARB staff understands there are parameters that manufacturers may not be able to control for the testing of real-world fleet vehicles over their normal operation. CARB staff therefore made changes to the Diesel Test Procedures in section 86.1920.B.3.2. as follows:

“The manufacturer must identify weather or logistical circumstances making the cold start requirements infeasible for the particular test. If a manufacturer believes that conditions may be infeasible to meet the cold start requirements (for example, due to ambient temperatures that are too high or fleet procedures), the manufacturers may request approval from the Executive Officer to begin the shift-day without a cold start. The Executive Officer will approve said request if he or she determines that the identified circumstances will not allow the manufacturer to meet the cold start test requirements. In assessing the request, the Executive Officer will rely on information provided by the manufacturer and his or her engineering judgement.”

### **(c) Comments Related to Warranty Period Amendments and Useful Life Period Amendments**

#### **(c)i. Warranty Period Amendments**

- (c)i.1. Comment: CARB offers no empirical data to support the purported benefits associated with the longer warranty periods. The staff analysis acknowledges that projected increases in incremental repair costs are expected to be passed on to vehicle purchasers through an increase in the vehicle purchase price.<sup>119</sup> Inexplicably, the analysis also claims purchasers would experience savings from the additional repairs that are covered under a longer warranty period.<sup>120</sup> If this were the case, why aren't more extended warranties

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<sup>119</sup> CARB, Staff Report: ISOR, p. IX-23.

<sup>120</sup> Ibid., p. V-11.

purchased today? Quite simply, truck buyers are either not receiving value from extended warranties or they can't afford them. In either case, the proposed longer warranty periods will only aggravate these situations by further adding to the cost of new trucks without any assurances these costs will be recouped. (CTA/ATA)

Agency Response: The fact that the majority of HD truck buyers already purchase warranties longer than the current required 100,000 mile minimum provides empirical support to the value truck buyers place on such longer warranties. According to the findings of the Sacramento Institute for Social Research survey conducted for the June 2018 Step 1 warranty amendment rulemaking, consultations with HD vehicle and engine manufacturers, and information provided by independent third-party warranty providers, 40 percent of new HHD vehicle purchases currently include an extended warranty out to 500,000 miles, and 45 percent of new HHD vehicle purchases include an extended warranty out to 250,000 miles. Only 15 percent of new HHD vehicle purchases retain the current regulatory period of 100,000 miles.<sup>121</sup> These data show that a significant portion (i.e., 85 percent) of the HHD vehicle purchases are already covered by warranties beyond the currently required 100,000-mile regulatory period. CARB staff estimates that in MY 2022, 40 percent of HHD vehicle purchases will have a warranty out to 500,000 miles, while 60 percent will rely on the regulatory Step 1 requirement of 350,000 miles.

CARB staff acknowledges that the longer warranties will lead to increased upfront vehicle purchase prices, which will then be offset by repair savings over time as the warranty covers repairs. Regarding the commenter's question of why more extended warranties aren't purchased today, the value of the longer warranty may not be immediately apparent to some HD vehicle buyers because the savings occur over a period of time at the expense of an upfront increase in purchase price. From CARB staff's estimates in Table IX-17 of the Staff Report, \$189 would be added to the HHD vehicle purchase price in MY 2027 with an additional \$915 added by MY 2031, giving an expected overall increase of \$1,104 once the Step 2 warranties are fully phased-in. These increases to the purchase price factor in the repair costs over the longer warranty periods and the associated financing costs paid by the vehicle buyer. Comparatively, consumers

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<sup>121</sup> Appendix C: Economic Impact Analysis / Assessment for the Rulemaking: "Public Hearing to Consider Proposed Amendments to California Emission Control System Warranty Regulations and Maintenance Provisions for 2022 and Subsequent Model Year On-Road Heavy-Duty Diesel Vehicles and Heavy-Duty Engines With Gross Vehicle Weight Ratings Greater Than 14,000 Pounds and Heavy-Duty Diesel Engines In Such Vehicles" (Step 1 Warranty), California Air Resources Board, May, 8, 2018. [https://ww3.arb.ca.gov/regact/2018/hdwarranty18/appc.pdf?\\_ga=2.203012433.1791822584.1568703793-1642656111.1560298095](https://ww3.arb.ca.gov/regact/2018/hdwarranty18/appc.pdf?_ga=2.203012433.1791822584.1568703793-1642656111.1560298095)

are currently paying over \$2,500 to buy extended warranty packages.<sup>122</sup> Therefore, CARB staff expects HD vehicle buyers would receive benefit from the Step 2 warranty periods, which are expected to offer longer coverage at lower prices when compared to the currently available extended warranty packages.

The commenter's claim that truck buyers do not purchase extended warranties because they cannot afford them is a very strong reason why CARB determined that longer warranties should be included in the purchase price of the vehicle. As discussed in the Staff Report, emissions-related malfunctions covered under warranty are far more likely to be addressed in a timely manner by vehicle owners than malfunctions outside of warranty, especially malfunctions that may not drastically affect vehicle performance, but which adversely impact air quality. The more quickly an emissions-related malfunction is repaired, the less environmental damage occurs. Additionally, the timely repairs of some parts such as turbochargers can prevent costly repairs to downstream parts such as catalysts and DPFs which would also adversely affect emissions.

- (c)i.2. Comment: The warranty proposal does not provide any assessment of the relationship between truck purchases and maintenance practices. Instead, the state's pending update to its Heavy-Duty Inspection and Maintenance (HD I/M) program is being undertaken to ensure proper maintenance is occurring and verified regardless of warranty status. With the HD I/M program focus on ensuring timely maintenance, it alleviates the need to pursue warranty provisions that will further increasing the cost of new equipment. We request the Board remove the longer warranty provisions and instead initiate efforts to develop an alternative, incentive-based approach which promotes vehicle maintenance by utilizing the existing extended and secondary-market warranty opportunities that exist today. (CTA/ATA)

Agency Response: It is important to note that because the Board has not approved any proposal for or implementation date of the Heavy-Duty Vehicle Inspection and Maintenance (HD I/M) program, the HD I/M program cannot be relied on to achieve the benefits anticipated from the Step 2 warranty provisions.

Assuming the HD I/M program is proposed, approved, and adopted, CARB staff expects that the upcoming HD I/M program would work in conjunction with the longer Step 2 warranty periods because many of these HD I/M-related repairs would occur under the longer warranty periods. The Step 2 warranty provisions would help ensure that it would be the manufacturers, and not vehicle owners, who would pay for problems caused by poor design and durability that the HD I/M program detects.

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<sup>122</sup> Staff Report: Initial Statement of Reasons for Proposed Rulemaking, "Public Hearing to Consider Proposed Amendments to California Emission Control System Warranty Regulations and Maintenance Provisions For 2022 and Subsequent Model Year On-Road Heavy-Duty Diesel Vehicles and Heavy-Duty Engines With Gross Vehicle Weight Ratings Greater Than 14,000 Pounds and Heavy-Duty Diesel Engines In Such Vehicles," (Step 1 Warranty), California Air Resources Board, May 8, 2018. <https://www.arb.ca.gov/regact/2018/hdwarranty18/isor.pdf>

Additionally, vehicle owners would be encouraged to get the repairs done in a timely manner (and discouraged from attempting to cheat the new HD I/M program) since they would be protected from paying out-of-pocket to replace the emissions-related components that are supposed to remain durable throughout the useful life of the engine. Additionally, the HD I/M program would make vehicle owners responsible for maintaining their engines and aftertreatment systems in order to register them in California. Although the request for an incentive-based program instead of mandatory warranty periods is outside the scope of this regulatory action, CARB staff nevertheless considers that the lengthened warranty periods could be likened to an incentive-based program in that they encourage vehicle owners to replace emissions-related parts that they might otherwise not do if they had to pay out-of-pocket at the time of repair. The HD I/M program once in place will provide an additional incentive to get the repairs done in a timely manner to avoid potential registration delays for needed repairs.

- (c)i.3. Comment: Allison believes that while CARB should consider longer regulatory useful life periods and warranties, the Agency should not move forward without a thorough consideration of individual components and systems. To meet the much more stringent emission levels contemplated, it is likely that new technologies may be needed. Not all technologies are created equally; major emission control systems and their components will not age in uniform manner.

CARB should not adopt a “one size fits all” approach to emission warranty and useful life periods. Allison supports further investigation of mechanisms which would “vary the length of warranty coverage across different types of components.”<sup>123</sup> It may not be possible in all cases to design, or cost-effectively design, every emission-related component to reach the same useful life period required with respect to a new engine. Moreover, consideration must be given to the upfront costs that could be experienced in adopting a singular focus on ensuring that all components meet the same useful life periods.<sup>124</sup> (Allison)

Agency Response: Because CARB staff believes the miles and hours that vehicles are actually operated should dictate the necessary lengths of emissions warranties, the warranty period should remain applicable to the entire engine and its emissions control systems, and not vary by component. For the air quality benefits of emissions warranty to be realized, such warranties need to apply to every component that can influence emissions. Specifically, if the warranty period were to vary by component, or be configured to vary over time, then more complexities would be introduced into a process that many stakeholders already believe is complicated enough. In particular, such a change could further confuse vehicle owners about their own warranty coverage, confuse and contribute to

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<sup>123</sup> 85 Federal Register at 3,325

<sup>124</sup>CARB received comments during its Post - September 26 [2019] Workshop that there could be “[large projected cost increases to cover warranty out to proposed periods.” See page 7 of workshop presentation.

complications with repair facilities in carrying out the warranted repairs, as well as create challenges for the OEMs when dealing with California's EWIR requirements.

Furthermore, in an effort to address the concerns raised by industry regarding the use of new technologies in these low NOx systems, CARB staff has offered as part of the proposed modifications to the Board adopted Regulations and test procedures some added flexibility to the maintenance scheduling in the years when the standards become more stringent and the useful life periods are lengthened. This would help to alleviate manufacturer's concerns regarding the new technologies and how they might be integrated with existing components.

For CARB staff's responses on the approach taken for the useful life periods, please see the Agency Responses in section A.(c)ii.

### **(c)ii. Useful Life Period Amendments**

- (c)ii.1. Comment: CARB's assessment of the durability of the proposed Stage 3 prototype is inadequate. As noted, CARB is proposing to extend the FUL requirements from today's 10 years/435,000 miles to 11 years/600,000 miles for MYs 2027 to 2030, and 12years/800,000 miles for MYs 2031 and later. Yet, when its research work is completed, SwRI will have aged the prototype Stage 3 system only to a theoretical equivalent of the current 10 years/435,000 mile requirements. CARB has made no assessment of the durability of the Stage 3 components out to the extended FULs over which the envisioned low-NOx systems will have to remain compliant. (EMA)
- (c)ii.2. Comment: The extended FUL requirements, in addition to being onerous, expensive, and undemonstrated, present especially unreasonable and unfair challenges for low-annual-mileage HD vehicles. It is evident that low-annual-mileage vehicles will have to comply with the initial extremely aggressive 0.020 g/bhp-hr NOx standard over a much greater portion of their FULs than will high-annual-mileage vehicles. Yet no feasibility demonstration has been made regarding the FUL requirements as applied to the low-annual-mileage vehicle case. (EMA)

Agency Response to Comments (c)ii.1 and (c)ii.2: The SwRI Low NOx Demonstration Program was primarily focused on demonstrating the technical feasibility of the 0.020 g/bhp-hr NOx standard at 435,000 miles. However, CARB staff used a linear regression method to extrapolate the SwRI data to 600,000 and 800,000 miles in order to establish the emissions standards for the 2027 and 2031 MYs. CARB staff's method accounts for the deterioration (i.e., emission increase) that would occur between 435,000 miles and 800,000 miles.

It should be noted that engine manufacturers currently age their engines to only a portion of the useful life, and then use the same linear regression methodology to

demonstrate compliance with the full useful life emission standards. Given the wide use of linear extrapolation by EMA members, CARB staff believes that the same methodology should be applicable to the SwRI data as well.

Some stakeholders have expressed their concerns regarding this tiered standard at the intermediate useful life as it relates to vocational vehicles. Specifically, because these low-annual-mileage HD vehicles would have a burden of compliance with the in-use testing requirements that would apply for a longer time period when compared to line haul tractors. Although the regulations seek to accommodate vocational vehicles by way of the operational hours, not all vehicle applications would benefit from this change. As such, CARB staff is proposing modifications to the Board approved regulations and test procedures to address this concern by changing intermediate useful life from 435,000 miles/ 10 years/ 22,000 hours to 435,000 miles/ 8 years/ 22,000 hours.

Finally, it is important to note that the SwRI Low NO<sub>x</sub> research began with the technologies that were available in 2013 for Stages 1 and 2 Low NO<sub>x</sub> programs, and in 2018 for Stage 3 Low NO<sub>x</sub> program. That is respectively 14 and 9 years before the implementation year of the proposed 0.020 g/bhp-hr NO<sub>x</sub> standards. CARB staff expects that more refinements could be made on the technologies and strategies employed to improve on current test results. Furthermore, manufacturers would have much better tools and resources compared to SwRI to conduct low NO<sub>x</sub> research and therefore achieve better results. Overall, CARB staff believes there is enough lead time for manufacturers to further refine research on these and other new technology developments and achieve the desired NO<sub>x</sub> levels for certification for the longer useful life periods.

Regarding the commenter's statement on the "assessment of the durability of the Stage 3 components out to the extended FULs over which the envisioned low-NO<sub>x</sub> systems will have to remain compliant," CARB staff is aware that U.S. EPA is funding their own studies at SwRI to measure the emissions out to the new useful life periods. Although the U.S. EPA CTI rule is still under development and the federal useful life periods are not yet defined, CARB staff will closely monitor the CTI development as well as the U.S. EPA-funded SwRI results and may propose changes in a future rulemaking, if necessary.

- (c)ii.3. Comment: Hours are included as a limit to emissions useful life periods only for HHDD engines. Cummins recommends CARB add hours to emissions useful life for other engine categories to address low vehicle speed, low mileage applications. (Cummins)

Agency Response: The operational hours are meant to account for vocational vehicles that are used mainly in stop/start, or idling operations that result in a much greater accumulation of hours than odometer miles. The lower weight engine categories for LHDD and MHDD do not currently have an operational hour period for their useful lives, and the Omnibus Regulation did not seek to

introduce one because, even in 2031 under the second phased-in periods, the proposed useful life mileages for these categories would remain at less than half of the proposed HHDD useful life mileage (i.e., 270,000 miles and 350,000 miles for LHDD and MHDD versus 800,000 miles for HHDD). Hence, CARB staff believes LHDD or MHDD vehicles would be much less likely to accumulate unreasonably high operational hours before exceeding their useful life mileage, and so including an hours period is not necessary at this time.

- (c)ii.4. Comment: The hours limit for HHDD engine useful life is effectively removed by reverting back to years or miles limits once the hours are reached. Cummins recommends CARB revisit the need for secondary years or miles limits and remove/adjust the values. (Cummins)

Agency Response: The useful life provisions that are being referred to by Cummins are based on the existing language in §86.004-2 (4)(v) that states:

*For an individual engine, if the useful life hours limit of 22,000 hours is reached before the engine reaches 10 years or 100,000 miles, the useful life shall become 10 years or 100,000 miles, whichever occurs first, as required under Clean Air Act section 202(d).*

The intent behind the existing language is to specifically address only HHD engines that would go into vehicles such as buses, trash trucks, etc., and experience the really extreme case in which they operate for many hours each day yet either travel at very slow speeds or not at all (i.e., power-take-off situations). CARB typically conducts in-use compliance testing on vehicles that have odometer mileages below their applicable useful lives, which for HHD engines is currently 435,000 miles. CARB staff believes that this provision offers reasonable protection to a manufacturer for such vehicles that accumulate a great number of hours but a small number of miles, while still ensuring that the engines meet the emission standards over the useful life.

The existing and amended language maintain the requirement of fine-tuning useful life based on how quickly the vehicle accumulates hours of operation. This technique is designed to normalize manufacturer liability for applications that accumulate service miles slowly (e.g., urban buses, and vocational vehicles such as concrete mixers, refuse haulers and street sweepers, etc.), while simultaneously preventing applications that accumulate miles quickly (e.g., non-vocational vehicles such as line haul tractors, delivery vehicles, and furniture movers, etc.), from prematurely exceeding useful life periods. The original provision reduces the useful life miles period to 100,000 miles (from 435,000 miles) for engines that accumulate 22,000 hours of operation before reaching the 100,000 mile mark. In this case, hours would no longer be used to limit useful life. This technique establishes a more balanced determination of useful life for non-vocational applications that are likely to exceed the useful life mileage period relatively quickly because of frequent highway operation (higher

average vehicle speed translates into quicker mileage accumulation). Accordingly, vocational vehicle manufacturers are not penalized with substantially longer useful life liability than non-vocational manufacturers for the same operational periods of use.

CARB staff modeled the provisions on the existing language, but adjusted it to reflect the longer warranty and useful life periods under the Proposed Amendments. The Proposed Amendments do not negate the inclusion of hours in useful life, but instead ensure high hour, low mileage vehicles have a reasonable useful life.

An example demonstrating how these provisions would work would be a 2027 MY trash truck that operates at a slow average speed of 10 mph and operates on double shifts so that it travels 41,600 miles per year. The truck would reach 30,000 hours sometime after its seventh year of operation, having a mileage of 300,000 miles. So, in this example, the provision in §86.004-2 (4)(iii)(B)(2) would apply because the 30,000 hours period would be reached before 11 years and 450,000 miles. Therefore, according to the provision, the useful life for that individual engine would then become either 11 years or 450,000 miles, whichever first occurs. And so given that at 11 years the mileage reached is 457,600 miles, which is greater than 450,000 miles, the useful life would then be 450,000 miles. Without the §86.004-2 (4)(iii)(B)(2) provision, the useful life would have ended after only seven years and 300,000 miles, which would be unreasonably short.

- (c)ii.5. Comment: An inconsistent basis was applied to determine the FUL period amendments of different classes of heavy-duty vehicles. When determining FUL for MHDD and LHDD, CARB used approximately 80% of the average mileage for an engine rebuild or replacement surveyed by MacKay & Co. (Table I-8). CARB, however, proposed HHDD engine FUL of 800,000 miles, which is currently used in the EMFAC Inventory Model and also recommended by MECA and MEMA; this mileage represents 94% of HHDD engine's service life, much higher than 80% used in MHDD and LHDD. As mentioned by CARB, the EMFAC values "do not reflect engine rebuilds or replacements" and have a different meaning from the average mileage from MacKay & Co. Likewise, for HDO engines, CARB proposed a useful life value for 2031 MY corresponding to 92% of the rebuild/replacement miles, based on a single manufacturer product literature recommendation (Isuzu, 2019). This inconsistent approach to determine full useful life values raises questions and requires clear justification. Recommendation: CARB should set the FUL of HHDD engine and HDO using the same basis as for MHDD and LHDD. (WSPA)

Agency Response: Different bases were used to determine the useful life periods for the HHDD and HDO engines versus the MHDD and LHDD engines to ensure proper operational representation. CARB staff selected useful life to be

equivalent to 80 percent of the service lives for the MHDD and LHDD engines because they were more closely aligned with the operation of light- and medium-duty vehicles and engines based on existing data. CARB staff determined that a higher percentage of the service life for HHDD engines was most reasonable to account for greater frequency with which these engines are rebuilt due to accumulating higher mileages as compared to MHDD and LHDD engines. Similarly, the use of a higher percentage of service life for the HDO engines was reasonable because, in addition to the Isuzu product literature that was referenced in the Staff Report, CARB staff also received affirmations of this common replacement mileage in conversations with stakeholders during the development of the proposal.

- (c)ii.6. Comment: If CARB does extend the service life and emissions warranty requirements for HD hybrids and Otto cycle engines, it is important that relevant maintenance intervals are updated starting in MY 2027. MEMA supports CARB's proposed updated maintenance intervals for HD diesel engines to include hybrid applications and HD Otto cycle engines. Further, the validation data requirements for emissions DF used by vehicle manufacturers for their certification now includes an option to use on-board sensors to validate the DFs submitted by vehicle manufacturers. Therefore, if the maintenance intervals of such components used for validation data were to be extended, then the intervals should not be extended beyond a point that the performance of those components is no longer sufficient to be used for compliance purposes. This needs to be considered when CARB reviews and updates the maintenance intervals for HD diesel engine applications.  
(MEMA)

Agency Response: As part of the modifications to the Board adopted regulations and test procedures, CARB staff has added flexibility to the maintenance scheduling in the years such as MY 2027 when the standards become more stringent and the useful life periods are lengthened. This flexibility would help to alleviate the industry concerns regarding the new technologies and how they might be integrated with the existing components. With respect to the use of sensors to validate DFs, the maintenance intervals for sensors have not been proposed to exceed their performance limits.

### **(c)iii. Warranty Provisions on Out-of-State Vehicles**

- (c)iii.1. Comment: MEMA opposes this proposed provision to extended emissions warranty coverage for HD vehicles that are California certified but registered in another state. Vehicles registered outside of California should be subject to federal emissions warranty requirements. MEMA urges CARB and U.S. EPA to work together to coordinate and align federal and California emissions warranty requirements starting in 2027 as much as possible. However, it is plausible that EPA could adopt different extended emissions warranty requirements. Having uncoordinated requirements would be extremely

burdensome for the industry. If emissions warranties are unaligned and CARB is requiring all California-certified engines to meet CARB's extended emissions warranty, regardless if the vehicle is registered outside California, this would add further complexities and costs, would be difficult to enforce, and would cause confusion. (MEMA)

- (c)iii.2. Comment: Applying California warranty provisions to vehicles owned by companies or persons outside of the state and registered in state other than California – as CARB's proposed regulations attempt to do – imposes measurable costs and burdens on such owners even if they never travel into the state of California. CARB attempts to justify the burden on the basis that such vehicles “may travel within the state in their normal operations.”<sup>125</sup> Indeed, some vehicles registered out-of-state may travel into California, but assuredly all vehicles will not. California's proposed regulation is thus overly-inclusive. (Allison)

Agency Response to Comments (c)iii.1 and (c)iii.2: CARB staff's intention behind removing the California-registered requirement for the warranty applicability is to address the emissions from HD vehicles that are originally sold and registered in California, and then later resold and reregistered outside of California. These vehicles often either return to California, or travel in and out of California, during their normal course of doing business. This is an important aspect to consider because EMFAC estimates that out-of-state Class 8 vehicles will account for 63 percent of California vehicle-miles-traveled (VMT) in 2027. Under the current regulations, once a vehicle is reregistered outside of California, the California warranty ceases to apply. By removing the registration requirement, the warranty would remain with the vehicle even if it is reregistered outside the state. For a more detailed example please see the warranty flowchart scenarios in the Agency Response to Comment A.(c)iii.3.

Overall, longer warranty periods would incentivize vehicle owners to seek timely repairs for faulty emission-related components, and so when the vehicles eventually do return and operate in California, they will have lower emissions. Additionally, CARB staff expects that keeping the California warranty in place even for vehicles no longer registered in California would benefit vehicle owners that purchase vehicles in California and pay the incremental purchase price associated with the longer California warranties, enabling them to retain the value of the longer warranties, even if they register the vehicles outside California.

- (c)iii.3. Comment: CARB should not finalize provisions that would extend emission warranty provisions to vehicles registered outside of the State of California. Such an action is both unsupported in the administrative record and contrary to law. CARB has not cited adequate statutory authority for this action, and

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<sup>125</sup> CARB, Staff Report: ISOR, p. III-42 (emphasis added).

extraterritorial application of California warranties to business and individuals in other states raises issues.

[W]hile the legal authority cited by CARB grants authority over the regulation of vehicles within the state, this authority is silent with respect to control of out-of-state vehicles and those located and registered (perhaps permanently) in other states. Indeed, none of Health and Safety Code (H&SC) sections cited in the Staff Report actually address vehicle registration at all. None of these provisions indicates that requirements for certification extend to entities that exist and/or operate beyond the borders of the state, much less that vehicles owned and registered in other states must comply with California vehicle warranty provisions simply by virtue of having obtained certification that vehicle meets California emission standards. (Allison)

Agency Response: CARB has broad authority to adopt and amend emission standards, test procedures, and emission-related requirements for motor vehicles (H&SC 39600, 39601, 43013(h), 43018(a), 43018(c), 43101, 43102, and 43104). Specifically for emission warranties, H&SC 43205.5 requires HD vehicles/engines to be (1) designed, built, and equipped to meet applicable emission standards (for a period of use determined by CARB), and (2) free from defects that cause the vehicles/engines to fail to meet applicable requirements for the same period of use (or a shorter period of use) as specified in (1). The California warranty registration requirements flow from the new vehicle/engine certification requirements, where:

1. H&SC 43151 to 43153 basically require that every new vehicle or engine sold, offered for sale, imported, delivered...for use, registration, or resale in California, must be certified pursuant to Chapter 2, Part 5, Div. 26 of the H&SC. Chapter 2, Part 5, Div. 26 includes the warranty requirements (H&SC 53205.5).
2. The Omnibus Step 2 warranty attaches to new vehicles and engines certified to California standards, so it clearly applies to vehicles/engines first sold into California.
3. The current warranty regulations in 13 CCR section 2035 limit the warranty to HD vehicles registered in California, but that is not a necessary limitation because H&SC 39600, 39601, 43013, 43018, and 43205.5 authorize CARB to simply apply the warranty requirements to all new vehicles/engines first sold into California.

For added clarity on how this is carried out please review the follow scenarios in the warranty flowcharts showing the existing warranty coverage that will apply through to the 2026 MY, and how that would change under the Omnibus Step 2 warranty amendments beginning with the 2027 MY:

**For California-certified HD vehicles through 2026 MY (Existing Requirements)**

- First sold and registered in California: California warranty applies.
  - Later sold and moved to another state and registered in that state: California warranty ceases and federal warranty applies except in any 177 state that has adopted California emissions standards and associated warranty requirements.
    - Later sold and re-registered in California: California warranty applies.
- First sold and registered outside of California: California warranty applies in any 177 state that has adopted California emissions standards and associated warranty requirements; otherwise, federal warranty applies.
  - Later sold and registered in California: California warranty applies.

**For California-certified HD vehicles 2027 and subsequent MY (Omnibus Requirements)**

- First sold and registered in California: California warranty applies.
  - Later sold and moved to another state and registered in that state: California warranty continues to apply because the California registration requirement has been removed.
    - Later sold and re-registered in California: California warranty applies.
- First sold and registered outside of California: California warranty applies if 177 states have adopted the proposed emission standards and associated warranty requirements, otherwise federal warranty applies.
  - Later sold and registered in California: California warranty applies.

**(c)iv. Generation of Additional Data for Warranty Information**

- (c)iv.1. Comment: For suppliers to meet the proposed significantly increased emissions warranty extension, suppliers need to quickly understand and improve durability issues as new technologies are adopted. Suppliers' ability to accelerate component improved durability will be determined by how soon the data flow between the suppliers and vehicle manufacturers can be improved and whether there are increased opportunities to gather higher quality data. Therefore, MEMA recommends that CARB could either fund a study, provide data, and/or require improved reporting mechanisms by vehicle manufacturers (or HD fleet owners) on emissions components. Both of those proposed options would need to start as soon as possible to be effective for all parties, because the emissions technologies development life cycle requires this information now. (MEMA)
- (c)iv.2. Comment: Suppliers do not currently have the field data necessary to make durability improvements for a substantially extended warranty period.

Currently, the data flow on parts in warranty from the vehicle manufacturer and back to the correct supplier is not strong enough and does not provide enough data to be useful. Few, if any “end of life” hardware is returned for review to suppliers without an intentional effort or intervention by the vehicle manufacturer or specific request by the supplier. Given the historical evidence of the lack of flow of data on parts, vehicle manufacturers and suppliers will need to work hard at developing data flow worthy of increasing warranty durations. While data flow may eventually improve between supplier and vehicle manufacture, because of the steep learning curve early in this process, HD engine component suppliers cannot wait for higher quality data to be reported from that path. Jacobs is now validating products for awarded business starting production in 2024 and is developing new technology for launch in 2025 - 2031. For Jacobs to meet the proposed increased emissions warranty extension, we need to quickly understand and improve durability issues as new technologies are adopted. A study funded by CARB, or a CARB requirement for improved reporting mechanisms by vehicle manufacturers on emissions components would need to start as soon as possible as emissions technologies development life cycle requires this information now. Jacobs requests CARB fund a study, provide data or create a reporting mechanism for vehicle manufacturers or fleet owners of HD vehicles on the road today, providing data on usage patterns, drive and duty cycles on the second and third owners of trucks. (JVS)

Agency Response to Comments (c)iv.1 and (c)iv.2: At the August 2020 Board Hearing CARB staff was directed by the Board to work with stakeholders to assess the warranty costs associated with the longer periods. Following that instruction, CARB staff initiated a Warranty Cost Study that outlined a set of goals that to help the industry to be better able to plan for compliance with the Omnibus Regulation. The list of goals for the Warranty Cost Study are:

- 1) Work collaboratively to better understand all of the assumptions made and all of the differences in the various warranty cost analysis methods.
- 2) Gather available data for HD vehicles to quantify the residual warranty value to the second and subsequent owners.
- 3) Gather available data on usage patterns, drive and duty cycles from the second and subsequent owners of vehicles used in a variety of applications to assess wear characteristics.
- 4) Make a plan for gathering and sharing data between OEMs and suppliers as new technologies to meet MY2024 and MY2027 standards are rolled out.
- 5) Facilitate discussions between OEMs and suppliers beyond the current 100,000 mile warranty period.
- 6) Review the results and the suggested next steps from the study.

The study is intended to help mitigate the uncertainty that manufacturers and part suppliers have regarding the costs for the longer warranty periods under first and subsequent vehicle ownerships. A critical aspect of this uncertainty mitigation

involves laying the groundwork for fostering and encouraging both greater communication and flow of relevant information between the manufacturers and suppliers beyond the current 100,000 mile warranty period.

- (c)iv.3. Comment: MEMA strongly supports a phased-in approach as this helps address suppliers' need for adequate lead-time to understand and improve component durability. Suppliers would take on significant cost implications early. They currently do not have access to the necessary data to assess and make improvements. MEMA requests CARB provide data on HD vehicles registered in California on the road today, higher quality data on usage patterns, as well as drive and duty cycles of second and third truck owners. (MEMA)
- (c)iv.4. Comment: CARB's proposed significantly extended emissions warranty – increasing from the current 100,000 miles to 350,000 miles in 2022, 450,000 miles in 2027 and then 600,000 miles in 2031 will have cost implications in order to develop new parts capable of meeting the extended warranty period.<sup>126</sup> Because of our current lack of adequate data, we will likely bear more of the burden and increased risks and costs. Again, an extended emissions warranty that allows a long lead-time and a phased-in approach is preferred to provide us time to gather data and learn. Allowing more lead time to fully understand estimate costs related to, and plan for the extended warranty will help alleviate risks and costs. We would like to ask CARB to help with providing that needed data. (MECA)

Agency Response to Comments (c)iv.3 and (c)iv.4: As mentioned in the Agency Response to Comments A.(c)iv.1 and A.(c)iv.2, CARB staff was directed by the Board at the Omnibus Regulation hearing to conduct a Warranty Cost Study. Two of the goals outlined for the study relate to the relationship between OEMs and suppliers. The intention behind those goals was to better understand the existing relationship, and explore pathways to improve the communication beyond the current 100,000-mile period. The study developed a plan for the gathering, and better sharing of data between OEMs and part suppliers, which would foster establishing a set of best practices when doing repairs.

As a way to initiate the sharing of the high-mileage, usage pattern data the suppliers are seeking, CARB staff provided MECA and MEMA with some HD activity datasets. This way they can better evaluate existing available data for its usefulness, which is intended to help to alleviate some of their anxiety for the upcoming Step 1 warranty requirements. Additionally, it would assist CARB staff in knowing what types of data the suppliers find useful, which would be helpful overall to facilitate the OEM and supplier discussions.

- (c)iv.5. Comment: Since CARB will significantly increase emissions warranty requirements for HD vehicles, MEMA encourages California to provide

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<sup>126</sup> For Class 8 vehicles.

guidelines or requirements for dealer and independent service providers to concurrently improve diagnostic routines, tools, and training. These improvements are important to better control repair costs. (MEMA)

Agency Response: Currently there are no specific requirements for manufacturers to follow when diagnosing failures. Manufacturers create their own troubleshooting and technician training methods. CARB staff does not recommend creating any requirements as troubleshooting would be different for different manufacturers and parts. It is already in the best interest of manufacturers to have accurate diagnosis of problems to save expenses on unnecessary warranty repairs. Also, it has been observed that manufacturers are already continually improving their troubleshooting and diagnosis methods as they learn more about specific failures or if they learn about warranty repairs that are being made unnecessarily. Manufacturers currently analyze returned warranty parts to determine failure modes and if they find that many of the returned parts have no trouble found, manufacturers improve diagnosis/repair procedures to ensure that working parts are being unnecessarily replaced.

- (c)iv.6. Comment: We believe that significant uncertainties remain about the appropriate warranty requirements for 2027 and 2031. Therefore, we would like to explore additional collaborative efforts, such as a demonstration program that could be undertaken by CARB, MECA, AESI, EMA and other stakeholders in the years leading up to implementation of the Omnibus requirements. Such efforts would be designed at working with truck fleets to survey field aged parts on in-use trucks to examine real-world deterioration from a representative cross-section of vehicle ages, state of repair and ownership status. This would provide useful information to OEMs and suppliers working to meet Omnibus warranty and durability requirements and lead to emission controls with higher durability, lower warranty claims, and ultimately reduced emissions.

[T]here is considerable uncertainty about the state of vehicles during the time of operation after the warranty expires. Much of the data on warranty claims and repairs as well as vehicle use characteristics originate from the time when the first owner operates a vehicle while data from repairs made by second and third owners is very limited. Suppliers do not have data on engine and aftertreatment components beyond today's warranty requirements (e.g., past 100,000 miles). Many suppliers do not have data on the durability, replacement or diagnostics of their parts past the warranty because the dealer network is not required to share that information. This lack of information leads to challenges for suppliers who are trying to design parts that will meet the extended durability requirements. (MECA, AESI)

- (c)iv.7. Comment: We do request the Board to direct staff to convene an industry stakeholder working group to oversee a project for the purpose of gathering data on field age engine and aftertreatment components to facilities better

industry understanding of the impacts of the proposed longer durability and warranty periods. This will help the component suppliers and vehicle manufacturers gather greater insights from field-aged parts with the goal of further improving durability. (MECA)

Agency Response to Comments (c)iv.6 and (c)iv.7: As mentioned in the Agency Response to Comments A.(c)iv.1 and A.(c)iv.2, CARB staff was directed by the Board at the Omnibus Regulation hearing to conduct a Warranty Cost Study. Working collaboratively with the different stakeholders, one of the goals for the study was to create a plan for gathering data as new technologies to meet MY 2024 and MY 2027 standards are rolled out. This would allow for the OEMs and suppliers to prepare for the longer durability requirements as parts age beyond the current 100,000-mile warranty period. Additionally, the warranty study gave a set of recommendations suggested next steps to continue fostering the communication and data sharing between the OEMs and suppliers.

#### **(d) Comments Related to EWIR and Corrective Action Procedure Amendments**

##### **(d)i. General Comments Related to EWIR**

- (d)i.1. Comment: CARB is proposing that the reporting threshold for EWIR reports be reduced from 1 % or 25 claims to 1 % or 12 claims, whichever is greater starting in 2022. CARB is also proposing that EWIR reporting continue throughout the useful life of a component.

In a substantial change from past requirements, CARB is additionally proposing that recalls be mandated when failure levels exceed certain levels (4 percent or 25 vehicles (whichever is greater) for 2024-2026 vehicles and the same levels for 2027 to 2030 Model Year vehicles for the first 5 years of the warranty period).<sup>127</sup> Currently, such vehicles were “subject to” recall by CARB, but recall is not automatically imposed. CARB is also proposing that such vehicles either be recalled or subject to other corrective action based on exceeding the percentage/number of vehicle levels.<sup>128</sup> The combined effect of these provisions is to create a default mechanism wherein recalls/corrective actions are imposed based on warranty claim occurrence only without a further assessment of the magnitude of the impact of any failure on actual emissions. Manufacturers would be required to submit a corrective action plan within 90 days of exceeding a corrective action threshold,<sup>129</sup> and required recalls and corrective actions be automatically imposed “when the number of valid failures meets or exceeds the corrective action thresholds.”<sup>130</sup>

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<sup>127</sup> Proposed amendments to §2143, Appendix A-1, Title 13 Proposed Regulation Order, p. 98.

<sup>128</sup> *Id.*

<sup>129</sup> Proposed amendment to §2146(a)(l), Appendix A-1, p. 103.

<sup>130</sup> Proposed §2167(a), Appendix A-1, p. 113.

This default mechanism carries with it substantial and potentially expensive consequences. Under the proposed Regulations, manufacturers would be required to recall and take corrective actions “including, but not limited to, providing an extended warranty as defined in section 2166.1, to correct the systematic failure of certain identified vehicle components when the number of valid failures meet or exceed the corrective action thresholds.”<sup>131</sup> For emission-related components, manufacturers are required to perform corrective actions based again solely on exceedance of the applicable threshold. Initiating corrective action for emission-related components would be required within 30 days of the corrective action plan approval, unless the manufacturer has shown good cause for the deadline to be extended.”<sup>132</sup> (Allison)

- (d)i.2. Comment: CARB indicates that amendments to the current process are needed to “clarify manufacturer responsibilities.”<sup>133</sup> But the proposed amendments are not a mere “clarification.” They are instead a fundamental shift away from an enforcement strategy that is focused on emissions to one that is based solely on numbers, no matter whether any emission impacts are significant. Under the proposed amendments, there would be no evaluation of the actual need for a recall pursuant to 13 CCR §2148 for any model year vehicle 2024 and later.<sup>134</sup> (Allison)

Agency Response to Comments (d)i.1 and (d)i.2: No change was made in response to this comment. The commenter correctly notes that the Amendments condition the need for corrective actions on the exceedance of specified failure rates, rather than on the existing criteria in 13 CCR § 2148. The Amendments will help ensure that manufacturers timely implement corrective actions to minimize the adverse impact caused by emission control components that are not functioning as intended.

The Agency disagrees with the commenter’s assertion that the corrective action thresholds do not affect emission increases resulting from failures of emissions-related components. As discussed in page III-66 of the ISOR, failures of emission-related components that are detected by the corrective action thresholds do result in increased emissions. Specifically, emission control components that gradually deteriorate will result in vehicles or engines emitting emissions above the levels they were certified to, even if the increased emissions levels have not yet exceeded applicable certification emission standards.

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<sup>131</sup> Proposed §2168(a), Appendix A-1, p. 114.

<sup>132</sup> CARB, Staff Report: ISOR, p. III-65.

<sup>133</sup> *Id.*

<sup>134</sup> The proposed amendments to 13 CCR §2143 do not cross-reference 13 CCR §2148(a) or (b) for 2024 and later heavy-duty diesel and Otto-cycle engines, and heavy-duty vehicles. Nor do the amendments provide for any determination of necessity that is allowed for earlier model years under the current 13 CCR §2143.

- (d)i.3. Comment: CARB justifies this large change in the current system as necessary to address several issues. CARB claims the reduction in reporting thresholds for EWIR reports is to account for small volume engine manufacturers.<sup>135</sup> At the same time, however, CARB does not proportionately “scale” the reporting threshold and allow higher levels for larger manufacturers, a result that would logically flow from CARB’s stated purpose. (Allison)

Agency Response: No change was made in response to this comment. CARB staff disagrees with the assertion that changes are necessary to increase the reporting threshold for larger manufacturers. The purpose of this provision is to account for small volume engine families. Engine families with larger volumes would not be affected by the provision as thresholds for them would be based on the percentage of vehicles that have experienced the problem. For example, the EWIR reporting threshold will be reduced from 1 percent or 25 warranty claims (whichever is greater) to 1 percent or 12 warranty claims (whichever is greater). Since exceeding the threshold is based on whichever is greater between the warranty claim rate and the number of warranty claims, the threshold for larger families would be subject to warranty reporting once 1% of the engine family has experienced the problem as that value would be greater than 12. For example, consider a large manufacturer that makes 5,000 of one component. The EWIR reporting threshold in this example would be 50, or 1 percent of the population (which is the greater of 1 percent or 12), just as it was before. The Amendments change the threshold for manufacturers making fewer than 2,500 of a component. Therefore, CARB does not need to modify the thresholds to account for engine families with larger volumes.

- (d)i.4. Comment: Another example of CARB’s push toward unilaterally expanded enforcement authority is found in CARB’s proposal to reject manufacturers’ “good engineering judgement” whenever CARB staff determines, presumably based on their own subjective assessments, “that a different decision would reflect a better exercise of good engineering judgement.” (See Proposed Regulation §2141(f)(4)(D)(2).) The potential ramifications of that new, largely unfettered authority are both sweeping and fundamentally disruptive of the regulatory paradigm that has existed on a nationwide basis for decades, where manufacturers’ good engineering judgement is an accepted criterion for multiple testing and certification-related requirements. For CARB to seek to claim unto itself the sole authority to determine in all cases what might be “a better judgement” could completely undermine the orderly implementation of critical well-established certification protocols and practices. CARB should abandon that additional effort toward unilateral and largely unbridled enforcement authority.

To the extent that CARB remains set on questioning what constitutes a manufacturer’s good engineering judgement, CARB should clarify that: (i) the

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<sup>135</sup> *Id.* at p. 152.

proposed provisions in §2141(f) apply only to the implementation of the EWIR Regulations, and not generally across all of CARB's HDOH Regulations; (ii) any decision to reject a manufacturer's good engineering judgement will be applied on a prospective basis only, and not retroactively to assess liability after the fact; and (iii) in those instances where CARB determines to reject a decision that a manufacturer has made using good engineering judgement, the manufacturer will have the right to challenge CARB's determination in proceedings held before an administrative law judge. Finally, if CARB elects to proceed with this regulatory shift away from the established principles of good engineering judgment, CARB should provide clear examples of the types of cases where, in CARB's view, it would be appropriate for CARB staff to substitute their good engineering judgement for the manufacturer's. Without those clear examples, this regulatory revision could quickly become arbitrary and unreasonable. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not change the Proposed Amendments in response to this comment. The Amendments explicitly define when good engineering judgment is not being used as instances where "incorrect information was deliberately used in the decision-making process, that information was deliberately overlooked, that the decision was not made in good faith, or that the decision was not made with a rational basis." This criterion ensures that CARB will not subjectively or arbitrarily determine that good engineering is not being used and provides examples of when good engineering is not being used. As described in the ISOR, the proposed regulatory language concerning good engineering judgement is necessary because of egregious examples of manufacturers consciously applying poor engineering judgement in the past in submittals to CARB (for example, deliberately ignoring or excluding data that supported a conclusion contrary to what the manufacturer was claiming).

The criteria will not be applied retroactively. 13 CCR 2141(f) explicitly states that it will only apply to 2024 and subsequent MYs. Also, 13 CCR 2141 consists of general provisions that only apply to warranty reporting.

- (d)i.5. Comment: Similarly unreasonable is the proposed requirement to report warranty claims during any extended warranty offered by an OEM, including when the tracking and reporting would have to continue out to FUL, which would cover as many as 12 to 13 years. The requirement for reporting through any OEM-extended warranty periods would penalize OEMs that offer extended warranties by increasing the reporting period and also increasing the chance that an OEM would reach the 1% level, or more importantly, the 4% field-action requirement level. Extending the period of warranty coverage for customers should not be penalized. The warranty reporting requirement should conclude at the end of CARB's proposed longer regulatory warranty periods. (EMA, Daimler, Navistar, Volvo)

Agency Response: No change was made in response to this comment. CARB staff disagrees with the assertion that manufacturers would be penalized for taking corrective action. Manufacturers would not be penalized for taking corrective action to address an in-use issue. The purpose of the extended warranty reporting is to ensure that the corrective action taken by manufacturers is successful and that replacement parts adequately address the in-use issues that the original versions of the parts were experiencing. This provision will help CARB staff determine the effectiveness of a manufacturer's solution to the in-use issue.

Manufacturers are already tracking the warranty claim rate for the replacement parts when an extended warranty is issued. Though manufacturers may be more likely to reach the 1 percent EWIR reporting threshold if required to report throughout the extended warranty period, further reporting and corrective action thresholds increase as vehicles age. Further reporting is only required at 4 percent within the first 5 years. The threshold is increased for later years (i.e., to 5 percent for years 6 and 7 and to 7 percent for years 8 to 10). Additionally, it is expected that warranty claim rates for replacement parts will not exceed reporting thresholds as they would have been improved so that they would not be susceptible to the same failure modes that the original versions of the parts were.

- (d)i.6. Comment: The EWIR provisions as proposed can have far-reaching effects. If a part reaches the 4% failure rate, for example, and a recall is required despite the lack of an emissions increase, the remaining 96% of the vehicles equipped with that part must be removed from the road for some period of time, depriving the owner of its ability to haul goods or do work, and interfering with the operations of that trucking company and its contracts with customers. The proposed EWIR provisions also would cause a substantial increase in required parts-manufacturing, which will increase emissions, as will the transportation of the new parts to the company warehouse, and then the shipping of those parts to all dealerships. Using a "fix-when-it-fails" approach and covering the customer cost with an extended warranty is far better for the environment than recalling 96% of the vehicles that are working properly at that time. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not change the Proposed Amendments in response to this comment. CARB staff would only require recall of critical emission-related components such as EGR valves, turbochargers, aftertreatment devices, etc. Vehicle owners would be able to plan and schedule for the recall repairs to be made as they would be notified of the necessary repair once the recall is launched. The required corrective action for the majority of components would be providing an extended warranty to the full useful life period following the "fix-as-fail" approach recommended by industry.

- (d)i.7. Comment: CARB proposes that if a 2024 or subsequent MY engine family or test group does not comply with the HDIUT requirements in title 13, CCR,

§§ 2111-2140, and Part II, Subpart T, or with the EWIR requirements in title 13, CCR, §§ 2141-2149, or if engines in a family are equipped with an emission control component that exceeds the thresholds specified in title 13, CCR, § 2143 (and the component was not improved for the model year for which certification is requested), a manufacturer cannot request a carryover or carry-across certification application based on data from that engine family or test group.

This new California provision focusing on failures of in-use testing of prior model years, or emission control component failures as low as 4% or 25 units where an improved component is not ready for production, would dramatically impact an OEM's ability to complete CARB's certification process in a timely or cost-efficient manner in advance of the start of new model years. Moreover, CARB is not clear regarding the potential consequences of this proposed change. It is unclear whether the restriction is that an OEM cannot check the "Carryover certification" box on the application, or that CARB will not certify the family without a complete set of new data, or, even worse, that the engine family cannot be certified at all. CARB should clarify the limitations imposed under its proposal. In that regard, CARB should recognize the potentially severe timing consequences at issue. For example, if a manufacturer's currently certified family should reach one of the carry-over-disqualifying conditions late in the year during which the carryover or carry-across application is pending, what will the consequences be? Any potential consequences clearly should not lead to production shut-downs or other overly disruptive outcomes. (EMA, Daimler, Navistar, Volvo)

Agency Response: Based on this comment, CARB staff in the 30-Day changes proposed to modify the requirement that would have prevented manufacturers from being able to request a carryover or carry across application based on data from an engine family or test group that is equipped with an emission control component that exceeds the thresholds specified in 13 CCR 2143 that has not been improved for the MY for which the application is for. Engine manufacturers have expressed concern about possible disruption to business practices and potential delays in production if emission control components exceed thresholds specified in 13 CCR 2143. The proposed change would allow manufacturers to request a carryover or carry across application based on data from an engine family or test group that is equipped with such an emissions control component only if they extend the emissions warranty coverage for that component to the full useful life period of the engine or test group for which certification is sought. The proposed change would address manufacturers' concerns while ensuring that emission control components with known defects will be functioning as intended throughout the useful life period because they will be repaired or replaced if a failure occurs.

Additionally, CARB staff in the 30-Day changes proposes an amendment to clarify that manufacturers must redesign, recalibrate, or manufacture a

component differently in order to demonstrate that it will not experience failures as it did for the previous MY. This may be achieved through modifications of hardware or software. The Proposed Amendments clarify that improvements to the component should address known defects from the previous MY.

- (d)i.8. Comment: The concerns relating to CARB's strict-liability approach to EWIR-related issues are heightened due to CARB's push to extend the emissions warranty provisions in 2027 and again in 2031 (up to 10 years and 600,000 miles) to "California-certified 2027 and subsequent model heavy-duty vehicles, regardless of whether they are registered in California." CARB does not have the authority to burden interstate commerce to such an extent, especially for vehicles registered and operated outside the borders of the State of California. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not change the Proposed Amendments in response to this comment. The Amendments already include increased thresholds to account for the longer warranty and reporting periods. As engines get older, they will be subject to higher thresholds because it may have been too stringent to require manufacturers to comply with the current thresholds for a longer warranty period.

CARB staff disagrees with the commenter's assertions that it lacks the authority to establish emission warranty requirements for new motor vehicles and new motor vehicle engines certified to California emission standards, and that such requirements must be limited to new motor vehicles and new motor vehicle engines registered and operated within California. CARB staff is removing the California-registered requirement for the warranty applicability to address the emissions from HD vehicles that are originally sold and registered in California, and are later resold and re-registered outside of California. Please see the Agency Response to Comment A.(c)iii.3 for the applicable sections in the Health and Safety Code (H&SC) that grants this authority.

CARB is authorized to adopt standards, rules, and regulations, and to perform such acts as may be necessary for the proper execution of the powers and duties granted to and imposed upon the Board by law (California H&SC sections 39600 and 39601). H&SC sections 39002 and 39003 place the responsibility for controlling air pollution from motor vehicles on CARB, and H&SC section 38560 directs CARB to adopt rules and regulations to achieve the maximum technologically feasible and cost-effective GHG emission reductions from sources, including mobile sources. CARB is also authorized to adopt and implement emission standards for new motor vehicles that are necessary and technologically feasible (H&SC section 43101), to adopt test procedures and any other procedures necessary to determine whether vehicles and engines are in compliance with the emissions standards established under Part 5 of the H&SC (section 43104), and to not certify a new motor vehicle or motor vehicle engine unless the vehicle or engine meets the emission standards adopted by CARB

pursuant to Part 5 of the H&SC under test procedures adopted pursuant to section 43104.

Certification specifically encompasses requirements that motor vehicle and motor vehicle engine manufacturers must warrant to ultimate purchasers and to subsequent purchasers that new motor vehicles and motor vehicle engines other than light-or medium-duty vehicles or engines are designed, built, and equipped to conform with applicable emission standards for a period of use determined by CARB, and are free from defects in materials and workmanship that cause such motor vehicles and motor vehicle engines to fail to conform with applicable requirements for the same or lesser period of use determined by CARB. Notably, H&SC section 43205.5 does not limit the aforementioned warranty requirements to motor vehicles or motor vehicle engines that are registered for use in California, but rather broadly applies to motor vehicles and motor vehicle engines that are produced on and after the 1990 MY that are certified to California emission standards.

The federal CAA authorizes the U.S. EPA to establish emission standards and other emission related requirements for new motor vehicles and new motor vehicle engines, and generally prohibits states and their local governments from adopting or enforcing separate emission standards and other emission related requirements for new motor vehicles or new motor vehicle engines.<sup>136</sup> However, California is the only state that is authorized, in the first instance, to adopt and enforce its own new motor vehicle and new motor vehicle engine emission standards and other emission related requirements, provided that it obtains a waiver of preemption from section 209(a) of the CAA from the Administrator of the U.S. EPA.<sup>137</sup>

The commenter improperly asserts that the aforementioned warranty requirements, when applied to California-certified motor vehicles and motor vehicle engines, burden interstate commerce. Article I, §8, cl. 3 of the United States Constitution states that the Congress has the power “[t]o regulate Commerce among the several States.” Courts have long recognized that this affirmative grant of power also includes an implicit or “dormant” limitation on the authority of states to affect interstate commerce. *Healy v. Beer Institute* 491 U.S. 324, 326, fn 1 (1989).

The threshold issue to be resolved in a Commerce Clause challenge to a state law is whether Congress has exempted that law from Commerce Clause scrutiny. Congress’ enactment of the CAA provisions allowing only California, in the first instance, to adopt and enforce new vehicle emission standards and other emission related requirements, such as the emissions warranty requirements at issue, in § 209(b), and new and in-use nonroad engine standards and emission-related requirements in § 209(e)(2)(A) of the federal

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<sup>136</sup> CAA § 209(a); 42 U.S.C. § 7543(a).

<sup>137</sup> CAA § 209(b)(1); 42 U.S.C. § 7543(b)(1).

CAA, clearly evidence its intent to exempt California's on and off-road vehicle and engine standards and emission-related requirements from Commerce Clause restrictions. Furthermore, the legislative history of the federal CAA indicates that Congress was fully aware that allowing states to establish their own separate motor vehicle emission standards would disrupt interstate commerce, and it therefore preempted the states from establishing their own motor vehicle emission standards. However, Congress specifically exempted only California from the federal CAA section 209(a) preemption. "Rather than being faced with 51 different standards, as they had feared, or with only one, as they had sought, manufacturers must cope with two regulatory schemes under the legislative compromise embodied in § 209(a)." *Engine Mfrs Ass'n v. U.S.E.P.A.* 88 F.3d 1075, 1079 (D.C. Cir. 1996). See also *Motor and Equipment Mfrs. Ass'n, Inc. v. E.P.A.* 627 F.2d 1095, 1108 – 1111 (D.C. Cir. 1979). Congress determined that authorizing California to establish separate and more stringent standards than those applicable to the rest of the nation would not unduly disrupt interstate commerce. Instead of a Commerce Clause review, Congress enacted in sections 209(b) and 209(e) of the federal CAA a procedure requiring the Administrator of the U.S. EPA to review California's Regulations and to authorize it to adopt and enforce its unique emission standards and other requirements.

Therefore, both the text and history of the motor vehicle and nonroad preemption and waiver provisions of the federal CAA indicate that Congress intended to exempt the warranty requirements at issue from Commerce Clause scrutiny.

Even if Congress did not exempt the warranty requirements from Commerce Clause scrutiny, as demonstrated in greater detail below, those requirements are not inconsistent with the provisions of the Commerce Clause.

In determining whether a state law violates the Commerce Clause, a court first determines if the law discriminates against interstate commerce, either on its face or in practical effect (*Hughes v. Oklahoma* (1979) 441 U.S. 322, 336)), *i.e.*, if the law accords differential treatment of in-state and out-of-state economic interests that benefits the former and burdens the latter. Such laws are virtually *per se* invalid. *United Haulers Ass'n at 338*, and will only survive if they "advance[] a legitimate local purpose that cannot be adequately served by reasonable nondiscriminatory alternatives." *Oregon Waste Systems Inc. v. Department of Environmental Quality of State of Oregon* (1994) 511 U.S. 93, 100-101.

The warranty requirements neither facially discriminate nor discriminate in practice against interstate commerce because they only apply to new motor vehicles and new motor vehicle engines that are certified to California emission standards for sale and use in California – they simply do not apply to new motor vehicles and new motor vehicles certified to federal emission standards for sale and use in States other than California.

The U.S. Supreme Court has held in certain situations that a state law that directly regulates commerce outside of that state's boundaries violates the Commerce Clause. This principle has been referred to as the extraterritoriality branch of the dormant Commerce Clause. In *Healy v. Beer Institute* (1989) 491 U.S. 324, the U.S. Supreme Court held that a Connecticut price affirmation statute for beer violated the Commerce Clause because it regulated out-of-state commerce by controlling prices and marketing practices in other states. Specifically, that statute effectively required interstate beer sellers to forego available promotional and volume discounts in other states, which deprived those sellers of any competitive advantages that might exist in bordering States. The *Healy* Court also found that the statute facially discriminated against interstate commerce. *Healy* (1989) 491 U.S. 324, 340.

In *Edgar v. MITE Corp.*, (1982) 457 U.S. 624, a plurality of the U.S. Supreme Court would have invalidated a statute regulating corporate takeovers on extraterritoriality grounds. The plurality found the statute would allow Illinois to regulate out-of-state transactions that had no significant connections to Illinois (i.e., the statute could be applied to regulate tender offers that would not affect a single Illinois shareholder). However, a majority of the Court ultimately invalidated the statute under the *Pike* balancing test discussed below.

The U.S. Supreme Court has not held, however, that the extraterritoriality doctrine per se invalidates state regulations that incidentally or indirectly regulate out-of-state commerce, but has upheld a state's ability to regulate extraterritorial commerce that has a direct nexus to that state and that substantially impacts that state. In *CTS Corp. v. Dynamics Corp. of America* (1987) 481 U.S. 69, the Court upheld an Indiana corporate takeover statute against a Commerce Clause challenge. The Court distinguished that statute from the Illinois statute in *MITE* in that the Indiana statute only applied to corporations with substantial numbers of shareholders in Indiana and would therefore affect a substantial number of Indiana residents. *Id.* at 93. The Court notably did not hold that the statute was invalid simply because it could also possibly regulate out-of-state transactions (i.e., non-Indiana corporations seeking to purchase shares from non-Indiana shareholders). Federal Courts of Appeal have similarly rejected assertions that state regulations that only incidentally affect out-of-state transactions are per se invalidated by the extraterritorial doctrine. *Alliant Energy Corp v. Bie* (7<sup>th</sup> Cir. 2003) 336 F.3d 545

The emissions warranty requirements do not raise the same issues that concerned the *Healy* and the *MITE* Courts. Unlike the price affirmation statute in *Healy*, the warranty requirements do not practically regulate commercial activity beyond California's borders; because those requirements only apply to motor vehicles and motor vehicle engines certified to California standards, they do not and cannot affect motor vehicles or motor vehicle engines that are certified to federal standards for sale in States other than California.

Even assuming, arguendo, that the emissions warranty requirements incidentally or indirectly affect out-of-state commerce, they do not directly regulate out-of-state commerce in a manner that is inconsistent with the Commerce Clause. Unlike the *MITE* statute, the emissions warranty requirements have a significant nexus to California interests – the requirements were specifically developed to ensure that the emissions control systems on motor vehicles and the motor vehicle engines certified for sale and use in California remain operational throughout a greater portion of their service lives, that incentives for owners to tamper or not properly maintain vehicles and engines are reduced, and to encourage manufacturers to design and produce more durable emission control systems and parts – which will collectively reduce the in-use emissions generated from HD vehicles that travel on California’s highways that directly affect California’s economic well-being, public health, natural resources, and environment. The emissions warranty requirements are therefore more akin to the statute in *CTS* because they have a direct nexus to in-use emissions of criteria pollutants that substantially impacts California, and is therefore consistent with the extraterritoriality doctrine.

If a court determines that a state law does not discriminate against interstate commerce or directly regulate commerce outside of the state’s boundaries, it then balances the law’s local benefits against its burdens on interstate commerce to determine if the law violates the federal Commerce Clause. *Pike v. Bruce Church* (1970) 397 U.S. 137, 142. The Supreme Court has stated that state regulations frequently pass muster under the Pike test. *Department of Revenue of Ky. v. Davis* (2008) 533 U.S. 328, 339. Under this test the state law will be upheld unless it imposes a burden on interstate commerce that is clearly excessive in relation to the putative local benefits. “If a legitimate local purpose is found, then the question becomes one of degree. And the extent of the burden that will be tolerated will of course depend on the nature of the local interest involved, and on whether it could be promoted as well with a lesser impact on interstate activities.” *Ibid.* Furthermore, courts will accord a greater presumption of validity to a state’s laws in the field of safety. *Pike* 397 U.S. 137, 143.

Courts recognize that preventing air pollution is and has been a traditional local safety concern. *Huron Portland Cement Co. v. Detroit* (1960) 362 U.S. 440, 445-446. This recognition is also expressed in the federal CAA section 101(a)(3), where the U.S. Congress declared that states and local governments are primarily responsible for preventing air pollution, and in California H&SC sections 39000 and 39001, where the California legislature declared a strong public interest in controlling air pollution to protect the “health, safety, welfare, and sense of well-being” of Californians.

As documented in the record for this rulemaking action: medium- and HD vehicles and the engines powering such vehicles are significant sources of criteria pollutant emissions in California; large numbers of such vehicles and

engines exceed applicable emission standards when tested in-use and exhibit high emissions warranty claim rates for major engine components; and a majority of vehicle owners do not repair defective emission control components that do not affect vehicle performance or fuel economy. The warranty requirements address these factors that result in increased emissions of criteria pollutants in California, and are therefore an important element of CARB's strategy to reduce such emissions. These considerations establish that this regulation serves the legitimate public purpose of protecting the health and welfare of California's residents, which purpose "clearly falls within the exercise of even the most traditional concept of what is compendiously known as the police power." *Huron Portland Cement Co.* (1960) 362 U.S. 440, 442.

If a court determines that the justifications for a state safety-based regulation are not illusory, as it would likely find in this case, it will accord the regulation significant deference. *Raymond Motor Transportation v. Rice* (1978) 434 U.S. 429, 449 (Blackmun, J., concurrence). The court will then assess the regulation's burden on interstate commerce. The warranty requirements at issue here do not unduly burden interstate commerce simply because the requirements only apply to vehicles and engines certified for use and sale in California, so that the entirety, or vast majority of the associated compliance costs will be passed by manufacturers to onto California consumers. Moreover, as discussed in the immediately preceding paragraph, the warranty requirements provide significant benefits to California because they are anticipated to limit and reduce the levels of emissions of harmful pollutants that are emitted by in-use HD engines and vehicles.

These considerations demonstrate that the warranty requirements do not impose a burden on interstate commerce that clearly exceeds its benefits of protecting the health and welfare of California's residents, and would likely be held not to unconstitutionally burden interstate commerce under the *Pike* balancing test.

- (d)i.9. Comment: [W]e ask CARB not to finalize the proposed changes to emissions warranty reporting, corrective actions, warranty periods and useful life periods. Changing those requirements at the same time as introducing new technology will increase prices further and likely impact the adoption of those technologies in the market. (Cummins)

Agency Response: No change was made in response to this comment. CARB agrees that changing the requirements as well as introducing new technology will increase prices, but disagrees that prices will increase so much that adoption of new technologies will be impacted in the market. Additionally, it is expected that vehicle owners will experience cost savings due to the new requirements which will offset some of the upfront price increases.

## (d)ii. Field Information Report

- (d)ii.1. Comment: Another burdensome and unreasonable EWIR-related proposal specifies that if a manufacturer amends a Field Information Report (FIR) by adjusting the number or percentage of failures, it must be done on the basis of an analysis of a new set of components. Often, the reason for amending the FIR is because the population of engines with that component has changed, typically due to new information or additional vehicles being sold into or out of California. There is no basis in such a case for an examination of “new parts.” The exercise would be wasteful. CARB should remove that provision from any Final Rule. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not change the Proposed Amendments in response to this comment. Requiring manufacturers to analyze a new set of parts would ensure that the new analysis would be based on more recent information that would more accurately represent the performance and status of the parts that are currently in-use. Also, oftentimes analyzing the same set of parts would not result in an adequate analysis as parts may degrade over time or may have been destroyed when they were first analyzed.

- (d)ii.2. Comment: CARB also is seeking to impose requirements on OEMs to retain failed components for a minimum of two years following the submittal of an FIR. That proposed requirement is problematic for several reasons. The 2022MY to 2026MY emissions warranty requirement is 5 years/350,000 miles. CARB has estimated that this could require the retention of 70 component parts for each FIR. FIRs are filed by part number, by engine family, and by model year. If we make the simple assumption that the average FIR is filed 3 years after the build model year, and that the accumulation of parts (by part number, by family and by model year) is 15 parts in Year 1, 40 parts in Year 2, and 70 parts in Year 3 through Year 5, the average number of parts in storage per part number, per family, per MY, is 53 parts  $((15 + 40 + 70 + 70 + 70)/5)$ . Among the 30 or so Emissions Related Component (ERC) part numbers on an engine, not all ERC part numbers will have FIRs filed. If we assume FIRs are filed for 10 out of 30 ERC part numbers, and another 10 ERCs only reach one-half the FIR threshold, and that the final 10 of 30 total ERCs have no failure issues, then the average accumulation of parts in storage for all ERCs per family, per model year, is 800 parts  $(10 \times 53 + 10 \times 0.5 \times 53 + 10 \times 0)$ . If we further assume that an OEM has 3 engine families, and multiply that number by the 5 overlapping model years of “average” storage requirements, the typical required quantity of parts in storage at any point in time could be 12,000 parts  $(800 \times 3 \times 5)$ . Some OEMs have estimated parts-storage requirements much higher than this estimation based on their reading of the proposed regulations. In any case, these estimated numbers are expected to grow substantially as additional ERCs are added to the engine-systems to comply with the proposed Low-NOx standards.

Current warranty processes do not lend themselves to retaining failed parts in this unreasonable way. Very often, failed components are sent to suppliers for analysis. Sometimes the fault investigation involves destroying the failed component. Even where parts are retained, there would be no benefit to holding 50 components with exactly the same failed condition. (EMA, Daimler, Navistar, Volvo)

Agency Response: Based on industry feedback, it was determined that physically storing parts for two years could be overly costly and burdensome and cause logistical problems. In response to the commenter's concern, CARB staff changed the Proposed Amendments to no longer require manufacturers to physically store parts, but rather manufacturers would be required to store failure mode and part analysis and identifying information throughout the useful life period of the engine family or test group and provide it to CARB upon request. This change would address manufacturers' concerns with being required to physically store parts, while still providing CARB with an increased ability to verify information provided warranty reports and evaluate failure mode analysis methodology used by manufacturers.

- (d)ii.3. Comment: There also are a number of concerns regarding CARB's interest in having the parts sent to CARB facilities. These are components that the OEM has openly declared through the FIR process to be failed parts. If CARB anticipates performing additional inspection or analysis of failed components, are manufacturers to expect that CARB will be second-guessing the conclusions drawn by OEMs' technical experts and suppliers? Does CARB expect to be able to draw better, more accurate conclusions from its own component analysis, especially without the benefit of drawings, specifications, test rigs, supplier interaction, and the extensive history that OEM specialists have gained with those components during the course of their development? Moreover, parts that may have sat on a shelf for up to seven years may have undergone degradation, including due to the effects of corrosion, that could lead to incorrect conclusions by CARB personnel in any follow-on inspections. (EMA, Daimler, Navistar, Volvo)

Agency Response: Based on industry feedback, CARB staff has determined that it is not necessary to require manufacturers to send failed parts to CARB facilities. In response to the commenter's concern, CARB staff changed the Proposed Amendments to instead require manufacturers to collect information about parts that are analyzed electronically and submit that information to CARB upon request. This will address manufacturers' concerns about storing and sending parts while still allowing CARB staff to obtain more information about failed parts if necessary.

### **(d)iii. Corrective Action**

- (d)iii.1. Comment: Warranty claims and component failures can be the result of upstream failures or system performance issues. In those cases where a root-cause investigation determines that the failure is actually caused by an upstream issue, CARB should not compel corrective action for the downstream component. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not change the Proposed Amendments in response to this comment. Manufacturers will have the opportunity to screen out warranty claims that are not considered valid failures in the field information report. This includes failures that are a result of an upstream issue. This is how the program currently works and this aspect of the program will not be modified.

- (d)iii.2. Comment: Another unreasonable element of the proposed requirements is that CARB would require a corrective action plan within 90 days of exceeding the corrective action threshold, including root-cause analysis (§ 2169). Inasmuch as the threshold could be reached with as few as 25 failed components, 90 days is inadequate time to determine a root cause, define a solution, verify its effectiveness, plan the tooling changes needed, verify and release the software changes, and plan the procurement of a sufficient stock of parts to allow the recall to proceed. The required timing is therefore wholly unreasonable and unworkable. Having an initial discussion with CARB within 90 days of reaching the corrective action threshold for a potential recall may be appropriate. Having all of the data required in § 2169, however, is absolutely not reasonable within the proposed 90-day period. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not change the Proposed Amendments in response to this comment. This requirement would only require manufacturers to submit a corrective action plan within 90 days of exceeding the corrective action threshold. Manufacturers would not have to implement the corrective action within 90 days of exceeding the threshold. Since only the plan must be submitted manufacturers would have additional time ensure that a sufficient stock of parts is available and all necessary tooling changes are ready. Manufacturers are constantly monitoring failure rates and are able to estimate when the threshold will be exceeded and therefore begin preparing the corrective action plan and implementation schedule prior to exceeding the threshold. Additionally, based on CCR 2169.8, manufacturers may be granted an extension if good cause for an extension is demonstrated.

- (d)iii.3. Comment: CARB also proposes to extend warranties to FUL for any parts replaced through a recall program, and to require reporting on the replaced components through FUL. When a recall is mandated under CARB Regulations, the OEM in effect commits millions of dollars to fix a part on up to 96% vehicles that have no evidence of excess emissions. As mentioned,

requiring both a recall and extended warranties is doubly punitive already, but also adding the reporting requirement for warranty claims on the replacement part could add one to five years of additional burden on OEMs that have already committed substantial staff and capital to resolving a 4% failure-rate issue. The additional requirement to monitor and report to that extent is extreme and unreasonable. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not change the Proposed Amendments in response to this comment. The purpose of the extended warranty is to ensure that replacement parts will last and function properly throughout the useful life period. It is expected that the failure rate for replacement parts used for a recall would be very low as the parts should be improved so that they are not susceptible to the same failure modes as the original versions.

Please see the Agency Response to Comment A.(d)i.5 regarding extended warranty reporting.

- (d)iii.4. Comment: CARB should revise proposed changes to emission warranty reporting and enforcement provisions. However, CARB's proposed large reduction for the defined reporting threshold is a 50% step down and CARB should not finalize regulations which would automatically trigger recall or corrective actions based solely on exceedance of reporting thresholds. Instead, CARB must assess whether any defects are significant and/or significantly impact emissions. (Allison)

Agency Response: CARB staff did not change the Proposed Amendments in response to this comment. The defined reporting thresholds are not a 50 percent step down from current thresholds. The thresholds have been modified to account for small volume engine families. For example, the reporting threshold for the emission warranty information report will be changed from 1 percent or 25 unscreened warranty claims (whichever is greater) to 1 percent or 12 unscreened warranty claims (whichever is greater). If 1 percent of an engine family's population is greater than 12 the engine family would not be impacted by the modification.

Regarding the consideration of the emissions impact when determining if corrective action is necessary, please see Agency Response to the comment A.(d)i.1.

#### **(d)iv. EWIR Definitions**

- (d)iv.1. Comment: CARB is proposing to define "Emission Warranty Claim" as meaning "an adjustment, inspection, repair or replacement of a specific emission-related component within the statutory warranty period for which the vehicle or engine manufacturer is invoiced." That definition is overly-broad. Inspection of a component does not imply any type of failure if there is no

issue found upon inspection. Moreover, the adjustment of an emissions-related component as a matter of routine maintenance, where the original setting is not found to be outside manufacturers' allowable settings, should not constitute a failure. Finally, manufacturers will sometimes perform replacements of certain components without evidence of failure as a measure of goodwill for customers. CARB should limit the definition of Emissions Warranty Claim to remove those types of cases from the scope of the definition. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not change the Proposed Amendments in response to this comment. The purpose of the EWIR report is to track the unscreened warranty claim rate. The need to inspect a part most likely indicates that there is a potential issue with the part that needs to be corrected. After inspecting the part and determining that no trouble is found manufacturers have the opportunity to screen the claim out as not being a valid failure in the field information report. Adjustments or repairs that are considered to be part of routine maintenance should not be counted as a warranty claim as vehicle owners are responsible for covering the cost of the repairs.

CARB staff has not observed it to be a common occurrence for manufacturers to replace certain components without evidence of a failure as a measure of goodwill for customers. These cases should be counted as warranty claims as manufacturers are responsible for the cost of the repairs. Manufacturers have the opportunity to screen out these types of claims in the field information report.

- (d)iv.2. Comment: In addition, CARB's proposed definition of "ERC" includes not only components that (1) affect regulated emissions and (2) illuminate the MIL, but also includes any component that "is part of the configuration of a California certified HD diesel or Otto-cycle engine, or HD vehicle." While the term "configuration" is confusing (should this be "certified configuration"?), the quoted section of the definition also appears to be redundant. Would any component that is either affecting emissions (and on the regulated ERC list) or that illuminates a MIL not already be "part of a [certified] configuration..."? CARB should remove this unnecessary and redundant element from the definition of "ERC" to avoid confusion. (EMA, Daimler, Navistar, Volvo)

Agency Response: In response to this comment, regulatory language has been corrected to state "certified configuration." Part three of the definition was included to make it clear that parts that are not part of the certified configuration would not subject to corrective action.

- (d)iv.3. Comment: CARB's definition of "Extended Warranty" references a time period that is "at a minimum equal to or more than the applicable certified useful life period of that vehicle or engine." CARB does not have the authority to extend warranties beyond the statutory useful life period and so should consider that

useful life period as the maximum extended warranty period, not the minimum. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not change the Proposed Amendments in response to this comment. CARB staff does not intend to require extended warranties that go beyond useful life period as part of normal corrective action. The definition states that the extended warranty must be “at a minimum equal to or more than the applicable certified useful life period” because manufacturers will be required to extend the warranty to the useful life period as part of normal corrective action, and manufacturers may extend the warranty period beyond the useful life period if they determine that it is necessary.

- (d)iv.4. Comment: CARB’s definition of “Systemic Failure” is stated as “any emissions-control component found to have valid failures that exceed the thresholds in §2143.” That definition is inaccurate, as it fails to account for the case where a component may have more than one failure mode. A single particular failure mode that exceeds the §2143 thresholds should be what constitutes a “systemic failure.” The same argument applies to the corollary provisions of §§ 2167 and 2168, which should be revised accordingly.<sup>138</sup> (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not change the Proposed Amendments in response to this comment. The number of valid failures is based on the total number of failures, regardless of the failure mode. Parts with multiple failure modes should not be counted separately when determining if the failure rate for that component exceeds the corrective action threshold, because failures above the threshold indicate a potentially significant problem and impact to emissions. This is how the program is currently being implemented, and this will not be changed by these amendments.

## **(e) Comments Related to Emissions ABT Program Amendments**

### **(e)i. General Comments Related to ABT Program Amendments**

- (e)i.1. Comment: CARB has proposed to apply a NOx FEL cap of 0.10 g/bhp-hr to model year 2024 through 2026 engines, and 0.05 g/bhp-hr to MY 2027 and later engines. Those unnecessarily low FEL caps again will disincentivize manufacturers from participating in the ABT program. EMA recommends that CARB follow the historical practice of setting the FEL cap at the level of the prior emissions standard; that is, to 0.20 g/bhp-hr for NOx. (EMA, Daimler, Navistar, Volvo)

Agency Response: Based on this comment, CARB staff has introduced a new certification pathway for legacy engines in 2024 and 2025 MYs with FTP NOx

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<sup>138</sup> The definition of “on-board computer” is overly broad, and should be limited to a “computer” that monitors and/or controls five or more sensors, systems or actuators.

FELs up to 0.20 g/bhp-hr, which has the same effect as raising the FTP NO<sub>x</sub> FEL cap to 0.20 g/bhp-hr for some MY 2024 to 2025 engines. This new certification pathway enables engine manufacturers to produce limited quantities of legacy engines in 2024-2025 MYs and help avoid any product availability issues in that period. This pathway would not lead to any adverse environmental impacts because all excess NO<sub>x</sub> and PM emissions from legacy engines must be offset with NO<sub>x</sub> and PM emission credits from other sources.

- (e)i.2. Comment: CARB has proposed to define “California Sales Volume” as “the number of new California-certified engines or new vehicles sold in a given model year within the State of California.” CARB’s definition requires additional detail. CARB staff needs to address key considerations, such as how to account for certified engines in the production pipeline, and for complete vehicles that remain unsold on dealer lots after the beginning of a subsequent model year. Further, the draft Regulation should clarify the treatment of engines or vehicles “first introduced for sale” in California, to avoid OEMs having to track vehicles that are traded among dealers across state lines. (EMA, Daimler, Navistar, Volvo)

Agency Response: Based on this comment, CARB staff has revised the definition of California sales volume to be the number of new California-certified engines or hybrid powertrains or ZEPs sold to an ultimate purchaser in the State of California in a given MY.

Please note that this definition is used for calculating the accumulated emission credits within a given MY. The end-of-year reports are due 180 days after the end of MY, and manufacturers have an additional 90 days to update the information. Therefore, there should not be any issues in terms of “engines in the production pipeline,” or for “complete vehicles that remain unsold on dealer lots after the beginning of a subsequent MY.” It should be noted that this 270-day period is consistent with the timelines currently used for submittal of annual certification fees by HD on-road engine manufacturers, where annual reports are due no later than September 30<sup>th</sup> following the end of each MY. Given that engine manufacturers have been submitting annual certification fee reports for over a decade, CARB staff does not believe any other flexibility for submitting the end-of-year reports is needed.

- (e)i.3. Comment: The 90-day period is insufficient to prepare and submit an accurate ABT report, given the intricacies of tracking production, distribution, and sales of engines and vehicles in the HD market. EMA recommends, consistent with our comments on EPA’s 2020 Technical Amendments Notice of proposed Rulemaking (NPRM),<sup>139</sup> that the ABT report be submitted within 180 days of the year-end. Manufacturers should then have an additional 90 days (in effect, 270 days from the end of the model year) to submit any

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<sup>139</sup> Improvements for Heavy-Duty Engine and Vehicle Test Procedures, and Other Technical Amendments; Proposed Rule, EPA-HQ-OAR-2019-0307, 85FR28140-28361, May 12, 2020.

corrections, if necessary. EMA also recommends that errors in ABT reports should be corrected regardless of impact to a manufacturer's credit position, or should not be accepted at all after the 270-day correction deadline. Finally, manufacturers should be allowed to request a reporting extension as circumstances may warrant. (EMA, Daimler, Navistar, Volvo)

Agency Response: Based on this comment, CARB staff has revised the deadline for submitting the end-of-year report to 180 days after the end of MY, and an additional 90 days are provided to update the information. The language for correcting the reports and its impacts on the manufacturers is identical to the federal requirements as described in 40 CFR 86.098-23 (h)(3)(iv) last amended April 28, 2014. Finally, CARB staff does not believe that additional extensions for submitting reports are warranted. It is important to recognize that the reporting deadlines are structured to provide manufacturers enough time to remedy any ABT deficits as soon as practical. Extending the reporting deadlines would only serve to further delay the remediation of non-compliance which should have been remedied in a timely manner.

- (e)i.4. Comment: Second, establishing a sunset date for newly-generated credits under this program disincentivizes manufacturers that might otherwise seek to take advantage of the ABT provisions to launch earlier introductions of lower-emissions engines. The 5-year sunset provision thereby limits the environmental gains CARB consistently attributes to ABT programs. CARB should follow the practice established under EPA's and CARB' MY 2007/2010 Regulation, which does not assign an expiration date to credits generated under the program. (EMA, Daimler, Navistar, Volvo)
- (e)i.5. Comment: CARB should not assign an expiration date to credits generated under the federal ABT program. It is manifestly unfair to retroactively assign a shelf-life to credits that were generated under the provisions of a regulation where no expiration or sunset dates were defined, and therefore not anticipated. (EMA, Daimler, Navistar, Volvo)

Agency Response to Comments (e)i.4 and (e)i.5: CARB staff did not make any changes to the Proposed Amendments based on these comments. A regulatory provision may present either a primary or a secondary retroactive effect. "Primary" retroactivity is altering 'the past legal consequences of past actions.' 20th Century Ins. Co. v. Garamendi, 8 Cal. 4th 216, 281 (1994), citing Bowen v. Georgetown Univ. Hosp., 488 U.S. 204, 219 (1988). "Secondary" retroactivity is altering "the future legal consequences of past transactions." (20th Century Ins. Co. v. Garamendi, 8 Cal. 4th 216, 281 (1994), citing Nat'l Med. Enterprises, Inc. v. Sullivan, 957 F.2d 664, 671 (9th Cir. 1992). "Secondary" retroactivity is "an entirely lawful consequence of rulemaking and hence does not itself offend any law, including the United States and California Constitutions and their respective due process clauses." 20th Century Ins. Co. v. Garamendi, 8 Cal. 4th 216, 281-282 (1994).

In this case, establishing an expiration date for previously generated credits presents only a permissible secondary retroactive effect because it only alters the future legal consequences of past transactions (i.e, it limits the ability of manufacturers to utilize previously generated credits to comply with California requirements in future model years), and does not impermissibly alter or affect manufacturers' past legal consequences of generating said credits.

The rationale for re-establishing sunset dates for credits is discussed in detail in the Staff Report (sections I.B.7, III.A.7). As noted in the Staff Report, credits used to have a three-year credit life when the federal-ABT program was amended for 1994 and subsequent MY engines. Based on requests from industry groups,<sup>140</sup> U.S. EPA removed the three-year credit life provisions to provide additional flexibility to engine manufacturers beginning with 2004 MY engines. U.S. EPA reasoned that even with an unlimited lifetime, all existing credits generated after the 2004 MY were expected to be used anyway by the 2010 MY. In other words, U.S. EPA assumed that all credits should be used within 6 years or less. However, that was not the case and many engine manufacturers currently have banked credits that were not utilized or needed in their transition to the 2007 and 2010 MY standards. CARB staff has had to address this in the Proposed Amendments by sunsetting all credits generated with pre-2010 MY engines. CARB staff believes that the absence of a credit life sunset requirement would undermine the benefits of emission standards as manufacturers could continue to use the credits to certify engine families to FELs above the applicable standards beyond what is needed to transition to the new standards and thus would negatively impact air quality in California.

- (e)i.6. Comment: Ford requests additional clarification of the methods that will be used to align the proposed ABT methodology with changes in engine FUL requirements proposed to occur in 2027 MY and 2031 MY. The value of an ABT program is to allow manufacturers to align their product plans and scheduled investments with the regulatory requirements. Programs scheduled ahead of regulatory changes can certify to FELs that generate credits while programs scheduled after regulatory changes can carry over at existing emission levels provided sufficient credits have been generated by other products. The ABT rules proposed by CARB appear to allow for such credit mechanisms to be applied to emission standards, but not to the new useful life requirements. As proposed, the 2027 MY and 2031 MY useful life requirements appear to apply as step change requirements to 100% of products in each of those model years. This eliminates the possibility of a manufacturer carrying over products from 2026 MY to 2027 MY or from 2030 MY to 2031 MY. Ford recommends that CARB revise the ABT rules and/or useful life requirements to allow manufacturers with sufficient emission

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<sup>140</sup> Summary and Analysis of Comments: Control of Emissions of Air Pollution from Highway Heavy-Duty Engines, United States Environmental Protection Agency, September 1997.  
<https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockkey=P100QQFN.pdf>

credits to carry over products through 2027MY and 2031 MY at their existing useful life levels. (Ford)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. Ford is correct in understanding that the Proposed Amendments will not allow an engine family certified to a lower useful life to be carry-over when the useful life increases, as is the case with engine useful life changes in MY 2027 and 2031. When the useful life changes with 2027 and 2031 MY engines, manufacturers will need to develop new emission DFs for those engine families that reflects the new useful life value. CARB staff has provided adequate lead time so that manufacturers can redesign their engines to make the engine's emission components more durable. It is important to understand that manufacturers have the ability to use generated credits with any MY engine, regardless of whether the certification useful life has changes so long as they use the credits within five years of when those credits were generated. For example, a manufacturer could generate credits with the 2026 MY and use them to help comply with the 2027 MY. However, as was discussed in the August 2, 2018, workgroup meeting, more credits would be needed to satisfy any given FEL emission value above the standard when the useful life values are increased.

- (e)i.7. Comment: Lastly, there has been some uncertainty within the stakeholder community about the ability for manufacturers to trade credits, though Tesla understands from CARB staff that the intent has always been to allow trading between manufacturers. As such, we recommend a clarification, similar to language used in the ACT. In the ACT, the ability for manufacturers to generate and trade credits is explicitly stated in section 1963.2(e), declaring that "Credits may be traded, sold, or otherwise transferred between manufacturers." Similar language should be included in the NOx rule to avoid any confusion regarding the ability for manufacturers to buy and sell credits. (Tesla)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. In California, trading of emission credits between different manufacturers has been a key aspect of the ABT program since 1998 and was described in section I.B.7.1 of the Staff Report. That is the reason the term "trading" is specifically used in the definition of the program. Therefore, there is no need to clarify further, as suggested by Tesla.

- (e)i.8. Comment: Overall, we ask that the Board maintain a strong oversight over the broader credit market to ensure that emission reductions remain on track and are not affected by excess credit generation or double-counting that could weaken or delay cleanup throughout the trucking fleet.

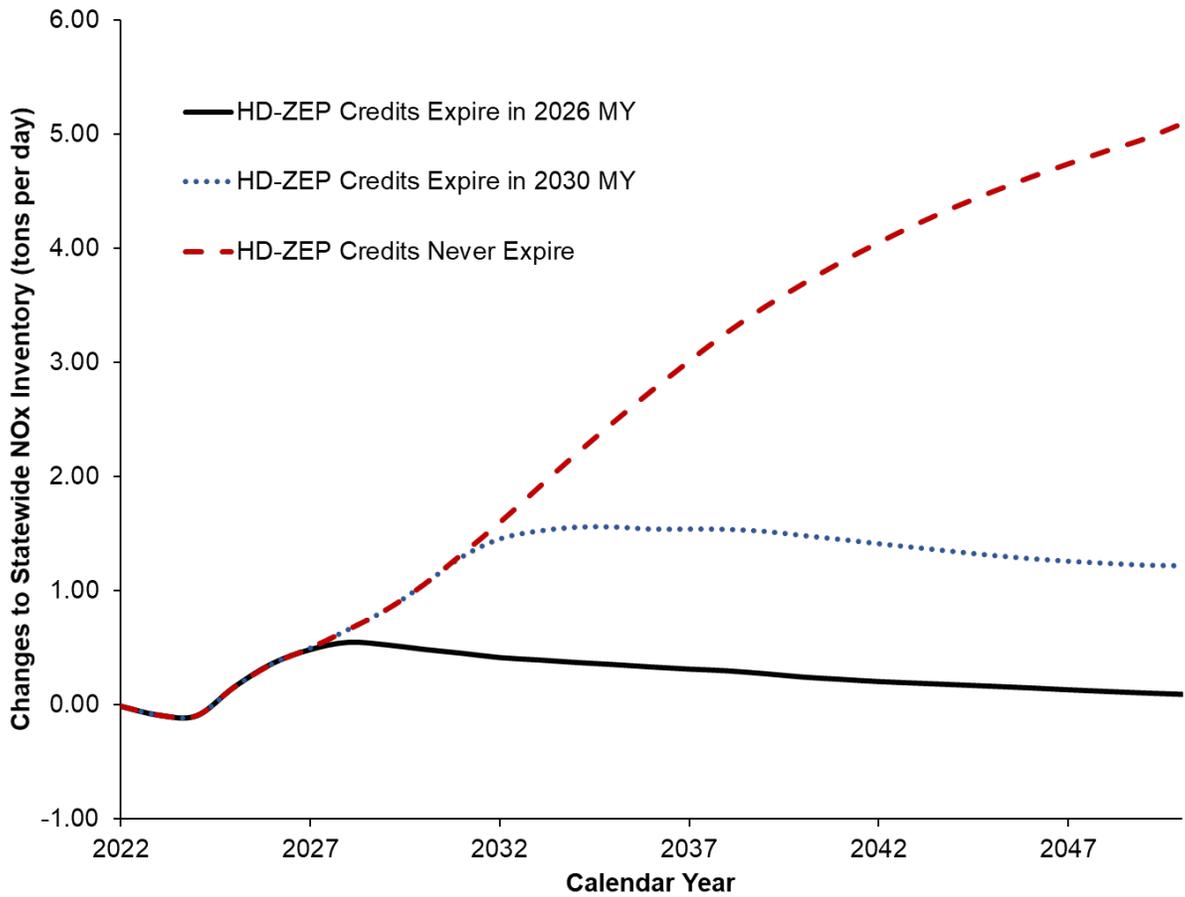
We encourage the Board to carefully review the credit provisions and timelines to avoid excess crediting, including the potential for double-counting

of credits between CARB programs, that may reduce the overall emissions benefits of the rule. (ALA)

Agency Response: Based on this comment and similar concerns, CARB staff modified the Proposed Amendments so that the HD zero-emission averaging set expires at the end of the 2026 MY. CARB staff shares the desire to avoid loss of emission benefits due to excess crediting and double counting of credits in different CARB programs. In developing the CA-ABT program, CARB staff relied on emission inventory analysis to ensure that no significant environmental dis-benefits were introduced via the introduction of the HD zero-emission averaging set.

The results from this analysis are shown in Figure IV.A.(e)i.8.1. As shown, while the introduction of HD-ZEP NO<sub>x</sub> credits leads to a small dis-benefit in terms statewide NO<sub>x</sub> inventory, the impacts are negligible over the long-term, as shown by the black line in Figure IV.A.(e)i.8.1. CARB staff believes that the small dis-benefit of 0.5 tpd of NO<sub>x</sub> is justified given that these credits can be traded in the open market and assist HD-ZEP manufacturers in early deployment of HD zero-emission technologies within the State of California.

**Figure IV.A.(e)i.8.1 Impacts of HD-ZEP NOx Expiration Dates on the Statewide Emissions Inventory**



(e)i.9. Comment: We submitted a comment letter with other advocates requesting the removal of the credit banking system which we recognize [is] well intended in effect, but [does] not ensure aggressive compliance with low NOx technology throughout all phases of the rule. (LCJA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. The ABT program provides flexibility to the manufacturers to attain compliance at the corporate level and to bank some credits from cleaner-than-required products. CARB staff does agree with the commenter that banked credits should not have a perpetual shelf life as this could potentially interfere with development of future emission control technologies. As such, the Proposed Amendments have instituted a 5-year credit life for any banked credits. Furthermore, the HD zero-emission averaging set would completely go away at the end of the 2026 MY.

CARB staff believes that the Proposed Amendments provide a balanced approach by providing flexibility and incentivizing the development of zero-

emission technologies while minimizing the overall environmental disbenefit to the statewide NOx inventory.

- (e)i.10. Comment: CARB has proposed an Averaging Banking and Trading provision that would allow manufacturers of heavy-duty zero emission vehicles to generate NOx credits as part of the Omnibus Regulation. We support the establishment of NOx credits for heavy-duty zero emission vehicles in the early years of the Omnibus to incentivize production of these vehicles, but request that CARB set a sunset date for those credits, so as not to dilute the stringency of the Regulation. (NESCAUM)

Agency Response: CARB staff has modified the Proposed Amendments based on this comment. The HD zero-emission averaging set now has a 2026 MY expiration date. All unused credits in the zero-emission averaging set would not be available in 2027 and subsequent MYs.

**(e)ii. General Comments Related to ZEV ABT Credits**

- (e)ii.1. Comment: MEMA's concern is that the proposed ABT program would allow vehicle manufacturers to generate credits for the HD NOx Omnibus program with the same HD ZEVs that are being used to comply with California's ACT rule. Vehicle manufacturers having the ability to earn ABT credits for HD ZEVs required by the ACT, creates a situation where not only is the best available HD NOx emissions control technology not needed or deployed, it is also spread across fewer diesel engine vehicles. Thus, suppliers' return on investment, which would be reinvested in development of HD electrified powertrains, will be lowered. (MEMA, JVS)
- (e)ii.2. Comment: The ABT program structured in this way will greatly disincentivize deploying the best available emissions control technology and could allow a significant portion of heavy-duty diesel engines on the road to have 60 percent higher NOx emissions without any increase to heavy-duty ZEV production than what is already required by the ACT. (MEMA)

Agency Response to Comments (e)ii.1 and (e)ii.2: Based on these comments, CARB staff has modified the Proposed Amendments to sunset all HD-ZEP credits at the end of 2026 MY. Please see the Agency Response to Comment A.(e)i.8. CARB staff believes that the Proposed Amendments present a balanced approach by incentivizing the development of zero-emission technologies while minimizing the overall environmental disbenefit to the statewide NOx inventory.

With regard to MEMA's and JVS comments that few sales of combustion technology or improved NOx emission control technology will provide less revenue to invest in ZEV technology, as mentioned in the paragraph above, the establishment lower FEL caps will provide support for the development and introduction of improved emission aftertreatment technologies. However, CARB

staff disagrees with MEMA's logic that the sale of more ZEVs would diminish revenues from MEMA's component suppliers because those same members would be generating revenue from the sale of electric component that could be "reinvested in the development of HD electrified powertrains."

- (e)ii.3. Comment: However, Jacobs has concerns the proposed CA-ABT program allows vehicle manufacturers to generate credits for the HD NOx Omnibus program with the same HD ZEVs required to comply with the ACT.<sup>141</sup> We believe the engine emissions and any related credit program needs to stand on its own without being combined with the HD ZEVs.

Vehicle manufacturers are required by law to produce HD ZEVs as a percentage of their fleet – starting at 9 percent in 2024 and 50 percent in 2030 – for compliance with the ACT. If vehicle manufacturers can earn credits in the Omnibus HD NOx rule CA-ABT for ACT compliance ZEVs, this would be double counting. We understand CARB staff adjusted the CA-ABT provisions where HD ZEVs do not earn credits past 2030 and any credits would sunset in 2031. While this is a step in the right direction, this does not fully address Jacobs' concerns.

If the OEMs are allowed credits for their ACT HD ZEVs, an OEM could produce 1.5 ZEV for every 1 HD diesel engine and would only have to meet a 0.05 g/bhp-hr NOx standard to meet CARB proposed 0.02 g/bhp-hr in 2027. Since ZEVs are not subject to the significantly extended emissions warranty, vehicle manufacturers would have further incentive to meet HD NOx compliance with HD ZEVs. (JVS)

- (e)ii.4. Comment: This Omnibus Rule is a vital complement to reduce and zero-out pollution from Heavy-duty vehicles. I urge the Board to vote yes on the rule and direct staff to address double counting ZEVs. (NRDC)

Agency Response to Comments (e)ii.3 and (e)ii.4: CARB staff has further refined the program by sunsetting all of the HD-ZEP NOx credits in the 2026 MY. This change has significantly reduced the concerns of double counting of HD ZEVs the commenter has mentioned and eliminates any impacts HD ZEVs would have on the Proposed Amendments 2027 MY requirements because HD-ZEP credits will expire by then. For additional information regarding double counting and adverse impacts on the emissions inventory based on CARB staff's changes to the program, please see the Agency Response to Comment A.(e)i.8.

The commenter also indicated that the difference in cost between the warranty requirements of the Omnibus Regulation compared to HD ZEVs under the ACT Regulation would drive manufacturers to produce more HD ZEVs. CARB staff does not agree with this assessment. As part of the ACT rulemaking, CARB staff

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<sup>141</sup> Class 4-8 straight trucks

analyzed the cost structure for HD diesel and HD ZEVs at various timeframes.<sup>142</sup> As shown in the report, there are many parameters that control the total ownership of a truck, such as vehicle price, fuel costs, maintenance costs, low carbon fuel standards (LCFS) revenues, etc. Therefore, it is difficult to make conclusive statements regarding the impacts of warranty costs. Nevertheless, in the examples for the 2018 through 2024 timeframes, the initial vehicle cost for a HD ZEV is higher than its corresponding HD diesel vehicle.

- (e)ii.5. Comment: Additionally, vehicle manufacturers having the ability to earn CA-ABT credits for HD ZEVs that are required for the ACT, creates a situation where not only is the best available HD NOx emissions control technology not needed or deployed, it is also spread across fewer diesel engine vehicles. Vehicle manufacturers deploying the best available technology and meeting the HD NOx emissions requirements of 0.02 g/bhp-hr- in 2027 is imperative to meet CARB's goals. Jacobs Vehicle Systems has invested millions of dollars to develop and advance technologies required to meet increased emissions standards including the proposed 0.02 g/bhp-hr HD NOx standard. (JVS)
- (e)ii.6. Comment: Compliance with the ACT should not be rewarded in the Omnibus Rule and could allow higher emitting diesel trucks to be sold in California through 2030. (MECA)

Agency Response to Comments (e)ii.5 and (e)ii.6: Based on these comments and similar ones, CARB staff has further refined the Proposed Amendments by sunsetting the HD-ZEP NOx credits and its averaging set by the end of 2026 MY. For additional information regarding double counting and adverse impacts on the emissions inventory, please see the Agency Responses to Comments A.(e)i.8 and A.(e)ii.3 and 4.

CARB staff believes that the Proposed Amendments present a balanced approach by incentivizing the development of zero-emission technologies while minimizing the overall environmental disbenefit to the statewide NOx inventory.

- (e)ii.7. Comment: The rule should not offer zero-emission vehicle credits or ZEV credits to manufacturers. The ACT Rule already gives manufacturers credits for selling zero-emission trucks that exceed the ACT's requirements in a given year by allowing those credits to be rolled forward to ease compliance in future years. The Low NOx Rule proposes to let manufacturers use these same credits to ease NOx reduction requirements without putting any additional zero-emission trucks on the road. This is double-counting and we cannot afford to delay these NOx reductions.

First, including ZEV credits in this rule will not incentivize manufacturers to

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<sup>142</sup> Advanced Clean Trucks Total Cost of Ownership Discussion Document. Preliminary Draft for Comment. Feb. 22, 2019. [https://ww2.arb.ca.gov/sites/default/files/2020-06/190225tco\\_ADA.pdf](https://ww2.arb.ca.gov/sites/default/files/2020-06/190225tco_ADA.pdf)

produce and sell more ZEVs, and will certainly not decrease emissions, even when accounting for more ZEVs on the road. Because the proposed Low-NOx rule offers manufacturers an additional set of ZEV credits for doing the same thing, these ZEV credits amount to double-counting. Any incentive that credits could offer toward producing ZEVs above and beyond the ACT's requirements has already been achieved through the specifics of the ACT rule. Moreover, the technology for 0.05 g NOx emission trucks is already available, so these credits are also not needed to push manufacturers to develop the required technology for compliance. Including ZEV credits in this rule is simply not necessary. Second, these credits would allow manufacturers to delay compliance with the Low-NOx rule, and therefore keep the air dirty for longer. California cannot meet its obligations under the SIP to reduce 80 percent of NOx emissions by 2031 unless the Board adopts the most rigorous emissions standards possible. Allowing manufacturers to bank credits and use them when the emissions standards become more stringent will translate to California delaying or failing to meet its clean air requirements under the SIP. Finally, granting credits to manufacturers dilutes the zero-emission benefits of the historic ACT rule and the benefits of this nation-leading low-NOx emissions standard. (Earthjustice, LACETBC)

Agency Response: Based on this and similar comments, CARB staff modified the Proposed Amendments to expire the HD zero-emission averaging set at the end of the 2026 MY.

The primary objective for introducing the HD zero-emission averaging set is to incentivize the production and sales of HD zero-emission technologies in the 2022-2026 MY timeframe. CARB staff recognizes that the ACT Regulation will mandate percentage-of-sales requirements for HD vehicle sales, however, in the earlier years, additional incentives are needed to assist the powertrain manufacturers to introduce zero-emission technologies in the marketplace and to help ensure the successful implementation of the ACT Regulation. CARB staff believes the overlap in the Omnibus and ACT Regulations in the early years will help increase HD ZEV sales.

For additional information regarding double counting and adverse impacts on the emissions inventory, please see the Agency Response to Comment A.(e)i.8.

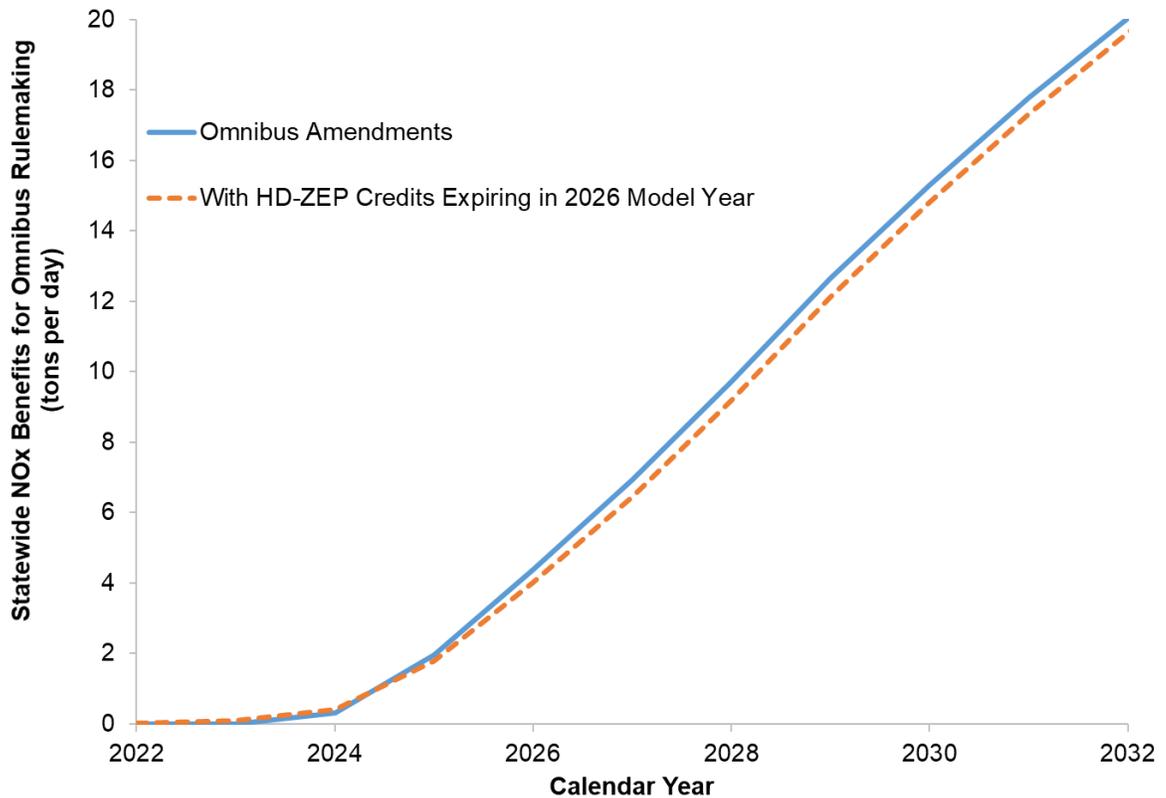
- (e)ii.8. Comment: Should CARB decline to adjust the stringency to reflect the deployment of ZEVs to meet ACT, CARB should limit the availability of ZEV credits to the volume of vehicles in exceedance of a manufacturer's required deployment under ACT. While UCS' preferred option is for the stringency of the NOx rule to reflect the ACT requirements for electric truck deployment, if the stringency is not further adjusted, additional steps must be taken to limit the availability of ZEV credits, which could substantially offset the emissions requirements for diesel trucks and thus fail to drive the improvements needed in Californian communities suffering from truck pollution.

One simple change CARB could make to respond to this issue is to add a qualifier to the “sales” term in the ZEV credit formula, restricting it to “sales above ACT requirements.” This would reduce the number of credits available to offset diesel vehicle emissions and focus the incentive on manufacturers that were investing heavily in electrification to reduce truck pollution above and beyond ACT requirements. (UCS)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. Please see the Agency Response to Comment A.(e)ii.8. Limiting the credits to sales above the ACT requirements in the early MYs (2022-2026) would not lead to any significant incentive mechanism for production and distribution of HD zero-emission technologies. Furthermore, analysis of the statewide emission inventory indicates that by limiting the zero-emission averaging set life span to 2022 through 2026 MYs, the relative impact of HD ZEV credits becomes negligible as shown by the orange line in Figure IV.A.(e)ii.8.1.

As stated in the Staff Report, the HD-ZEP NOx credit program was designed to provide a meaningful incentive program to manufacturers of HD zero-emission technologies while minimizing the environmental impacts of these incentives. CARB staff believes that the emission inventory analysis confirms the validity of the program.

**Figure IV.A.(e)ii.8.1 Impact of HD-ZEP NOx Credits on the Statewide NOx Inventory**



(e)ii.9. Comment: Lastly, with regard to the proposed HD ZEV Credit provision, South Coast AQMD staff recognize the proposed provision is intended to "incentivize production of HD ZEVs, especially in early years before they are required by the ACT Regulation." Although South Coast AQMD generally support incentive measures to accelerate the deployment of HD ZEVs, staff is concerned that this provision as written would essentially double count NOx credits for HD ZEVs and reward manufacturers for simply complying with the ACT sales requirements starting MY 2024. Furthermore, as this provision allows HD ZEV credits be transferred to other vehicle weight classes, manufacturers may opt to produce lighter weight class ZEVs (Class 4-6) and use the credits to sell higher emitting HD diesel engine families which could result in further delay of the development and deployment of low NOx technologies. South Coast staff recommend ZEV credit generation to be limited to early compliance and surplus productions above and beyond the ACT sales as well as restrict credit transfer between weight classes. These measures will close potential loopholes and ensure intended emissions reduction are realized. (SCAQMD)

Agency Response: Based on emissions inventory analysis and feedback from stakeholders including this comment, CARB staff has modified the shelf life for HD-ZEP credits so that all zero-emission credits expire at the end of 2026 MY. The environmental impacts of HD-ZEP credits are shown in Figures IV.A.(e)i.8.1 and IV.A.(e)ii.8.1. CARB staff believes that the Proposed Amendments provide a meaningful and balanced incentive mechanism to manufacturers of HD-ZEP technologies while minimizing the negative impacts on the environment.

CARB staff would also emphasize that the data shown in Figures IV.A.(e)i.8.1 and IV.A.(e)ii.8.1 assumes that all HD-ZEP credits are traded and used by engine manufacturers to produce higher emitting engines certified at FELs above the applicable standards. As such, the information on the figures should be considered as worst-case scenarios in terms of emission disbenefits. Based on review of historical emissions trading data in the HD sector, it is also plausible that the market for HD-ZEP credits would only be a fraction of what is shown in the figures, meaning the overall emission disbenefits would be smaller than what is shown in Figures IV.A.(e)i.8.1 and IV.A.(e)ii.8.1.

- (e)ii.10. Comment: Changes are needed in the CA-ABT provisions to appropriately recognize manufacturers' investments. Powertrain manufacturers should receive credit for their zero-emission powertrains instead of the vehicle manufacturer. Provisions for ABT of emission credits are longstanding and provide flexibility for manufacturers in managing the investment and lead times associated with complying to new, stringent requirements. Associated with the new CA-ABT program, CARB has proposed to allow vehicle manufacturers that certify Class 4-8 ZEVs to generate NOx credits for use in complying with the HD Omnibus Regulation NOx standards if the ZEV family uses a CARB-certified zero-emission powertrain. As proposed, a zero-emission powertrain manufacturer such as Cummins who does not manufacture vehicles would be prevented from generating such credits. Since the HD Omnibus Regulation sets new NOx standards and other requirements for engine/powertrain certification applicable to the engine/powertrain manufacturer, it is more appropriate for zero-emission credits brought into the Omnibus program to be earned by the zero-emission *powertrain* manufacturer, rather than the zero-emission *vehicle* manufacturer. This change would provide consistency with NOx and greenhouse gas credit ownership in existing engine regulations, continue to foster a level playing field among manufacturers, and provide incentive for powertrain manufacturers, including vertically integrated manufacturers who manufacture both the powertrain and the vehicle, to invest in and develop zero-emission powertrain technology.

Additionally, the CA-ABT program should recognize the early investment that has already been made by manufacturers certifying to CARB's optional 0.02 g/bhp-hr NOx standard by allowing early credits without adding new requirements. Additional new requirements beyond today's requirements

(e.g., longer DF testing, MAW in-use protocol, longer emissions warranty and useful life periods, etc.) should not apply for pre-MY 2027 0.02 g/bhp-hr NO<sub>x</sub>-certified engines to receive early compliance credits. Also, such engines should be allowed to generate credits and qualify for purchase incentives at the same time. (Cummins)

Agency Response: Based on this comment and other similar concerns, CARB staff has modified the Proposed Amendments so that the HD-ZEPs would be able to participate in the HD zero-emission averaging set.

However, CARB staff did not make any changes to the Proposed Amendments based on the second part of the comment for optional low NO<sub>x</sub> engines. Currently, engines that certify at FELs below the applicable emission standards have the ability to generate emission credits. Therefore, there is already a pathway for these engines to generate credits. Engines certified to optional low NO<sub>x</sub> standards are not eligible for generating emission credits, but maintain eligibility for incentives funding.

CARB staff believes that manufacturers that make good faith efforts to produce engines that would meet future emission standards and requirements should be encouraged and be eligible for early compliance credits and potentially credit multipliers if they meet all the Omnibus Regulation requirements early. In order to be eligible for credit multipliers, these engines would need to meet all of the elements of future regulations such as compliance with LLC standards, meeting future more stringent in-use compliance testing requirements, satisfying the more stringent durability demonstration program requirements, and when complying with 2027 and subsequent MY requirements, a much longer useful life. CARB staff does not believe that currently certified NG engines could meet all of the 2024 MY requirements without additional investment. Additional research and development would be required to make today's NG technology comply with the more stringent 2024 and subsequent MY requirements. Therefore, CARB staff believes that early credit multipliers would be needed to incentivize manufacturers to develop engines complying with the Omnibus Regulation early.

- (e)ii.11. Comment: UCS supports the inclusion of a credit for zero-emission trucks in order to incentivize sales of electric trucks that exceed the volumes required under the ACT standard. However, because CARB did not factor neither the required deployment of electric trucks nor their availability in setting the standard, adjustments are necessary to the proposal to limit backsliding on diesel truck emissions while continuing to incentivize the transition to electric trucks.

Given the large penetration of zero-emission truck (ZET) volumes required under ACT (Table 1), CARB should have incorporated electrification in assessing the potential stringency levels for heavy-duty NO<sub>x</sub> reductions in

order to maximize pollution reductions and better support its air quality mandate.

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*Electric truck percentages under the Advanced Clean Trucks standard*

Model Year	Class 2b-3	Class 4-8 Straight Trucks	Class 7-8 Tractors
2024	5%	9%	5%
2025	7%	11%	7%
2026	10%	13%	10%
2027	15%	20%	15%
2028	20%	30%	20%
2029	25%	40%	25%
2030	30%	50%	30%
2031	35%	55%	35%
2032	40%	60%	40%
2033	45%	65%	40%
2034	50%	70%	40%
2035	55%	75%	40%

*Table 1. The Advanced Clean Trucks standard requires electric truck sales of 30 percent or more by 2030, which has a significant impact on the overall stringency of the Omnibus Rule.*

Under the proposed standard, baseline deployment under ACT creates a bank of over 1800 metric tons of lifetime NOx credits—this is such a substantial volume of credits that manufacturers could offset 100 percent of the required improvement for Class 8 vehicles in 2027-2030 simply by applying credits earned under baseline ACT compliance.

Correcting the stringency to drive the diesel emissions reductions identified as achievable and recognizing the electric truck deployment already required achieves a 15 percent reduction in lifetime NOx emissions over the proposed Omnibus program for 2024-2030. ACT-mandated ZET credits should not be used in lieu of diesel emissions reductions—adjusting the stringency explicitly recognizes the NOx reductions which are already required to occur under the ACT standard and avoids the double-counting that allows for additional emissions from diesel vehicles. (UCS)

Agency Response: CARB staff made changes to the Proposed Amendments that address the concern raised by this commenter regarding limiting backsliding on diesel truck emissions while continuing to incentivize the transition to electric trucks.

Namely, the CA-ABT program was modified to limit participation in the HD zero-emission averaging set to 2022 through 2026 MYs. Given the smaller penetration rates of HD ZEVs in this period, CARB staff does not believe that the impacts of HD ZEVs would be as large as indicated in the comment. In fact, CARB staff analyzed the impacts of the NOx credit mechanism for HD-ZEPs to assure that the environmental impacts are minimized as shown in Figures IV.A.(e)i.8.1 and IV.A.(e)ii.8.1.

Second, regarding the stringency for future HD diesel engine emissions standards, CARB staff relied on the results from the SwRI Stage 3 program to assign technically feasible and cost-effective emission control technologies.<sup>143</sup> The program also examined the durability and the deterioration of the emission control system for the proposed useful life values.

Third, the Proposed Amendments rely on the implementation of FEL caps that limit the ability of manufacturers to certify high emitting engines in California.

Finally, it should be noted that the proposed emissions standards in the Omnibus Regulation apply to engine manufacturers, whereas the ACT Regulation establishes requirements for vehicle manufacturers. While there are vertically integrated manufacturers that produce both engines and vehicles, there are also cases where the engine manufacturer does not produce any vehicles and is therefore not subject to the ACT Regulation. For an engine manufacturer, it would be difficult to plan product development based on the required applicable fleet averaged emission standard for each individual vehicle manufacturer. Therefore, CARB staff does not believe that the ACT Regulation requirements should be considered in establishing the emissions standards under the Omnibus Regulation.

- (e)ii.12. Comment: MECA believes that the inclusion of proposed HD ZEV NOx credits in the Omnibus Regulation for model year 2022-2030 electric trucks effectively rewards compliance with the ACT rule in the Omnibus and could result in unintended consequences of higher emitting diesel trucks operating for decades in the state. Furthermore, the HD ZEV NOx credits can be sold and/or transferred to any HD vehicle weight class, whereas credits for HD low NOx vehicles are only provided for early compliance and can only be used within the same vehicle weight class. Therefore, the easier to electrify lighter (class 4-6) weight classes could generate significant NOx credits that manufacturers could use to offset higher emitting diesel engines at the FEL cap from the class 7-8 trucks. We calculated the number of class 7-8 diesel engines that could be built from 2027-2030 that emit NOx at 2.5 times the

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<sup>143</sup> Sharp, Christopher. "Further Development and Validation of Technologies to Lower Oxides of Nitrogen Emissions from Heavy-Duty Vehicles, Low NOx Demonstration Program – Stage 3," Southwest Research Institute, ARB Contract 16MSC010, SwRI® Project Number 03.23379, Final Report, April 16, 2021. <https://www.arb.ca.gov/lists/com-attach/79-hdomnibus2020-Uj4AaQB2Aj8FbAhw.pdf>

standard. We estimated electric truck sales from the total truck sales projections in the state from the ACT ISOR multiplied by the ACT sales requirements for years 2024-2030. We then assumed credits would be generated through 2030 and used by OEMs to meet the MY 2027 emission standard of 0.02 g/bhp-hr by averaging with diesel engines certified from MY 2027-2030 to 0.05 g/bhp-hr. As a consequence of this scenario, over 12,000 higher emitting diesel trucks with service lifetimes of 10-15 years could be sold, generating an additional 523 tons of NOx over their useful lives. This scenario assumes no additional ZEV trucks are sold beyond what is already required in ACT.

We believe that the NOx inventory impact from direct NOx credit averaging and banking is a conservative estimate because HD ZEV credits fail to take into account the upstream NOx emissions from the electrical grid that will be used to charge electric trucks. Lifecycle emissions analysis is becoming the established methodology for understanding the upstream and downstream impacts of the transportation sector and can be used to predict the overall environmental impact of policy decisions. (MECA)

(e)ii.13. Comment: The ZEV credits to manufacturers will not help with accelerating ZEV production, rather give polluters the opportunity to continue to impact frontline communities' respiratory health. (CAEJ)

(e)ii.14. Comment: We also appreciate that the staff are recommending tightening the zero-emission credit provisions, and believe that those should be limited in duration and they should be in excess of the ACT requirements. (ALA)

Agency Response to Comments (e)i.12 through (e)i.14: Based on this comment and similar comments from other stakeholders, CARB staff modified the Proposed Amendments by limiting the shelf life for the HD zero-emission averaging set to 2026 MY (i.e., such credits cannot be used after the 2026 MY).

CARB staff has examined the impact of the HD-ZEP credits on the statewide emission inventory and described the analysis in Agency Response to Comment A.(e)i.8. In addition to the shelf-life requirements, the Proposed Amendments also impose an effective FEL cap to prevent manufacturers from introducing high emitting engines into California commerce. For example, in the 2027 and subsequent MY period, an FEL cap of 0.05 g/bhp-hr NOx is in effect, while at the same time the use of HD-ZEP credits would have expired.

However, CARB staff believes that allowing cross trading of HD-ZEP credits between different classes is warranted to allow for an accelerated introduction of as many HD ZEVs as possible without having significant environmental impacts, as shown in Figures IV.A.(e)i.8.1 and IV.A.(e)ii.8.1. It should be noted that the applicable useful life requirements combined with the numerical value of the transient cycle conversion factor (ECF) make the necessary correction between

various primary intended service classes so that trading between vehicle classes accounts for the total emissions impact.

Additionally, the ACT Regulation would further constrain the number of HD combustion engines that could be sold in the California market in 2024 and subsequent MYs.

Therefore, CARB staff believes that the current CA-ABT proposal presents a balanced approach by incentivizing HD ZEV sales in the 2022 through 2026 MY period while minimizing the impacts to the statewide NOx inventory.

### **(e)iii. Expiration of ZEV ABT Credits**

- (e)iii.1. Comment: The Board should direct staff to reform the current HD ZEV NOx crediting provision to support early ZEV sales through MY 2023, but retire all banked credits with the end of MY 2026. As it's currently written, the rule allows manufacturers to generate NOx credits from ZEV sales to offset emissions from engines certified above the emission standard through the CA-ABT. The proposed Rule currently allows ZEV NOx credits through MY 2030, after which all credits are terminated. Policies to promote HD ZEV sales in the near term while the market is still nascent is understandable, however the HD ZEV market has changed dramatically over the past seven years since CARB first began developing the rule in 2013. Even in the narrow window since this proposal was released, CARB voted to adopt the ACT rule,<sup>144</sup> the Board set clear goals for 100 percent ZEV sales,<sup>145</sup> and California joined 14 states in committing to accelerate the zero-emission truck and bus market.<sup>146</sup> CARB is also planning to vote on a clean truck purchase rule in 2021 that will require fleets to buy an increasing number of ZEVs.<sup>147</sup> The combination of ZEV mandates along with clearly defined state objectives means the transition towards HD ZEVs will ramp up by the end of this decade, irrespective of crediting in the Omnibus Rule.

Further, it is possible that higher than expected ZEV sales could cause the Omnibus Rule to become overwhelmed by ZEV NOx credits, weakening the emissions standards. Critically, in the current proposal, the ZEV NOx credits can be averaged into any engine family and would have a credit life of five years or last until MY 2031—whichever comes first. Consequently, sales of Class 4 ZEV delivery trucks in MY 2026 could offset NOx emission requirements for MY 2030 Class 8 diesel tractors. While the expressed purpose of this provision, to “incentivize production of heavy-duty ZEVs”, is something we are deeply committed to, the functional outcome is to ease compliance with the Omnibus Rule. To avoid an outcome where robust ZEVs

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<sup>144</sup> <https://ww2.arb.ca.gov/rulemaking/2019/advancedcleantrucks>

<sup>145</sup> <https://ww3.arb.ca.gov/regact/2019/act2019/finalres20-19.pdf>

<sup>146</sup> <https://www.nescaum.org/documents/multistate-truck-zev-governors-mou-20200714.pdf>

<sup>147</sup> <https://ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets>

sales offset emission reductions from HD fossil fuel vehicles, the rule should end new ZEV NOx crediting after MY 2023 and terminate ZEV NOx credit balances after MY 2026. (NRDC)

- (e)iii.2. Comment: EDF strongly urges the Board to eliminate the proposed provision that would allow trucks subject to the proposed low NOx Regulation to claim NOx credits based on MY 2024 and newer zero emission trucks sold in compliance with the separate ACT rule. The zero emission trucks sold to comply with the ACT Regulations provide real NOx and PM emission reductions that will help attain ozone National Ambient Air Quality Standards (NAAQS) in California. Allowing these same zero emission trucks to also generate NOx credits that can be transferred and used to help HD combustion engines comply with the proposed low NOx rule is essentially double counting and would result in fewer emission reductions than otherwise achievable by the low NOx rule. Such a provision would result in thousands of new trucks sold in California with higher actual emissions because they can avoid complying with the proposed low NOx standards EDF would support restructuring the proposed rulemaking to provide NOx credits as an incentive for ZEVs sold prior to the implementation of the ACT rule (MYS 2022-2023) because the sale of these trucks would be voluntary and not required by CARB Regulation. These credits could be used through the end of the 2026 MY and then sunset. (EDF)
- (e)iii.3. Comment: Because ZEVs are mandated by the ACT rule, AESI believes that the inclusion of proposed HD ZEV NOx credits in the Omnibus Regulation for MY 2022-2030 electric trucks effectively rewards mere compliance with the ACT rule in the Omnibus and would result in unintended consequences of higher emitting diesel trucks operating for decades in the state. The HD ZEV NOx credits can be sold and/or transferred to any HD vehicle weight class, whereas credits for HD low NOx vehicles are only provided for early compliance and can only be used within the same vehicle weight class.

A recent MECA analysis of the HD ZEV credits illustrates that crediting battery electric trucks as zero NOx in the ABT program is not warranted. For these reasons, AESI recommends that HD ZEV NOx credits issued for HD ZEVs under the Omnibus be limited to only the earliest years of implementation, no later than MY 2026. (AESI)

- (e)iii.4. Comment: We support the use of compliance multipliers for ultra low NOx engines ahead of implementation dates, but we are concerned with the current proposal's allowance of credits for electric trucks which are already mandated by ACT MECA recommends that HD ZEV NOx credits issued for electric trucks under the Omnibus be limited to only the earliest years of implementation to provide flexibilities to truck manufacturers to introduce the cleanest diesel trucks in the state as early as possible while limiting potential excess NOx emissions. (MECA)

- (e)iii.5. Comment: ACEEE recognizes the value in encouraging the early adoption of ZEVs and supports CARB in their proposal to grant ZEV emission credits through MY 2030. ACEEE, however, also recommends that these credits must not be extended past the proposed 2031 MY, as by that point in time the ACT rule already mandates a robust HD ZEV market, and any emission credits could serve to reduce the stringency of the NOx rule, with limited additional ZEV adoption benefits. (ACEEE).
- (e)iii.6. Comment: ACEEE supports CARB in the proposal to grant ZEV emission credits through now model year 2026. ACEEE, however, also recommends that CARB not grant any extension to these credits beyond that date. (ACEEE)
- (e)iii.7. Comment: If you do adopt credits for ZEVs, then we suggest that those sunset, as the staff have proposed after 2026. And if you do adopt a 50-state option, we agree with MECA that the standard could be set tighter. We note that there are 0.02 trucks already in existence meeting CARB optional standard. (CCA)
- (e)iii.8. Comment: CEERT believes that under the CA-ABT provision ZEV credits should only be allowed to count towards NOx fleet averaging through the year 2023 with credits expiring at the end of 2026. (CEERT)
- (e)iii.9. Comment: MECA and AESI support the staff proposal with some minor changes to provisions that could result in higher NOx emissions. Omnibus ZEV credits should not reward compliance with ACT and allow higher emitting diesel trucks until 2030. We estimate that between 2024-2030 credits generated in the low NOx rule by complying with the ACT would allow nearly 17,000 diesel tractor trucks on the road at more than double the emissions. (AESI, MECA)
- (e)iii.10. Comment: The NOx standards are feasible without the use of NOx credits. And the credit provisions do not provide ample incentive for manufacturers to sell significantly more zero-emission trucks than required by the ACT Rule. (EDF)

Agency Response to Comments (e)iii.1 through (e)iii.10: Based on feedback from stakeholders, CARB staff has modified the life of HD-ZEP credits so that all credits expire by the end of 2026 MY (rather than in 2030 MY as originally proposed). For further information regarding the rationale of allowing HD-ZEP credits and the associated emissions impacts, please see Agency Responses to Comments A.(e)i.8, A.(e)ii.8 and A.(e)ii.9.

In developing the HD-ZEP credit provision, CARB staff focused on proposing a balanced approach that would incentivize the production of zero-emission technologies while minimizing the impacts on the statewide NOx inventory.

With regards to the optional 50-state-directed emissions standards, please see Agency Responses to Comments A.(a)x.1 through A.(a)x.21.

- (e)iii.11. Comment: CARB staff is considering additional actions to address concerns from some stakeholders on the inclusion of ZEVs in the NOx Regulation. Specifically, the current regulation enables the use of NOx credits generated by ZEVs until 2030. This sunset provision would ensure that many of the credits generated in the program will have only a limited timeframe within which they can be generated, traded, and used to offset deficits. Tesla supports the current sunset date and does not recommend moving it forward given the limitations the 2030 sunset already creates on the opportunity to utilize these credits. (Tesla)
- (e)iii.12. Comment: CARB has proposed a limitation on the use of ZEV NOx credits for both the Diesel [I.15.B.3.(j)(3)] and Otto-cycle [I.15.B.2.(i)(3)] engine ABT programs. In both cases, the proposed regulation states that “Any banked zero-emission NOx credits would no longer be available in the CA-ABT program for 2031 and subsequent MYs.” Ford believes that credits commensurate with the actual emission benefits of zero emission powertrains should continue to be included in a manufacturer’s credit bank beyond the 2031 MY. This will allow manufacturers a margin for compliance given uncertainties with the technical feasibility of the proposed full useful lives and standards.

Eliminating these credits from a manufacturer's ABT bank creates a disincentive for any manufacturer producing fueled engines as well as heavy-duty ZEVs to exceed their heavy-duty ZEV obligations under the Advanced Clean Truck Regulation. Manufacturers in need of ABT NOx credits would instead be incentivized to introduce hybrid vehicles with fueled engines that would qualify for ABT credits.

If CARB's intention is to prevent manufacturers from complying with 31 MY+ NOx requirements primarily via purchasing credits, Ford recommends that CARB instead consider a cap on the amount of a manufacturer's 31+ MY compliance obligation that can be met through trading of ZEV credits under the ABT program (e.g., "No more than 15% of a manufacturer's total obligation can be met through purchased or traded ZEV credits"). The cap should be developed with manufacturer input and should be set at a level that balances competing considerations. (Ford)

Agency Response to Comments (e)iii.11 through (e)iii.12: CARB staff did not make any changes to the Proposed Amendments based on these comments. Please see Agency Response to Comment A.(e)i.8 for more detailed information.

In developing the CA-ABT mechanism for HD-ZEPs, CARB staff considered a balanced approach that would both incentivize the production and distribution of HD zero-emission technologies while minimizing the adverse impacts to the environment. As shown in Figure IV.A.(e)i.8.1, removing the sunset date on HD-ZEP credits could potentially be detrimental to the statewide NOx inventory. As such, CARB staff imposed a sunset date that incentivizes HD-ZEP productions in the early years (2022-2026 MYs), while eliminating the averaging set in 2027 and subsequent MYs, when the ACT Regulation would require significant HD ZEV productions.

#### **(e)iv. Averaging Set of ZEV ABT Credits**

- (e)iv.1. Comment: CARB has proposed that NOx emissions credits generated from the sale of HD ZEVs may be applied to any other HD ABT credit averaging sets where a deficit may exist. EMA supports the use of zero-emissions credits for achieving compliance with the proposed NOx standards, while maintaining the prohibitions that currently exist for NOx and GHG ABT where credit transfers are not allowed across averaging sets. EMA objects to the use of any ZEV credits in an averaging set other than the averaging set from which they were earned. More fundamentally, CARB should make it clear that any HD ZEV NOx credits that are earned are the property of the certifying powertrain manufacturer, not the vehicle manufacturer as implied in the proposed amendments to the California provisions of § 86.007-15. (EMA, Daimler, Navistar, Volvo)
- (e)iv.2. Comment: Additionally, the proposed CA-ABT program would allow HD ZEV credits to be “transferred into any other averaging set for CA-ABT calculations [allowing] a manufacturer to make more HD ZEVs in lieu of certifying other engine families to more stringent standards.”<sup>148</sup> This credit transfer provision would essentially allow vehicle manufacturers to generate a significant amount of NOx credits from selling Class 4 and 5 ZEVs and apply those credits to Class 8 diesel engine line hauls. Then vehicle manufacturers could certify those Class 8 diesel engine vehicles at 0.05 g/bhp-hr until MY2030. Consequently, a significant portion of MYs 2027-2030 Class 8 diesel engines, which would be on the road for the next 15-20 years, could have 60 percent higher NOx emissions than if the CA-ABT did not provide credits for HD ZEVs required by the ACT.

The HD NOx Omnibus Rule and the CA-ABT program should be encouraging cleaner HD diesel engines with significantly reduced NOx emissions in

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<sup>148</sup> CARB, Staff Report: ISOR, p. III-76

accordance with California's air quality goals. Instead, the CA-ABT program could allow higher NOx emissions from diesel engines (than if the CA-ABT did not allow HD ZEV credits) without any increase to HD ZEV production than what is already required by the ACT. (MEMA, JVS)

- (e)iv.3. Comment: NOx credits are proposed for use in any averaging set. Cummins recommends CARB maintain averaging set restrictions for ZEV NOx credits, consistent with averaging sets that are currently in place in today's regulations for engine NOx and GHG credits. (Cummins)
- (e)iv.4. Comment: Additionally, Tesla recommends harmonizing the Regulation with provisions in the ACT rule that limit the use of credits generated from lower weight class ZEVs to offset heavier weight class vehicle deficits. Under the ACT, credits generated within a weight class can only be used to offset deficits for that same weight class or for a lower weight class. For example, credits generated from Class 4 ZEVs may not be used to meet compliance shortfalls associated with Class 7-8 tractors.<sup>149</sup> This framework is not currently in place within the NOx rule, and manufacturers are able to use NOx credits generated by ZEVs from any weight class to offset deficits in any other weight class. Tesla recommends changing the NOx Regulation to use the same framework as the ACT to ensure the emissions benefit will always be equal or greater than what is being offset. (Tesla)
- (e)iv.5. Comment: Under the current ABT program, credits earned under a particular vehicle class may only be used to offset debits within that class (HDO, LHDD, MHDD, and HHDD). However, CARB is proposing the introduction of a unique ZET bank, which could transfer credits to any class. This unnecessary flexibility creates a significant loophole for erosion of Class 8 truck requirements under the proposed standards.

In order to ensure NOx reductions for every community affected by HD trucks, whether that is a community located along a freeway freight route or near a warehouse district or port, it is prudent to limit trading of all credits to those within a particular service class, regardless of technology.

In addition to addressing potential disparities between truck vocation/route and emissions reductions, retaining the prohibition on trading credits between service classes limits the adverse impact of the current proposal by reducing the fungibility of ZEV credits earned under baseline ACT adoption. Prohibiting the transfer of credits between classes would eliminate 60 percent of the credits available to offset Class 8 tractors, the class of vehicle likely to have the highest cost of compliance under the proposed Omnibus, something which significantly reduces the potential for abuse under the current proposal. (UCS)

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<sup>149</sup> Advanced Clean Trucks Regulation Section 1963.3(c) and 1963.3(e).

Agency Response to Comments (e)iv.1 through (e)iv.5: Based on feedback from stakeholders as reflected in Comments A.(e)iv.1 through A.(e)iv.5, CARB staff has modified the HD zero-emission averaging set provisions so that the credits would be accrued and owned by California-certified HD-ZEP manufacturers.

CARB staff did not however make any changes to the Proposed Amendments with regards to limiting the HD-ZEP credits to assigned vehicle classes. While CARB staff has maintained the prohibition on cross trading of emission credits between different combustion-cycle primary intended service classes, CARB staff's proposal allows for cross trading of HD-ZEP NOx credits to remedy deficits in all primary intended service classes. It should be noted that the HD zero-emission averaging set was developed with the intent of incentivizing the production and distribution of HD zero-emission technologies. As such, this allowance is meant as a tool to accelerate the development of zero-emission technologies.

Given that the emission credit calculations for different service classes are a function of the applicable useful life period and the ECF, CARB staff does not believe that cross trading of HD-ZEP credits between different powertrain classes would have any significant impacts on the results shown in Figures IV.A.(e)i.8.1 and IV.A.(e)ii.8.1.

CARB staff would also emphasize that the data shown in Figures IV.A.(e)i.8.1 and IV.A.(e)ii.8.1 assumes that all HD-ZEP credits are traded and used by engine manufacturers to produce higher emitting engines certified at FELs above the applicable standards. As such, the information on the figures should be considered as worst-case scenarios in terms of emission dis-benefits. Based on review of historical emissions trading data in the HD sector, it is also plausible that the market for HD-ZEP credits would only be a fraction of what is shown in the figures, meaning the overall emission disbenefits would be smaller than what is shown in Figures IV.A.(e)i.8.1 and IV.A.(e)ii.8.1. As such, CARB staff does not believe that there is a good rationale for prohibiting the cross trading of HD-ZEP credits.

Also, CARB staff has proposed to change the expiration date for HD-ZEP credits to the end of 2026 MY. As such, there should not be any concern regarding the use of these credits in 2027 and subsequent MYs.

#### **(e)v. Federal ABT Credits**

- (e)v.1. Comment: Marginalizing ZEVs in the program runs the risk of sending the wrong signal. As we look to federal NOx reform, attention will be paid to California and it's important that ZEVs be clearly recognized for the role they can play in reducing NOx.

Tesla recommends eliminating the ability to transfer credits from the existing federal NOx program into the new CA credit system. These federal credits are based on deployment of legacy technologies dating as far back as 2010. The Regulation should not reward past deployments at the expense of incentivizing new technologies. (Tesla)

Agency Response: CARB staff did not make any changes to the Proposed Amendments in response to this comment. The Omnibus Regulation only allows the transfer of emission credits from 2010 and subsequent MY engines into the CA-ABT program. CARB staff has examined the California issued executive orders from the 2010 through 2019 MY period, and very few credits have been generated in that period.

However, some manufacturers have begun certifying engines with FEL values below the applicable standard starting with 2020 MY. CARB staff believes that engine manufacturers that have or are currently produce cleaner-than-required engines should be able to accrue transferrable emission credits because of the environmental benefits of early emission reductions.

#### **(e)vi. Early Multiplier Credits**

- (e)vi.1. Comment: While there is no dispute that we must quickly move away from diesel combustion to address the cancer hotspots created by diesel exhaust, promoting alternative combustion fuels that generate NOx and ultrafine particulate pollution is not the answer. Our organizations ask that this rule not provide credit multipliers to manufacturers that certify to emission reduction standards earlier than required. We project that these early compliance credit multipliers will be used to support natural gas technology that already exists and will not help advance cleaner technologies as is the intent of this rule. (Earthjustice)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. Under current regulatory structure, cleaner-than-required HD NG engines have two pathways to certification. The first option is to certify to optional low NOx standards and become eligible for incentive funding through the Moyer program. Manufacturers that use this pathway would not be eligible to generate any emission credits. The second option is to certify the engine to an FEL below the applicable standard and generate emission credits. Manufacturers using the second option would not be eligible for incentive funding through the Moyer program. As of today, all NG vehicle manufacturers have chosen to use the first option for certification to help offset the additional higher cost associated with NG vehicles fuel storage cost and other costs.

CARB staff believes that manufacturers that make good faith efforts to produce engines that would meet future emission standards and requirements should be

encouraged and be eligible for early compliance credits and potentially credit multipliers if they meet all the Omnibus Regulation requirements. In order to be eligible for credit multipliers, these engines must meet all of the elements of future regulations such as compliance with the LLC standards, meeting future more stringent in-use compliance testing requirements, satisfying the more stringent durability demonstration program requirements, and when complying with 2027 and subsequent MY requirements, a much longer useful life. CARB staff does not believe that currently certified NG engines could meet all of the 2024 MY requirements without additional investment. Additional research and development would be required to make today's NG technology comply with the more stringent 2024 and subsequent MY requirements. Therefore, CARB staff believes that early credit multipliers would be needed to incentivize manufacturers to develop engines complying with the Omnibus Regulation.

(e)vi.2. Comment: Tesla recommends eliminating the provisions in the Regulation that provide credit multipliers for hybrid powertrains. Under this approach, the proposed regulation is asserting that hybrid powertrains are more valuable, in terms of NOx mitigation, than ZEVs. For example, MY 2022 and 2023 hybrid powertrains generate 2.5 times as many credits as a ZEV if used to offset deficits associated with MYs 2031 and thereafter. Notably, in 2031, ZEV credits have been taken out of the regime altogether, and any early action ZEV credits would have already expired pursuant to the 5-year life that ZEV credits have under the proposed Rule. It simply does not make sense to favor hybrid technologies in the NOx rule over zero emission solutions, nor does it comport with the approach taken in the ACT. Under the ACT, while Near ZEVs are able to generate credits, the Regulation both discounts the value of these credits and puts limits on the extent to which they can be used to meet a manufacturer's compliance obligations. (Tesla)

(e)vi.3. Comment: Of special concern is the inclusion of early compliance multipliers in the credit banking system, which we project will again benefit so-called low NOx, but really very polluting NG operations early on. We project that these early compliance credit multipliers will be used to support highly polluting NG technology that already exists and will not accelerate the use of cleaner technologies as is the clear intent of this rule. (LCJA)

Agency Response to Comments (e)vi.2 and (e)vi.3: CARB staff did not make any changes to the Proposed Amendments based on these comments. Under existing HD regulations, cleaner-than-required HD engines are eligible for generating emission credits while HD-ZEPs are not eligible for generating emission credits. The Omnibus Regulation introduces HD-ZEP credits allowed to offset combustion engine emissions for the first time. The purpose of introducing HD-ZEP credits is to further encourage early development of zero emission technology, as combustion engine manufacturers subject to the Omnibus Regulation invest in the transition to zero emission technology. However, it is important to understand that there are incentives and regulatory programs (e.g., ACT) that already support HD-ZEP

technologies. Thus, there needs to be a balance between encouraging HD-ZEP technology investment and deployment with the needs to significantly reduce emissions from combustion engines.

Under the Omnibus Regulation, HD-ZEPs would become eligible for generating NO<sub>x</sub> credits in the 2022-2026 MY timeframe to help engine manufacturers comply with the new Proposed Amendments. While this provision could lead to some level of statewide emission dis-benefits as shown in Figures IV.A.(e)i.8.1 and IV.A.(e)ii.8.1, CARB staff has structured the program to limit the adverse emission impacts. In order to limit the adverse emission impacts that HD-ZEPs would have on the Omnibus Regulation, CARB staff proposed, and the Board agreed to limit HD-ZEP credits to only apply early in the introduction of this technology, which also coincides with modest introduction of this technology under the ACT Regulation. Thus, the Board approved to allow HD-ZEP credits but further limited the generation and usage of those credits to only through the 2026 MY, whereas CARB staff had originally proposed to allow these credits through the 2030 MY. Also, the Board agreed to restrict HD-ZEPs from generating any credit multipliers under the Omnibus Regulation.

However, HD engines that meet future MY requirements, including hybrid powertrains using combustion engines, would be eligible for generating credit and for early compliance credit multipliers. These provisions are consistent with previous rulemakings affecting HD engines that provide manufacturers flexibility in their compliance plans and provide additional incentives to introduce earlier than required advanced technology through the use of credit multipliers. The overall impacts of the adopted credit multipliers are shown in Figure IV.A.(e)vi.3.1. CARB staff believes that these credit multipliers offer a balanced incentive for introduction of new emission control technologies while minimizing the impacts to the overall statewide emission inventory.

Thus, the Board acted consistently to allow credits and credit multipliers for combustion engines, including those used to power hybrid systems, while assigning HD-ZEP credits for 2022 through 2026 MYs.

- (e)vi.4. Comment: Furthermore, to further support early NO<sub>x</sub> reduction and obtain attainment goal in 2023, South Coast staff proposes that CARB significantly increase to early compliance credit multipliers to support the rapid deployment of low-NO<sub>x</sub> trucks early. (SCAQMD)
- (e)vi.5. Comment: South Coast AQMD staff strongly urges CARB to adopt the more stringent 0.01 g/bhp-hr OLNS starting MY 2022 to encourage gaseous fueled engine improvement and increase early compliance credit multipliers to 2.5, 3.0 and 3.5; adopt program to allow credits for engines previously certified to OLNS since MY 2016. (SCAQMD)

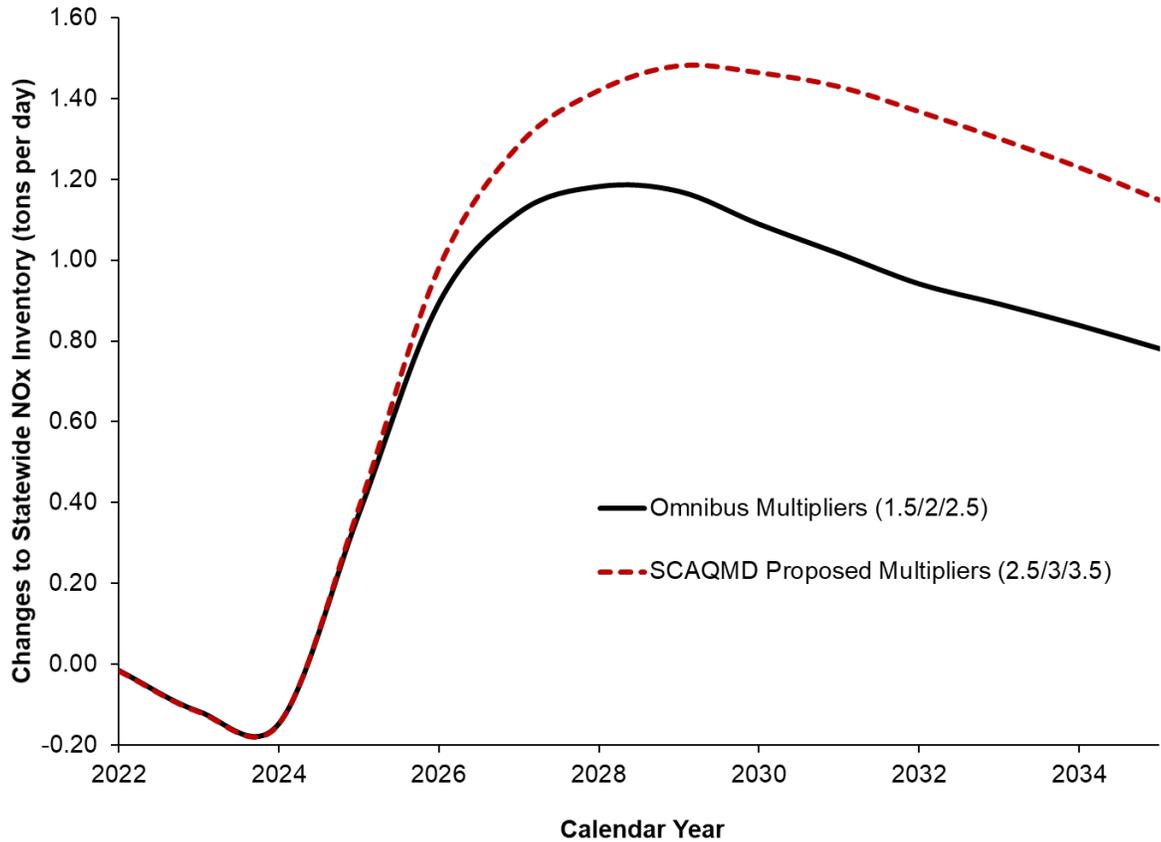
Agency Response to Comments (e)vi.4 and (e)vi.5: Based on the comment from SCAQMD, CARB staff included a more stringent 0.01 g/bhp.hr optional low NOx standard in the Omnibus Regulation starting with 2022 MY as part of the 30-Day Notice Amendments.

However, CARB staff did not make any changes to the Proposed Amendments based on the request for higher credit multiplier. The Omnibus Regulation early compliance credit multipliers were developed to incentivize the early development and production of advanced emission control technologies while minimizing the adverse impacts of these credits to the environment. Larger values of credit multipliers could lead to more detrimental environmental impacts, and hence CARB staff did not change the multipliers in response to this comment.

In order to quantify the environmental impacts of multipliers, CARB staff performed an emission inventory analysis examining a scenario in which five percent of the HD diesel engines sales in California would be replaced with cleaner-than-required engines that meet the 2031 MY requirements in 2022 through 2030 MYs. The credits generated from these cleaner-than-required engines were then used to certify HD diesel engines at the maximum possible FEL level for the 2024 through 2030 MY period. Figure IV.A.(e)vi.3.1 shows the impacts of multipliers on the statewide NOx inventory in tpd in California. As shown, benefits to the NOx inventory would be observed in the 2022 to 2024 MY timeframe because of the replacement of 0.20 g/bhp-hr NOx engines with products that meet the 2031 MY requirements. However, as the generated credits are used by the OEMs to introduce products at the maximum FEL levels, the NOx inventory would be adversely impacted. And the larger the multiplier, the more detrimental the environmental impact. Given that the Proposed Amendments attempt to balance the levels of incentives and the associated environmental impacts, CARB staff does not believe that allowing larger credit multipliers of 2.5/3/3.5, as suggested by SCAQMD, is advisable.

Additionally, the existing HD regulations prevent the Optional Low NOx Standard engines from participating in the ABT program. Therefore, credits cannot be retroactively assigned to past sales. CARB staff also does not see any benefits in giving these past production engines any retroactive credits as those credits would then be used to certify engines at the maximum FEL levels which would have a detrimental impact on the statewide NOx inventory.

**Figure IV.A.(e)vi.3.1 Impacts of Early Compliance Credit Multipliers on the Statewide NOx Inventory**



(e)vi.6. Comment: [W]e are very concerned about the high value ascribed to natural gas and hybrid powertrains. As shown by the staff proposal, by virtue of the credit multipliers in the rule, it essentially values these vehicle types over ZEVs, which is clearly out of step with their relative emission impacts. It's also inconsistent with the ACT, which included measures that limited the use of credits generated by hybrid vehicles.

Tesla asks the rule be modified to emulate the ACT, whereby credits from a given weight class can only be used to address deficits in that or a lower weight class. This ensures the emission benefits always be equal or greater than what is being offset. (Tesla)

Agency Response to Comment (e)vi.6: CARB staff did not make any changes to the Proposed Amendments based on this comment. CARB staff has analyzed the impacts of the multipliers as shown in the Agency Response to Comments A.(e)vi.4 and A.(e)vi.5 and believes that the multipliers provide a balanced

approach by incentivizing the development of advanced emission control technologies while minimizing the impacts to the statewide NOx inventory.

For the second part of the comment, please see the Agency Response to Comments A.(e)iv.1 through A.(e)iv.5.

- (e)vi.7. Comment: [T]he Omnibus Regulation will not drive any early adoption of low-NOx trucks and will not result in any significant near-term emission reductions, largely because the credit program is not expected to work.

If the credits aren't going to work to get early turnover, as staff predicts, the Regulation will ultimately place more conventional diesel trucks on the road. As a reminder, these trucks will likely stay on the road for the next 15 to 20 years, if not longer. (SoCalGas)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment.

CARB staff has analyzed the impacts of HD-ZEP credits, and credit multipliers as shown in the Agency Responses to Comments A.(e)i.8, A.(e)ii.8, A.(e)vi.4 and A.(e)vi.5 and believes that these Amendments provide balanced approaches by incentivizing the development of advanced emission control technologies while minimizing the impacts to the statewide NOx inventory.

The impacts of early compliance credit multipliers are described in the Agency Response to Comment A.(e)vi.5, and once again CARB staff believes that the program offers a balanced approach for incentivizing the development of advanced emission control technologies while minimizing the impacts to the environment.

Additionally, the Proposed Amendments include FEL caps and sunset dates for the generated emission credits to assure that the emission credits could not be used perpetually to avoid compliance with the proposed emission standards.

CARB staff does not believe that the Omnibus Regulation will lead to an increase in the population of diesel trucks on California roads. First, the ACT Regulation would mandate specific percent-of-sales values for ZEVs. Second, the Omnibus Regulation would mandate the sales of cleaner diesel trucks in California. The overall contributions/benefits of the Omnibus Regulation to the statewide NOx inventory are shown in Figure IV.A.(e)ii.8.1.

CARB staff believes that the combination of all these elements offer a balanced approach for mitigating future air quality issues in California.

### **(e)vii. ABT Credits and Incentive Funding**

- (e)vii.1. Comment: The ABT credits proposed as a part of the HD Engine and Vehicle Omnibus Regulation appear to be insufficient to meet these early commitments in the Valley. The District understands and appreciates the benefit for manufacturers to gain credits for selling clean trucks before the required years; however, the magnitude of the incentive provided towards accelerating the deployment of zero/near-zero trucks created by the proposed credit is unclear. In fact, as proposed, any trucks sold under the proposed regulatory credit would be ineligible to participate in an incentive grant program in the future. As summarized previously, CARB and the District are depending on incentive grant-based accelerated turnover of HD trucks to achieve significant NOx reductions as a part of the State's commitment for the Valley's PM2.5 SIP, and the proposed ABT program does not seem to be designed to work in concert with the existing incentive funding commitments included in the Valley's PM2.5 SIP. To ensure a more rapid transition to currently available near-zero 0.02 g/bhp-hr NOx and a new OLSN of 0.01 g/bhp-hr NOx HD truck technologies, the District recommends that additional credit multipliers be considered, while ensuring that the short term and long-term emissions implications of the regulatory credit structure (including compliance with the ACT Regulation) are also carefully considered. As part of this evaluation, CARB staff could consider alternative approaches that would allow for a combination of regulatory credits and incentive funding to expedite the transition to zero and near-zero technologies in the shorter term, including continued efforts to identify additional incentive funding sources (such as settlements) to reduce NOx and diesel PM emissions. (SJVAPCD)
- (e)vii.2. Comment: Indeed, Agility recently applied for two additional low NOx certifications from CARB for its 8.0 liter (L) propane system and its 6.0L Renewable Natural Gas (RNG)/CNG system. The 8.0L propane system will be certified at 0.015 g/bhp-hr, which easily satisfies CARB's 0.02 g/bhp-hr NOx standard. Even more impressive, the 6.0L RNG/CNG system was calibrated by Agility to achieve a 0.0062 g/bhp-hr. Based on CARB's publicly available data, this may be the lowest NOx engine ever certified. Relevant here is that CARB must promote this new, cutting edge technology. It is incumbent on CARB to adopt a regulation that encourages adoption of these increasingly clean trucks, so that Californians can enjoy cleaner air tomorrow, and not decades from now. Accordingly, we request that CARB modify the Regulation to remove the provision preventing low NOx trucks from being eligible for state vehicle incentive programs if they receive early sales credits, and amending the Regulation to state that additional requirements for warranty, useful life, testing, etc. do not apply to low NOx trucks until 2027. (AFS)
- (e)vii.3. Comment: This is why we strongly support continued incentives for low NOx HD trucks, especially those fueled by in-state RNG derived from organic

waste. These trucks must be able to continue to participate in incentive programs including, but not limited to, Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) and/or a modernized and improved Carl Moyer Program, in order to encourage immediate and early deployment of these lower emitting technologies. (RRC)

- (e)vii.4. Comment: [W]e are concerned that as proposed, the Omnibus Regulation will not drive early adoption of low-NOx trucks and will not result in near-term emission reductions.

Instead, the Regulation will ultimately place more conventional diesel trucks on our roads. We request that CARB amend the regulations so that low-NOx trucks do not lose eligibility for State vehicle incentive programs if they receive early sales credits. (AFS)

- (e)vii.5. Comment: In the Omnibus Regulation, low-NOx trucks should not lose eligibility for State vehicle incentives or other incentive programs if they receive early sales credits. As proposed, in order to receive early credits with an in quote big multiplier, manufacturers should, must sacrifice their low-NOx engines access to other market incentive programs.

The Omnibus Regulation should be amended to be fuel neutral, so that low-NOx trucks are treated the same as zero-emission vehicles. Without this change and given that full adoption of zero-emission vehicles will take a decade or more, what is CARB doing about clean air in the next seven years. (AFS)

- (e)vii.6. Comment: Despite our patient and persistent pursuit of a clear pathway to continue to add low NOx, low carbon, and renewable natural gas fueled trucks, this package does not encourage or incentivize that clean air choice for fleet owners. Near-term emission reduction opportunities are lost, unless you take action to ensure appropriate credits at the manufacturer level in this package and for fleet owners deploying low NOx in advance of the ACT purchase requirements.

The clarity that my waste fleet owners need today is whether this Board has interest in supporting near-term, low-NOx truck purchase, given the past stripping away of financial incentives, and the passes of ACT, which singles out the waste industry for a full transition to zero-emission vehicles.

Help us and help the San Joaquin Valley and others by giving credit for RNG low NOx in this and future regulations.

[F]or some direction ... provide for a credit formula for fleets that deploy low-NOx vehicles now. (Clean Fleets)

Agency Response to Comments (e)vii.1 through (e)vii.6: CARB staff did not make any changes to the Proposed Amendments based on these comments.

The Omnibus Regulation is focused on establishment of future emission standards for HD engines. Modifying the incentive funding programs is not included in this rulemaking and would be outside the scope of this Regulation. It should be noted that there are some incentive programs today that could potentially provide incentive funding for engines that are emission-credit-generating engines.

The rationale for choosing the numerical value of the credit multipliers is explained in the Agency Response to Comments A.(e)vi.4 and A.(e)vi.5. CARB staff believes that the proposed multiplier values offer a balanced approach for incentivizing the development of advanced emission control technologies while minimizing the impacts to the environment. Excessively large multiplier values are detrimental to the statewide NOx inventory as depicted in Figure IV.A.(e)vi.3.1. As this figure shows, there could be some slight environmental benefits in 2022-2024 MYs due to the sale of cleaner-than-required NG engines that qualify for credit multipliers. However, the credits accumulated by these engines would be used in 2024 and subsequent MYs to certify HD engines with FELs above the emission standards, resulting in a loss of emission benefits due to use of NG engines.

Additionally, CARB staff believes that credit multipliers should only apply if the manufacturers make the investments in their product development and distribution to assure that products meet all future MY requirements such as the emissions standards, useful life, warranty, etc. Products that meet current MY requirements should not be eligible for credit multipliers as the manufacturer has not made sufficient investments in their product development to meet all future MY requirements.

**(f) Comments Related to HD Certification Engine Durability Demonstration Program and In-Use Emissions Data Reporting Amendments**

**(f)i. Leadtime for the HD Engine Durability Demonstration Program**

- (f)i.1. Comment: CARB's proposed lengthening of the DF process will compel manufacturers to map-out their product-development projects and timelines in a very different way. DF tests are typically conducted using components from production-like tooling, and generally having design and materials characteristics consistent with manufacturers' final production intent. The calendar time that would be consumed by the greatly expanded DF testing would force manufacturers to freeze designs much earlier in the development cycle (for example, DF testing would need to start at least one year earlier), limiting manufacturers' ability to get the best possible technical solutions in place, and further exacerbating the leadtime concerns EMA has already highlighted. CARB should permit manufacturers to use accelerated aging

cycles to reduce the total calendar time that otherwise will be consumed by DF testing. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff has modified the durability demonstration procedures based on this and other comments received. Based on feedback from stakeholders, CARB has introduced new aging options for the 2024 through 2026 MY period that reduce the amount of engine aging hours and increase the amount of accelerated aftertreatment aging. The new options are available to manufacturers that pledge to submit in-use emission data reports for 50 percent or more of their California production volume. CARB staff believes that the additional information from the in-use emission data reports would help validate the laboratory DF program.

CARB staff is supportive of the use of accelerated aftertreatment aging process for a portion of the durability program and has an allowance to use this process for manufacturers that agree to submit annual in-use emission data reports. The data in the in-use emission reports will be used by CARB certification staff to determine whether proper aging techniques were used in the demonstration at time of certification. This in-use data will be used to either allow or deny the ability to carryover the certification DF to future MYs or carry across the DF to other similar engine families.

Historically, manufacturers have typically aged the engine and aftertreatment system to a portion of useful life using manufacturer customized cycles and a fuel-consumption-based approach and then extrapolated the data to full useful life in order to determine the applicable DF value. Laboratory studies have shown a great deal of discrepancy between this extrapolation methodology and the DF value from aging the engine and aftertreatment system to full useful life.<sup>150</sup> Therefore, CARB staff believes that there is a great deal of value in aging the engine and aftertreatment system to full useful life using representative drive cycles to validate emission-related component durability and calculating the appropriate DF value.

CARB staff also believes that a significant portion of the engine aging program should be conducted on an engine dynamometer to check emission-related component durability on the engine side as well. CARB staff believes that the proposed changes provide reasonable options that engine manufacturers can choose from.

- (f)i.2. Comment: It is important to recall that DF testing needs to be done before emissions certification-testing starts so the final calibration for compliant emissions testing can be determined. Emissions testing typically begins 11-12 months before the applicable certification date (which would be prior to

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<sup>150</sup> “Public Workshop to Discuss Methods of Heavy-Duty Diesel and Off-Road Diesel Engine Deterioration Factor Validation.” CARB Mail-Out #ECC 2020-03 [REVISED]. June 29, 2020. [https://ww3.arb.ca.gov/msprog/mailouts/ecc202003/ecc202003\\_ada.pdf](https://ww3.arb.ca.gov/msprog/mailouts/ecc202003/ecc202003_ada.pdf)

January 1, 2024, under the Omnibus Regulations. For Option 1, as noted, that would put the start of DF testing at January 2021 (5 months from the scheduled date of the Board hearing to adopt the Omnibus Regulation). For Option 2, the start of DF testing would be January 2022. Yet, the Omnibus Regulation is not expected to be fully finalized until mid-2021. That provides significantly negative leadtime for Option 1, and just five-months leadtime for Option 2, which is clearly insufficient and violative of multiple statutory and administrative rulemaking requirements. (EMA, Daimler, Navistar, Volvo)

- (f)i.3. Comment: CARB's proposed durability and DF testing far exceed the time available in the manufacturer's product development schedule and should be revised. (Cummins)
- (f)i.4. Comment: More flexible, streamlined alternatives are needed to complete durability/DF testing due to the short lead time for MY 2024. One of the most critical concerns related to the short lead time for complying with MY 2024 requirements is the long-hour testing driven by CARB's proposed new durability/DF requirements. The proposed new procedures would require the equivalent of full useful life aging, for example, 4,200 hours of engine dynamometer testing for medium heavy-duty engines and 9,800 hours for heavy heavy-duty engines (with an option for 4,900 hours plus accelerated aftertreatment aging and in-use emissions reporting). Even the reduced option would consume at least one year of the roughly three calendar years between now and 2024. These test durations exceed the time available in a manufacturer's product development schedule considering technology evaluations, product design choices, and early product development builds which must, be completed before DF testing, and OBD demonstrations and other pre-certification activities which must be completed after DF testing. Flexibility is needed to allow manufacturers to streamline the DF procedures and use alternative approaches in demonstrating durability to address the short lead time for certification of MY 2024-2026 products. (Cummins)

Agency Response to Comments (f)i.2 through (f)i.4: Based on these and similar comments, CARB staff has added several new options for conducting durability testing in the 2024 through 2026 MY period. These changes were briefly described as part of the proposed 15-Day Notice Amendments at the time of the Board Hearing on August 27, 2020.

The new options 3 and 4 for 2024 through 2026 MYs provide for shorter aging periods if the manufacturer makes the commitment to submit in-use emission data reports for at least 50 percent or more of their corresponding California sales volume. The additional information from the in-use emission data reports would then be used to verify the validity of the proposed DFs.

In terms of OBD aging program, the program (and the engine) is separate from the certification DF testing and could be performed in parallel with the certification DF

test. Therefore, the OBD requirements should not interfere with the proposed certification DF testing program.

Furthermore, CARB staff has reviewed information from certification preview plans and information from the past durability demonstration programs and does not believe that the specified durability requirements would cause adverse impacts on the product development cycles.

#### **(f)ii. HD Engine Durability Demonstration Program**

- (f)ii.1. Comment: Most manufacturers use their engine-durability test cells to accumulate engine hours during the aging phases of DF testing, and those test cells are generally not equipped with the more costly dynamometers capable of operating with the engine in a motoring condition. Upgrading test cells to have that motoring capability would cost manufacturers approximately \$1.5 million per test cell, and perhaps double that figure if electrical supply upgrades would be needed as well. That is an unreasonable expense that would be added to the already unreasonably expensive DF test requirements. In addition, aging cycles are used for more than just DF testing. There are aging cycles used to fulfill OBD requirements as well, which could lead to upgrade requirements for more than just a single cell at an OEM's lab. CARB should permit manufacturers to conduct the required aging cycles without any motoring requirements. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any modifications to the Proposed Amendments based on this comment. CARB staff believes that current durability demonstration requirements already necessitate the use of a motoring dynamometer. Every time a truck driver shifts gears, the engine encounters a motoring event. Motoring events are also encountered during downhill driving conditions as well. It is therefore crucial to include motoring events to simulate meaningful transient operations as part of the aging cycle.

The service accumulation requirements in CARB/EPA durability workshop clearly specify the need to include transient operations as part of the aging cycle.<sup>151</sup> Furthermore, the requirements for OBD aging include the following provision:<sup>152</sup>

- Accelerated aging cycle to include operation at rated power/100 percent load, operation at >80 percent of peak torque, and transient operating conditions (e.g., Mode 2 (LA non-freeway portion) of FTP transient cycle)

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<sup>151</sup> Engine Certification Workshop - Durability and Deterioration Factors. March 24, 2010.  
[https://ww2.arb.ca.gov/sites/default/files/2020-05/ADA\\_Engine%20Certification%20Workshop%20-%20Durability%20And%20Deterioration%20Factors.pdf](https://ww2.arb.ca.gov/sites/default/files/2020-05/ADA_Engine%20Certification%20Workshop%20-%20Durability%20And%20Deterioration%20Factors.pdf)

<sup>152</sup> Workshop for 2018 HD OBD Regulations Update. November 2, 2017.  
[https://ww2.arb.ca.gov/sites/default/files/classic/msprog/obdprog/hdobd\\_2017wspresentation.pdf](https://ww2.arb.ca.gov/sites/default/files/classic/msprog/obdprog/hdobd_2017wspresentation.pdf)

CARB staff believes that inclusion of transient operations in the aging cycle is contingent on inclusion of motoring events. As an example, the FTP cycle, which represents transient HD engine operations, includes roughly 14.8 percent of motoring events.

Given that transient operations are a requirement for the current certification and OBD aging programs, CARB staff believes that manufacturers should already have access to and be using motoring dynamometers. Hence, EMA's comment regarding the cost to upgrade test cells to add motoring dynamometers is not valid.

- (f)ii.2. Comment: CARB's proposed optional accelerated aftertreatment aging process is largely undefined in the draft Omnibus Regulations, other than through the statement that good engineering judgment must be used to determine thermal and chemical degradation, and that the aging process must equal 50% of FUL (for the 2024-2026 MYs, with a greater percentage for future MYs) for the aftertreatment system, using the same aging cycles used in the test cell with the DF engine. EMA has been working with CARB and EPA on the development of a more cost-effective accelerated aftertreatment-aging protocol, including verification testing to demonstrate the validity of the rapid-aging procedure. EPA and CARB should work expeditiously to get that much-needed development work underway, so that it can be utilized for MY 2024 and later engine families. Importantly, to the extent that CARB continues forward unilaterally to develop unique and far more onerous California-only DF demonstration requirements, out of sync with EPA's requirements, that significant misalignment will stand as another compelling reason for HD truck manufacturers to exit the California market. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. The accelerated aftertreatment aging process identified by CARB in the ISOR has been used by SwRI to age both Stage 2 and Stage 3 technology demonstrations. Information regarding the methodology can be found in the Low NOx Demonstration Program - Stage 2 SwRI report.<sup>153</sup> There are also publications that describe the diesel aftertreatment accelerated aging cycle (DAAAC) methodology in more details.<sup>154</sup> In addition, the accelerated procedure used by SwRI in the Stage 2 and 3 demonstrations was vetted with stakeholders, including the commenter EMA. Therefore, the statement that the procedure is "undefined" is not correct. It should be noted that the proposed durability

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<sup>153</sup> Sharp, Christopher. "Heavy-Duty Engine Low-Load Emission Control Calibration, Low Load Test Cycle Development, and Evaluation of Engine Broadcast Torque and Fueling Accuracy During Low-Load Operation," Low NOx Demonstration Program – Stage 2," Southwest Research Institute, SwRI Project No. 03.22496, Final Report. May 6, 2020.

<https://www.arb.ca.gov/lists/com-attach/1-hdomnibus2020-VDdXMFihU2IAWQlw.pdf>

<sup>154</sup> Bartley, Gordon, (SwRI) "The DAAAC Protocol for Accelerated Aging of Diesel Aftertreatment Systems," 2012 CLEERS Workshop, April 30 - May 2, 2012.

[https://cleers.org/wp-content/uploads/formidable/3/Bartley\\_CLEERS2012.pdf](https://cleers.org/wp-content/uploads/formidable/3/Bartley_CLEERS2012.pdf)

demonstration procedures also allow engine manufacturers to develop and demonstrate alternative aging procedures, if so desired. This additional provision provides additional flexibility to the affected stakeholders if the manufacturer decides to use an alternative aging method.

Since the U.S. EPA has yet to publish their proposal for the durability demonstration program under the CTI, CARB staff is unable to comment on the methodology. U.S. EPA has been an active participant in the Stage 2 and 3 technology demonstration programs, including the ability to comment on the DAAAC aging procedure used in those programs. Given that the proposed durability amendments include: a reasonable number of aging hours on the engine dynamometer, DAAAC aging for a significant portion of useful life and validation of DFs via submittal of in-use emission data reporting, CARB staff believes that the Omnibus Regulation's methodology offers a balanced and reasonable methodology for demonstrating durability for the complete engine and aftertreatment system. CARB staff is hopeful that U.S. EPA will propose similar accelerated aftertreatment aging procedures as in the Omnibus Regulation. CARB staff continues to coordinate closely with U.S. EPA staff and has recommended that U.S. EPA staff align their upcoming CTI proposal, including its durability procedures, with the Omnibus Regulation.

- (f)ii.3. Comment: CARB's DF demonstration proposal also does not address the question of whether multiplicative or additive DFs should be applied. The draft Regulation text only directs that additive or multiplicative factors must be calculated for 2024 and subsequent MYs, but gives no indication of the criteria that CARB would use in deciding whether to accept a manufacturer's proposal to apply one or the other. When considering the extremely low-NOx levels that CARB is proposing, multiplicative DFs would pose serious challenges for manufacturers given the degree of measurement variability that will occur during emissions testing. There is a material risk of falsely projecting unduly high and inaccurate DF factors for NOx if multiplicative DFs are applied. Multiplicative DFs of 2.0 or greater may be common, especially for NOx pollutants. CARB should eliminate that undue and unfair risk by working collaboratively with EMA on a guidance document to address the appropriate application of additive DFs to assess compliance with the low-NOx standards. (EMA, Daimler, Navistar, Volvo)

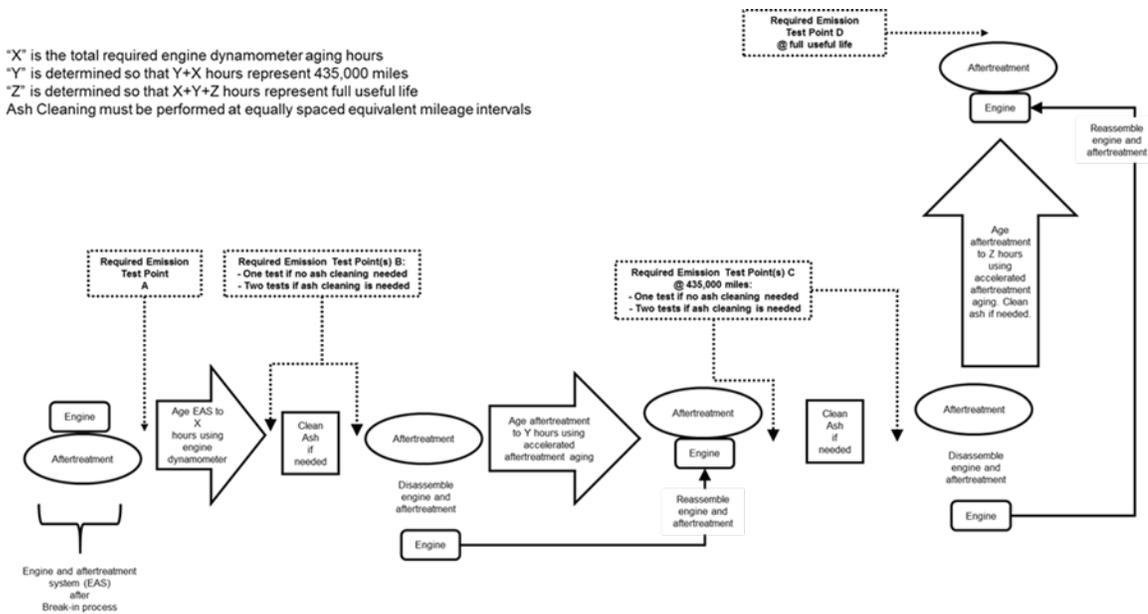
Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. The applicability of multiplicative and additive DFs is described in subparagraphs §86.004-28 (c)(4)(iii)(B)(1) and (2) of the Diesel Test Procedures. CARB staff believes that the current process for determining which method to use continues to be valid.

CARB staff agrees with EMA's comment that applicable NOx standards with values at or below 0.05 g/bhp.hr level would pose a concern when using multiplicative DFs. As stated, the current process addresses the commenter's concerns.

(f)ii.4. Comment: CARB also is defining two different FUL NOx stringencies, one for 2027 to 2030 MYs, and one for 2031 and later model years. For a HHDD engine, one standard will apply up to 435,000 miles of useful life, and a second, higher standard for the remainder of the fully-extended FUL. The Omnibus Regulations do not address this “two-stage” aspect of the NOx standards as it relates to the determination of the DFs for NOx. CARB should include clear DF testing and application requirements as applied to the proposed two-stage FUL standards. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. The sequence of the required emission testing points for 2027 and subsequent MY HHDD engines is described in Figure CA26-5 of the Diesel Test Procedures. This figure is relabeled as Figure IV.A.(f)ii.4.1 and is shown below:

**Figure IV.A.(f)ii.4.1 Alternative Durability Demonstration Using Accelerated Aftertreatment Aging for 2027 and Subsequent MY Heavy Heavy-Duty Engines**



As depicted, the Omnibus Regulation requires an emission test to be performed at the equivalent 435,000 miles interval (emission test point C). Data from emission test points A, B and C can be used with a linear regression model as described in subparagraph §86.004-26.B.1.3 of the Diesel Test Procedures to calculate the applicable DF value at the 435,000 mile interval.

(f)ii.5. Comment: There also appears to be no provision in the Omnibus Regulations for carry-across DFs. The draft Omnibus Regulations state that aging under “Cycle 1” or “Cycle 2” must be assessed for each engine family, and that the one with the highest load factor must be used. It is unclear from the draft

language if that truly requires a DF for each engine family, or if this is just the assessment methodology that must be used for the selected DF engine for a DF group. CARB should clearly indicate that carry-across DFs are permitted. That long-standing, practical and cost-effective provision is an important aspect of controlling the already significant costs which would more than triple under CARB's proposal of the DF demonstration testing requirements. Further, carry-across DFs should not be limited on the basis of one engine family having generated, for example, a "Cycle 1" aging cycle result, while the candidate carry-across family may have generated a "Cycle 2" cycle result. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. Carry across and carryover of DF data are described in subparagraph §86.001-24 (f) of the Diesel Test Procedures and will continue to be in effect under the Omnibus Regulation.

In terms of applicability of Cycle-1 or Cycle-2, CARB staff believes that the highest load factor for each cycle must be calculated and reported as a new parameter in the carry across spreadsheet as part of the certification process. The load factor will therefore be a new parameter which will be considered when determining the worst-case engine family/model for durability testing of an engine family or DF group.

- (f)ii.6. Comment: In amended §86.004-26.B.1.2.1 of the Omnibus Regulations, CARB proposes to increase the default break-in period for MY 2024 and later engines with SCR systems from 125 hours to 300 hours to ensure that stabilized emissions are achieved on emissions-data and durability-data engines. Alternatively under that provision, a manufacturer may run a minimum of three emissions tests at 60-hour intervals until emissions are sufficiently stabilized. However, the proposed regulations do not provide criteria for what constitutes "stabilized emissions." CARB should provide specific criteria for stabilized emissions, and should provide flexibility to utilize intervals different than 60-hour test intervals. (EMA, Daimler, Navistar, Volvo)

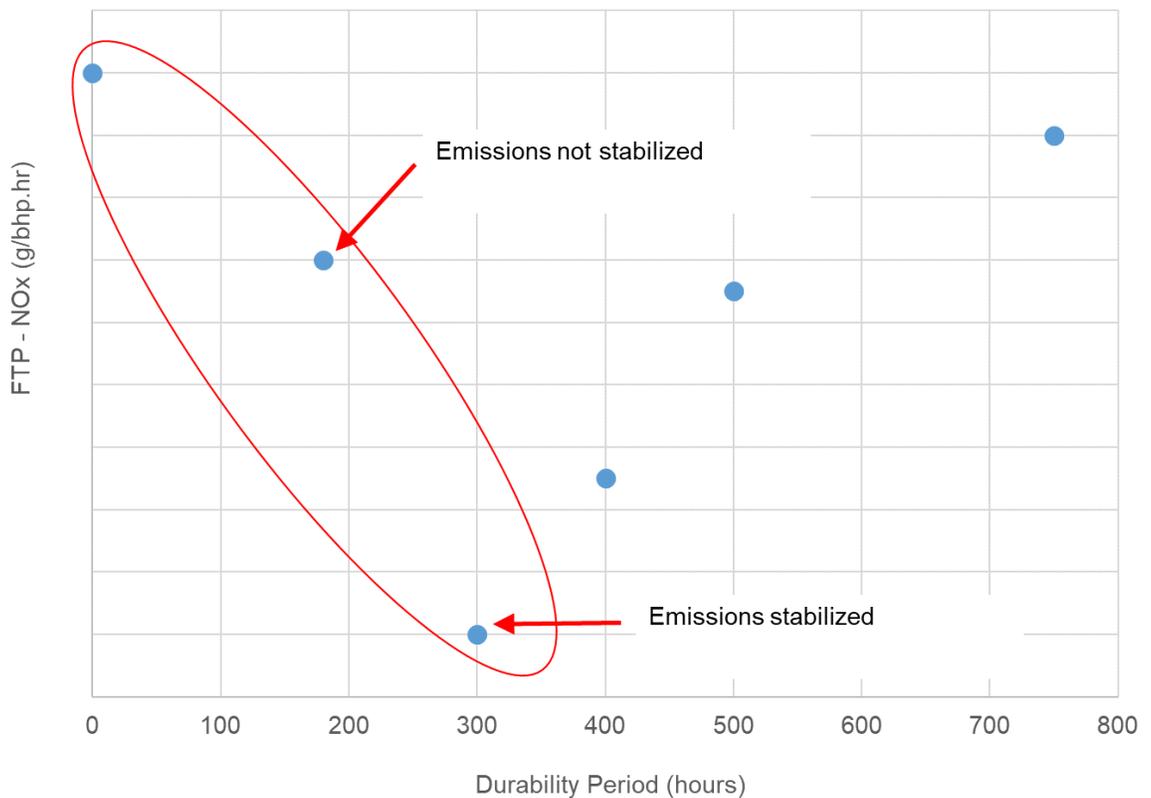
Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. Demonstration of stabilized emission levels would fall under good engineering judgement provisions and as stated in §86.004-26.A.(c)(4) of the Diesel Test Procedures: "The manufacturer shall maintain, and provide to the Administrator if requested, a record of the rationale used in making this determination."

As an example, the scenario depicted in Figure IV.A.(f)ii.6.1 shows a case where emission data was not stabilized during the first 180 hours of break-in. FTP-NO<sub>x</sub> measurements continue to decrease until the 300-hour test point. However, measurements show that the FTP-NO<sub>x</sub> emissions increase after the 300-hour measurement. In such cases, CARB staff believes that the actual break-in period

should be 300 hours, meaning the low-hour FTP-NOx value corresponds to the measurement at 300 hours.

CARB staff is not supportive of emission test intervals smaller than 60 hours since the measurement test-to-test variation may be larger than the actual changes in the emission levels for shorter (< 60 hour) test intervals. The manufacturer has the choice of either running the default 300-hour break-in period, or demonstrating shorter break-in period as described in section I.26.B.1.2.1 of the Diesel Test Procedures.

**Figure IV.A.(f)ii.6.1 Example for Non-Stabilized Emissions After 180 Hours**



- (f)ii.7. Comment: CARB’s proposed amendments also fail to indicate which duty cycles manufacturers should use for the accumulation of hours during the break-in period. If CARB intends for manufacturers to use the same cycles as are proposed for durability aging (i.e., certification cycles or GEM cycles), EMA has concerns that the load factor of those cycles is not sufficient to demonstrate stabilized emissions. More specifically, CARB’s proposed sequence of low load-factor operations is insufficient to produce the stabilized DF anchor point required for establishing a true (accurate) baseline value prior to conducting the DF testing exercise. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any modifications to the Proposed Amendments based on this comment. Under existing regulations, manufacturers have the flexibility to choose their preferred cycle for the break-in period. The same practice would continue to be in effect under the Omnibus Regulation. The Proposed Amendments do not mandate the use of any specific cycle for the break-in period.

- (f)ii.8. Comment: CARB should include in the regulatory provisions relating to durability demonstration testing a statement that manufacturers are permitted to design their DF programs with controls in place to establish “like” starting conditions for the emissions test points to ensure that the DF demonstration is assessing deterioration, and is not impacted by other conditions that can influence DF results. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did make modifications to the Proposed Amendments to address this comment. CARB staff concurs with the assertion that preconditioning of an engine and aftertreatment system does impact the subsequent emissions measurement levels. As such, in the 30-Day Notice Amendments, CARB staff has revised the preconditioning requirements described in subparagraph §1065.518.B of the Diesel Test Procedures to address this issue.

- (f)ii.9. Comment: Tellingly, the limited work CARB has done to assess the feasibility of the “intermediate” FUL standards has been done with an aging protocol that CARB considers unacceptable for manufacturers to use for their own DF testing. EMA supports the aging techniques that CARB has used for this work, which involve bench-aging of aftertreatment systems to accelerate the aging process. EMA has been pushing for that type of accelerated process for DF demonstrations for some time, as it would help manufacturers try to cope with the insufficient lead times CARB has proposed, including with respect to the 2024 MY standards. CARB, however, has proposed in this Omnibus Rulemaking that manufacturers must age engines and aftertreatment systems out to 9,800 hours to develop DFs. That is as much as three to six times longer than traditional DF demonstrations. For engines being certified for 2031 and later MYs, the minimum dynamometer-based aging would be reduced to 4,900 hours, but would need to be followed by aftertreatment bench-aging equivalent to 13,100 engine hours.

If CARB feels that there is not a well-enough-developed aftertreatment bench-aging protocol for manufacturers to utilize, then CARB should not utilize such an accelerated bench-aging process as a tool for setting aggressive low-NOx standards linked to new certification cycles and in-use test protocols. Simply stated, CARB has not made a fair or robust demonstration of the long-term technical feasibility of the Omnibus Low NOx standards. As a consequence, CARB’s DF demonstration at SwRI is not sufficient to support this rulemaking. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. Accelerated aftertreatment aging is a key component of the durability program under the Omnibus Regulation. CARB staff has included provisions to use accelerated aftertreatment aging for a portion of the useful life in order to ensure that manufacturers would have sufficient time for durability demonstration and product planning. However, since accelerated aftertreatment aging only examines the aftertreatment system and does not address emission-related component durability on the engine side, CARB staff believes that some amount of engine and aftertreatment system aging on a dynamometer is needed to verify that engine components are also durable and to measure the impacts on tailpipe emissions. As such, the Proposed Amendments propose a combination of engine and aftertreatment system aging on a dynamometer and accelerated aftertreatment aging for durability demonstration.

It should be noted that the SwRI DAAAC was developed and correlated to in-use engine and aftertreatment system aging and was used to demonstrate the feasibility of attaining the proposed engine standards in Stage 2 and Stage 3 demonstration programs. However, the demonstration programs were not focused on developing a new durability demonstration method for certification. It is well understood that the majority of NO<sub>x</sub> and PM emissions are controlled by the exhaust system aftertreatment and so the DAAAC procedure evaluates the durability of the most significant emission control components. However, there are emission control components on the engine, including the EGR system, that should be included in the overall demonstration of emissions durability for certification. The SwRI demonstration programs were not developed to establish a new certification method but to demonstrate the emission control feasibility of a diesel engine using prototype emission control components to reduce emissions down to 0.020 g/bhp-hr NO<sub>x</sub> levels.

The Proposed Amendments to the certification durability requirements try to strike a balance between a very lengthy option to age the engine and aftertreatment system to full useful life on an engine dynamometer and full DAAAC aging that is solely focused on aftertreatment aging. The durability program amendments also require the collection of engine in-use data if accelerated aging such as DAAAC is used by a manufacturer for certification. This data will be used to compare the certification durability demonstration data with real-world in-use emission data to help establish correlation between lab and field aging of the engine and aftertreatment system.

Once CARB staff has evaluated engine family emissions data from the lab and collected field data on several engine families, CARB staff would be willing to make further modifications to the durability demonstration program that would allow even more accelerated aging in a future rulemaking if an accelerated durability demonstration aging method is shown to correlate well with engines aging in the field.

### **(f)iii. In-Use Emissions Data Reporting Amendments**

- (f)iii.1. Comment: If CARB feels that having access to on-board-derived emissions data provides additional and sufficient assurances such that accelerated durability demonstrations can be allowed, and if CARB is already going to be receiving those data through the HD I/M program, CARB should simply allow for the accelerated durability demonstrations without imposing the reporting burden on manufacturers.<sup>155</sup> To that end, CARB should include the elimination of the REAL emissions-reporting obligations from the Omnibus Regulations as a provision of the soon-to-be adopted HD I/M Regulations to ensure that this excessive and duplicative requirement is removed from the Omnibus Regulations as expeditiously as possible. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments in response to this comment. At this time, the HD I/M Regulation has not been officially proposed or approved for adoption. Depending on the future timing and content of the HD I/M Regulations, CARB staff plans to revisit the in-use emission data reporting provisions in the Omnibus Regulation, if needed, to ensure that duplicative reporting of in-use emission data would not be required.

- (f)iii.2. Comment: Under CARB's DF proposal, in the case where manufacturers select the reduced dynamometer-aging option (Option 2), they would have to provide CARB with annual reports of in-use emissions and other data from vehicles originally sold in California. The emissions data would be derived from CARB's OBD NOx-binning requirements (the REAL requirements). That is the same data CARB is proposing to require annually from every vehicle that operates in the state of California as part of CARB's upcoming HD I/M Regulation. OEMs would be required to provide the annual report for each engine family certified by CARB, and would need to include data from at least 20% of the California-sold vehicles annually. It is unclear if the provisions would require reporting from the covered vehicles throughout their FUL, but, if so, that would lead to required annual reporting for 10 years for all diesel families from three consecutive model years.<sup>156</sup> For 2027 and later MYs, the data-submission requirements would more than double, increasing to 50% of engines within all engine families for an even longer FUL from as many as 5 consecutive MYs. That is an extreme and unduly burdensome requirement, especially for manufacturers that have not implemented telematic systems to facilitate the acquisition of those data. To alleviate this unreasonable and redundant data-submission requirement, CARB should limit the period of reporting to 3 years, or perhaps 5 years for 2031 and later MY families.

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<sup>155</sup> As discussed above, joint work is underway by CARB, EPA and EMA to validate a more cost-effective accelerated aftertreatment aging protocol, which will make any additional reporting associated with Deterioration Factor testing unnecessary.

<sup>156</sup> The consequences of an OEM's failure to provide REAL data after utilizing Option 2 are unclear.

Because owners often allow telematics contracts with OEMs to expire after as little as two years following purchase, CARB should have a declining percentage reporting requirement over the later reporting years of a model year. Additionally, many of the parameters to be required have nothing to do with emissions deterioration, and should be eliminated from the reporting requirement. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. Please see Agency Response to Comment A.(f)iii.1 for the HD I/M Regulation.

The reporting period for in-use emission data reporting is three consecutive MYs for 2024 through 2030 MY products, and five consecutive MYs for 2031 and subsequent MYs (as described in §86.004-26.B.1.1.3.8 of the Diesel Test Procedures) for at least 20 percent of California sales volume for each applicable engine family. Manufacturers that submit in-use emission data reports for 50 percent or more of their California sales volume would be subject to a different durability schedule as outlined in §86.004-26.B.1.1.2.1.5 and 1.1.2.2.5 of the Diesel Test Procedures. These timelines are identical to what EMA is requesting in its comment; therefore, no changes were made to these reporting timelines.

CARB staff believes that the requested list of parameters such as the tailpipe NOx emissions, vehicle family name and engine family name are relevant to determining the deterioration of different vehicle categories.

## **(g) Comments Related to Powertrain Certification Test Procedures for HD Hybrid Vehicles Amendments**

### **(g)i. General Comments Related to Powertrain Certification Test Procedures for HD Hybrid Vehicles Amendments**

- (g)i.1. Comment: It is too early to include HD hybrid powertrains in the same extended emissions warranty and FUL requirements as similar conventional engines. We appreciate CARB is intending these requirements to be technology neutral while providing consumers with similar protection for any powertrain platforms they chose.<sup>157</sup> However, there is currently very limited numbers of HD hybrids in the market. As a result, it would be difficult and impractical to have data assessing the feasibility of the extended FUL and emissions warranty requirements for HD hybrid powertrain under this proposal. MEMA recommends that CARB postpones requiring HD hybrids to be subject to the same extended emissions warranty and FUL requirements as similar conventional engines. (MEMA)

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<sup>157</sup> CARB. Public Hearing to Consider the Proposed Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments. Staff Report: [ISOR](#), June 23, 2020. p. III-56

Agency Response: CARB staff did not change the Proposed Amendments in response to this comment. The hybrid powertrain certification test procedure provides an optional, alternative pathway for manufacturers to certify hybrid powertrains to criteria pollutants and GHG emissions standards for installation in HD vehicles. This certification process provides another option for manufacturers of hybrid powertrains to use to certify their product, in addition to the existing HD engine certification. Unlike the current process for HD hybrid vehicle certification, where only the engine is certified and hybrid components are later added on, the hybrid powertrain test procedure requires the entire hybrid powertrain, including the combustion engine and all associated hybrid components, to be tested and certified as a total package. As such, the complete hybrid powertrain package will be required to undergo the durability demonstration that will provide data essential for building a robust hybrid powertrain system.

The warranty coverage and useful life requirements for hybrid powertrains match those for similar conventional engines and, as noted by the commenter, are intended to be technology neutral while providing the consumers with similar protection for any power platforms they choose to purchase. As mentioned above, the hybrid powertrain test procedure provides manufacturers an optional certification procedure that they could use to optimize and account for the benefits of hybridization that traditional engine certification procedure is unable to fully capture. This is intended to be a separate but equal pathway to certify to the required emission standards. To ensure that the certified emission levels are maintained throughout the life of the product, as well as to warrant that the two certification pathways are equal, it is critical that the same requirements for warranty and useful life are applied, regardless of which certification procedure is utilized.

CARB staff concurs that because of the small number of HD hybrid vehicles, there is limited data to fully assess warranty implications. This is true for the current generation of hybrids, where the certification warranty and useful life requirements are mainly applicable to the combustion engine that is certified and are generally not applicable to the hybrid components. Recognizing this issue, the proposed hybrid powertrain certification procedure has provisions requiring hybrid powertrain manufacturers to fully test the hybrid powertrains to understand and demonstrate durability for the group of components that are to be certified as a complete hybrid powertrain system. The commenter argues that the lack of data for HD hybrid vehicles renders it difficult and impractical to assess the feasibility of the longer useful life and emissions warranty requirements for these vehicles. The lack of data for hybrids, however, to some degree, stems from the fact that HD hybrid vehicles up to this point have not been required to have, or to demonstrate, longer durability as have been required for conventional HD engines and vehicles. In addition, HD hybrid vehicles, heretofore, have not been able to be certified to any criteria pollutants emission standards. The hybrid powertrain test procedure is intended to allow hybrid manufacturers to move hybrid technology beyond the status quo and

provides procedures for full certification, including testing requirements for criteria pollutants emissions and for durability demonstration, the same as currently required for conventional HD engines. A manufacturer choosing to use this optional procedure to certify hybrid powertrains would have the requisite durability data for their hybrid powertrains by following the specified testing regiment and, at the successful completion of the certification process, would have the data to demonstrate durability for their hybrid system. Thus, they would be able to ensure that the hybrid powertrain's emission levels are durable such that the certified emission levels would be maintained throughout its useful life.

By having to fully demonstrate durability for the hybrid powertrain as a condition for certification, manufacturers would have a better idea on how robust and durable their hybrid powertrains are prior to manufacturing them for sale to the consumers. CARB staff believes the consumers need to have confidence in a technology in order to assure a commercially successful future for that technology. Putting into market a hybrid technology that is not as reliable or durable as competing technologies would not advance the development of hybrid technology.

- (g)i.2. Comment: Key-on/engine-off time does not count for purposes of identifying the end of warranty or useful life periods. Cummins recommends CARB allow key-on/engine-off time to count for cases such as hybrids where the hybrid components are still active even when the engine is off. (Cummins)

Agency Response: CARB staff did not change the Proposed Amendments in response to this comment. Hybrid systems are generally designed to work in tandem with the conventional drivetrain in a HD hybrid vehicle in specifically designed roles. Different hybrid architectures and different levels of hybrid integration affect how the hybrid system interface with the combustion engine and other vehicle components. Depending on the design parameters, a range of hybrid system is possible, from a weak hybrid, such as in an engine stop/start system, to a strong hybrid, where the hybrid system has the primary role in the vehicle's operation, including providing motive power with the combustion engine fully disconnected from the drive axles. Because of the existence of these two separate, but interrelated systems, there could be operational regimes where the engine is off with the hybrid system on, and vice versa, or when both systems are operating at the same time. Depending on the hybrid design, a key-on/engine-off event does not necessarily involve the hybrid system being rigorously operational. The hybrid system in this situation could be passively utilized to maintain the desired temperature range of an aftertreatment system, or it could stay dormant awaiting signals from the vehicle's computer to turn the engine back on. In these situations, the hybrid system's operation does not really equate to engine operation. In addition, some of the hybrids on time could be spent with the conventional engine as well as with the electric drive train components not moving such as in idle mode, so it cannot be claimed that hybrid on time equals engine on time. However, as previously inferred, for some hybrid systems and in

specific situations, key-on/engine-off could be considered engine on time. CARB staff plans to investigate this issue in a future rulemaking, in consultation with U.S. EPA during its CTI rulemaking process, to provide a uniform and consistent nationwide set of requirements for these specific situations.

(g)i.3. Comment: In our review of the Proposed HD Omnibus Regulation, BAE Systems found a number of areas of ambiguity in identifying the requirements applicable to the hybrid components versus the engine, such as the following:

- It is unclear what warranty language applies to the hybrid components on vehicles with engines certified for use in hybrid vehicles exclusively, not optionally certified under the hybrid powertrain.
- It is unclear if the defined time associated with the extended warranty under any recall as it applies to the hybrid components that may cause the MIL to illuminate.
- It is unclear that the “useful life” requirements are applied to the hybrid components outside of the optional hybrid powertrain certification.
- It is unclear the extent to which these changes are applicable to the hybrid components that light the MIL.
- It is unclear if 13 CCR sections 2167 and 2168 are applicable over the periods of use defined by “useful life” in 13 CCR section 2112 (I)(21) or whether there is another defined period of use for the hybrid components.
- It is unclear that there was consideration for the practical and physical limitations on electro-chemical components (e.g. batteries) in the definition of useful life.
- It is unclear whether medium HDE warranty is applicable for optionally certified hybrid powertrains when used in HD vehicles. (BAE)

Agency Response: CARB staff did not change the Proposed Amendments in response to this comment. Since there are multiple concerns raised in the BAE comments, CARB staff is addressing each of these concerns as indicated below.

Regarding the first bullet on the warranty language for hybrid components, the proposed warranty language applies only to hybrid powertrains that are certified under the optional hybrid powertrain certification procedures. Existing warranty requirements continue to apply to engines certified for use in hybrid vehicles exclusively. CARB certification staff has been reviewing and issuing Executive Orders for these engines and hybrid systems and will communicate as appropriate with manufacturers of the conditions for obtaining CARB certification for this type of hybrid technology.

Regarding the second bullet on the defined time associated with the extended warranty, California test procedures section 86.080-12, and elsewhere, explicitly provide as having the same meaning the terms “hybrid powertrain” and “engine” and “hybrid powertrain family” and “engine family.” Insofar as any recall-related provisions apply to “engine family,” those provisions also apply to “hybrid

powertrain family” that were certified using the optional hybrid powertrain certification test procedure. The extended warranty period for components subject to the recall provisions, including hybrid components in a hybrid powertrain family that may cause the MIL to be illuminated, is defined in 13 CCR 2166.1 to be, at a minimum, equal to or more than the applicable certified useful life period of that vehicle or engine.

Regarding the third bullet on the “useful life” requirements of hybrid components, the useful life language applies only to hybrid powertrains that are certified under the optional hybrid powertrain certification procedures. Existing useful life requirements continue to apply to engines certified for use in hybrid vehicles exclusively. CARB certification staff has been reviewing and issuing Executive Orders for these engines and hybrid system and will communicate with manufacturers of the conditions for obtaining CARB certification for this type of hybrid technology.

Regarding the fourth bullet on the extent to which these changes are applicable to the hybrid components that light the MIL, CARB staff is unclear what “changes” the commenter is referring to as pertain to the hybrid components that light the MIL. The intent of the optional hybrid powertrain test procedure is to provide an alternative but equivalent pathway for certifying hybrid powertrains to criteria pollutants and GHG emission standards. As such, any certification requirements, such as OBD, useful life, emissions warranty, recall provisions, etc. that apply to an engine that was certified on an engine dynamometer would also apply to a hybrid powertrain that was certified using the optional hybrid powertrain certification test procedure. California test procedures section 86.080-12, and elsewhere, explicitly require a hybrid powertrain optionally certified pursuant to 13 CCR 1956.8 to comply with all requirements applicable to on-road HD engines, including requirements for OBD system as specified in 13 CCR 1968.2 and 1971.1 et seq. All components, both hybrid and conventional components, that are grouped together as a certified hybrid powertrain would be subject to those requirements, including any hybrid components that cause the MIL to be illuminated.

Regarding the fifth point on 13 CCR 2167 and 2168 clarifications, 13 CCR 2167 and 2168 also apply to hybrid components that are certified in a hybrid powertrain family. California test procedures section 86.080-12, and elsewhere, explicitly provide as having the same meaning the terms “hybrid powertrain” and “engine” and “hybrid powertrain family” and “engine family.” Insofar as the provisions in 13 CCR 2167 and 2168 apply to “engine family,” those provisions also apply to “hybrid powertrain family” that were certified using the optional hybrid powertrain certification test procedure. All hybrid components that are certified as a hybrid powertrain family using the optional hybrid powertrain certification procedure are subject to the applicable useful life period for optionally certified hybrid powertrains as defined in 13 CCR 2112(l)(23). CARB certification staff has been reviewing and issuing Executive Orders for engines

used exclusively in hybrid vehicles and the associated hybrid system and would communicate with manufacturers during the certification process the period of time applicable to the recall and corrective action requirements for hybrid components.

Regarding the sixth bullet on electro-chemical components, the rechargeable energy storage system (RESS) is an integral component of a hybrid powertrain system and is considered to be an emission-related component. Its proper functioning is critical in the performance of the hybrid system, including the hybrid powertrain's impacts on fuel economy and emissions. As such, the optional hybrid powertrain certification contains a provision requiring an RESS to be subject to the same useful life requirements as the other components of the hybrid powertrain, including the combustion engine. Without this requirement, if all other components of a hybrid powertrain that are otherwise functioning properly, but if the battery pack's efficiency has deteriorated or has failed, the emission characteristics of the certified hybrid powertrain system would likely be negatively affected.

The useful life requirement is applicable to all types of RESS, and not only to battery systems. For hybrid powertrain with batteries as the RESS, CARB staff has determined it is technological feasible for such battery system to meet the useful life requirement. BYD and Proterra are currently providing a 12-year battery warranty for the batteries used in their electric transit buses, coaches and HD trucks. If a hybrid powertrain manufacturer elects not to include a battery system in its hybrid powertrain that is capable of achieving the required useful life, the manufacturer could comply with the required useful life either through arranging for battery leasing or developing a scheduled battery replacement interval (battery swap out) so long as the applicable total useful life required is achieved.

Regarding the last bullet on medium HDE warranty, optionally certified HD hybrid powertrains are warranted according to the GVWR classification of the HD vehicle in which they are installed and is as specified in 13 CCR 2036(b)(10).

Hybrid systems are generally designed to work in tandem with the conventional drivetrain in a HD hybrid vehicle in specifically designed roles. The primary intended service class, as described in 40 CFR 1036.140, describes three groups of HD engine service classes (i.e., light heavy-duty (LHD), medium heavy-duty (MHD), and HHD), based on the GVWR, in which heavy-duty engines are normally installed. As described in 1036.140, a LHD engine is normally installed in vehicles with GVWR at or below 19,500 pounds, a MHD engine is normally installed in vehicles with GVWR ranges from 19,501 to 33,000 pounds, and a HHD engine is normally installed in vehicles with GVWR exceeding 33,000 pounds. For conventional non-hybrid vehicles, the primary intended service classes of engines work as expected because the engines that

are installed in these vehicles are normally properly sized for the vehicle service class. But for hybrid vehicles, that may or may not be the case.

A hybrid powertrain may be designed with a smaller (i.e., downsized) engine than would “normally” be expected to be installed in the vehicle service class for which the hybrid powertrain is going to be installed. For example, a hybrid powertrain may use a MHD engine, or even a LHD engine, coupled with a hybrid system and is installed in a HD vehicle with a GVWR greater than 33,000 pounds. In this example, the power requirements of the vehicle may be met by the aggregate power output of the hybrid powertrain, which combines the power outputs of both the downsized engine and the hybrid system. If the emissions warranty requirement, for example, follows the engine category, which, in this example, is a MHD engine, there would be a mismatch in the emissions warranty between the vehicle class (i.e., 19,501 - 33,000 pounds) for the primary intended service class of the MHD engine and the actual vehicle class (i.e., > 33,000 pounds) where the engine is ultimately installed as part of the hybrid powertrain. If the emissions warranty and other certification requirements are not tied to the vehicle’s GVWR, a purchaser of a HD hybrid vehicle may not have the length of warranty coverage or useful life that are normally expected for that vehicle class.

- (g)i.4. Comment: [T]his proposed regulation will negatively impact the costs of bringing full zero emission technology to the California marketplace and achieve the targets set forth in the ICT rule that results in 100 percent zero-emission bus purchases starting in 2029. There is no difference between BAE Systems’ zero emission powertrains and low emission hybrid powertrains in that they share common components. If the aforementioned concerns [these concerns are shown and addressed by CARB staff in comment A.(g)i.3, above] do in fact apply to the heavy-duty electric hybrid components, the impact will be to drive up cost. For BAE Systems, the additional cost burden will carry across both low and zero emission powertrains. BAE Systems has invested in low and zero emission technologies to help California achieve its clean air goals. The proposed Rule combined with the ICT and ACT Regulations unfairly disadvantages leading manufacturers like us, and favors later market entrants who solely service the zero emission markets and who do not have to comply with current and proposed low emission regulations. If CARB intends to move forward with these changes unmodified, BAE Systems recommends that transit bus heavy duty hybrids be exempted. (BAE)

Agency Response: CARB staff did not change the Proposed Amendments in response to this comment. Currently, some hybrid systems, including the BAE Systems hybrid powertrains as referred to in the comment, have been certified using the process allowed under existing procedures. That certification process, and the attendant requirements, remains available for manufacturers to utilize if they so choose. However, if a manufacturer elects to use the optional hybrid powertrain test procedure to certify their hybrid powertrains to criteria pollutants

emission standards, the certification requirements associated with the optional procedure will apply. Since the new hybrid powertrain certification test procedure is an optional certification pathway, CARB staff believes that a manufacturer will elect to certify their hybrid powertrains using this option only if it provides them with a net benefit over the existing certification process, either monetary or other ancillary benefits, such as in market expansion or in improved economy of scale.

Contrary to the assertion made by the commenter on causing established, leading manufacturers like BAE Systems to be unfairly disadvantaged compared to later market entrants who solely service the zero emission markets, the optional hybrid powertrain test procedure does not discriminate against any manufacturers. Since the requirements of the optional hybrid powertrain test procedure only apply to hybrid powertrains that were certified using this process, they, of course, do not apply to ZEVs, including ZEVs manufactured by BAE Systems. CARB staff concurs that there are some commonalities of components used in a hybrid vehicle and a ZEV, and so there is a potential for cost to bleed onto components used in ZEVs manufactured by the same manufacturer, as argued by the commenter. However, in making that argument, the commenter is attempting to redistribute the cost to comply with the requirements for hybrid powertrains onto their zero-emission product, which the hybrid powertrain test procedure does not directly impact, a disconnect that CARB staff believes is unjustifiable. Any manufacturer electing to use the optional hybrid powertrain test procedure will be subject to the same requirements, regardless of their market footprint.

Concerning the suggestion that transit bus HD hybrids be exempted from the requirements, CARB staff believes that this is not warranted. If a manufacturer chooses to certify their hybrid powertrain intending for installation in a transit bus application, that manufacturer will need to comply with all the requirements that are part of the certification process. CARB understands that the transit bus sector has a unique dynamic in terms of engine availability and the Board has directed CARB staff to offer compliance flexibility to transit agencies. Please refer to the Agency Response in section (a)xi for specific flexibility options that have been developed for the transit bus sector.

- (g)i.5. Comment: However, South Coast AQMD staff has concerns that the added hybrid components warranty as well as additional engine certification requirements might lead to an increase in the system cost and ultimately limit the technology development. As stated in the ISOR, CARB has previously adopted Innovative Technology Regulation (ITR) that provides regulatory streamlining to encourage early technology innovations like diesel-hybrid vehicles. South Coast AQMD staff believes the new diesel hybrid powertrain option could lead to another near-term cost-effective low-NOx option and achieve much needed NOx reduction early. Staff recommends CARB to add provisions similar to ITR to remove certification burden of this new technology pathway. (SCAQMD)

Agency Response: CARB staff did not change the Proposed Amendments in response to this comment. The hybrid powertrain certification requirements are intended to ensure that hybrid powertrains that are certified using this optional procedure are able to achieve and comply with the certified emission standards, maximize the possibility of maintaining the expected degree of emissions control in-use, and provide an even competitive framework for hybrid and conventional technologies in terms of manufacturers' warranty and other obligations. The hybrid powertrain certification test procedure, similar to the previously adopted ITR, provides an optional certification pathway for manufacturers to bring advanced technology to the market. Ultimately, CARB staff believes that these requirements are necessary to ensure that any emissions benefits from hybrid powertrains are real and durable.

## **(h) Comments Related to Medium-Duty Engine Clarifications and Amendments**

### **(h)i. General Comments Related to Medium-Duty Engine Clarifications and Amendments**

- (h)i.1. Comment: MY 2023 timing to increase useful life for medium-duty engines used in 10,000-14,000 pounds gross vehicle weight rating vehicles does not align with other regulatory changes or product development timelines. Cummins recommends CARB move the change to MY 2027 or at least MY 2024 to better align with other regulatory changes and product development timelines. (Cummins)

Agency Response: As recommended in the comment, the proposed implementation of the MDE useful life was modified to the suggested 2024 MY to better align with other Proposed Amendments. CARB staff did not delay this requirement to the suggested 2027 MY because such a delay would result in additional years of unnecessary non-alignment between the useful life periods of medium-duty vehicles and of MDEs used in such vehicles.

- (h)i.2. Comment: However, despite the potential inconsistency with [Low Emission Vehicle] LEV III requirements, MECA suggests that CARB align LHDD engine durability requirements with these larger engines and cap useful life at 12 years instead of the 15 year requirement currently proposed. (MECA)

Agency Response: No change was made in response to this comment. As discussed in the ISOR, consistency with the medium-duty vehicle useful life of the LEV III program was the primary rationale for proposing the same useful life period of 15 years for engines used in such medium-duty vehicles. Having the same useful life periods for medium-duty vehicles and for engines used in medium-duty vehicles will eliminate any potential loopholes and discrepancies where one certification pathway is easier to comply than another. Furthermore, the original intent of the LEV III amendments included extending the useful life period of MDEs to 15 years, identical to the medium-duty vehicle useful life;

however, this engine requirement was inadvertently missed from the final proposal. Thus, the current Amendments will correct this previous oversight, and no change was made to the Proposed Amendments in response to this comment.

## **(i) Comments Related to Economic Impact Analysis**

### **(i)i. General Cost Comments**

- (i)i.1. Comment: The proposed Omnibus Regulations are cost-prohibitive... and, as confirmed by independent expert analyses, fall well short of any reasonable cost-benefit metrics. CARB has grossly underestimated the costs associated with nearly all aspects of the proposed far-reaching Omnibus Regulation, and has materially overestimated their potential benefits. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. CARB staff has conducted detailed cost analysis of the Omnibus Regulation, as shown in section IX of the ISOR. The cost and savings estimates of sub-elements, the Omnibus Regulation as a whole, costs per vehicle, emissions benefits, health benefits, and cost benefit analysis are all included in the ISOR. Since the Board Hearing, CARB staff has conducted additional cost and benefits analyses to include the recently adopted ACT Regulation and the 30-Day and 15-Day Notice Amendments.

Since the Board Hearing, CARB staff updated the analysis as discussed below:

CARB staff updated the projected sales volume of medium- and HD combustion engines to be based on the legal baseline. In the Standardized Regulatory Impact Assessment (SRIA), which was prepared in early 2020, CARB staff performed the cost analysis based on the modeled baseline to account for the proposed ACT Regulation as both the proposed ACT Regulation and the Omnibus Regulation would impact the same class of vehicles and engines during the same timeframe. However, the California Department of Finance (DOF) indicated in their comments on CARB's submitted SRIA that CARB must base the main cost analysis on the legal baseline and hence should not have included the proposed ACT Regulation in the baseline. In response to DOF's comments, CARB staff provided a cost and benefit impact analysis based on the legal baseline excluding ACT Regulation in a level of detail similar to that in the SRIA as an attachment to the Public Notice released June 9, 2020. In March 2021, the ACT Regulation was fully adopted. Hence, it is now appropriate to include the ACT Regulation in the legal baseline. CARB staff has therefore updated the cost analysis using a legal baseline including the adopted ACT Regulation (and thus with fewer sales of engines compliant with the Omnibus Regulation).

CARB staff proposed a limited exemption for 2024 through 2026 MY HD diesel engines rated at or above 525 brake horsepower (bhp) maximum power from the exhaust emissions standards for 2024 and subsequent MY HD diesel engines. The proposed change is necessary since these engines have relatively few sales in California and manufacturers may find it difficult to allocate resources to redesign them while also investing resources and managing design changes to their other more popular engine families. Thus, the proposed change would provide manufacturers the flexibility to continue to certify and make products available for California businesses and consumers which otherwise may not have been possible without this exemption.

CARB staff proposed adding “Transit Agency Diesel-Fueled Bus and Engine Contract Exemption Request Requirements” to provide flexibility to transit agencies that are experiencing difficulty in purchasing diesel-fueled buses because the dominant manufacturer of diesel-fueled urban bus engines recently expressed its intent to no longer produce 2024 and subsequent MY diesel-fueled urban bus engines in California. The announcement created an obstacle for transit agencies that were planning to buy diesel-fueled buses as a part of their compliance plan for meeting the ICT Regulation. In the proposed Transit Agency Diesel-Fueled Bus and Engine Contract Exemption Request Requirements, transit agencies are required to seek out funding support to accelerate the fleet’s transition to ZEBs and reduce their diesel-fueled bus purchasing plans. If the transit agency has alternative-fueled buses in their fleet, the transit agency must consider expanding the number of alternative-fueled buses in their fleet or explain why it is cost prohibitive. If the transit agency meets the proposed exemption request requirements, the Executive Officer issues an exemption allowing transit agency to purchase, rent, or lease exempt buses, contract with bus service providers to operate exempt buses, or re-power buses with diesel-fueled engines that are federally certified.

CARB staff proposed to increase the in-use HDIUT conformity factor to 2.0 in the early years of implementation from 2024 to 2030 MY engines. These changes have been reflected in Table III-3. For 2031 and later MY engines, the conformity factor would revert back to today’s conformity factor of 1.5. Manufacturers had voiced concerns regarding meeting the emission thresholds with the current 1.5 conformity factor for new technology meeting new and much more stringent NOx standards with 2024 and 2027 MY engines. To address their concern, the conformity factor was changed from 1.5 to 2.0 for the first 3 years after a change in the NOx emission standard. This change would provide an additional compliance margin for manufacturers as they simultaneously comply with the proposed new lower emission standards and proposed new HDIUT in-use test procedures. The increased conformity factor required reanalysis of the emissions benefits. The associated emissions inventory and health benefits were adjusted to reflect the increased conformity factor.

CARB staff proposed to eliminate the parts storage provision from the proposed EWIR Amendments. The originally proposed language required manufacturers to store parts that were analyzed to determine the valid failure rate reported in the field information report for a period of two years and submit such parts to CARB upon request. Based on industry feedback, it was determined that physically storing parts for two years could be overly costly and burdensome and could cause logistical problems. The newly proposed language would no longer require manufacturers to physically store parts. Instead, manufacturers would be required to store failure mode and part analyses and identifying information and provide such information to CARB upon request. This change would address manufacturers' concerns with being required to physically store parts, while still providing CARB with an increased ability to verify information provided in warranty reports and evaluate failure mode analysis methodology used by manufacturers.

CARB staff proposed to provide manufacturers with a legacy engine provision, providing an option to certify and sell 2024 and 2025 MY engines that meet the current exhaust standards for NO<sub>x</sub> and PM, provided those manufacturers purchase and retire HD-ZEP credits (i.e., from the zero-emission averaging set), sufficient to offset any NO<sub>x</sub> or PM credit deficits generated from this option. If a sufficient number of credits from the zero-emission averaging set are not available at or below specified cost thresholds (up to 20 percent of the cost of the engine), a manufacturer may submit a request to use other credits to CARB's Executive Officer. If a sufficient number of zero-emission or combustion credits are not available to offset the deficit for the 2024 or 2025 MY, then the manufacturer will be required to cover the remaining deficits with a 1.25 multiplier at the end of 2026 with first zero-emission credits, then second combustion credits, or lastly submit a remediation proposal to CARB's Executive Officer to sufficiently cover the remaining credit deficit with clean-up projects in disadvantaged communities that are disproportionately impacted by poor air quality. Thus, no changes were made to the emissions benefit estimates for the Omnibus Regulation because any incremental emissions from the allowance of legacy engines would be offset by the above mentioned provisions.

The Omnibus Regulation is estimated to have a total NO<sub>x</sub> benefit of 225,763 tons between 2022 and 2050. As a result, the Omnibus Regulation is expected to reduce the total number of incidents for premature mortality, cardiovascular hospitalization, acute respiratory hospitalization, and emergency room visits by 4,494 for 2022 through 2050, which is equivalent to the monetized health benefits of approximately \$23.4 billion. The Omnibus Regulation would impose approximately \$2.39 billion in cost and \$353 million in savings to California businesses from 2022 through 2050. The cost-effectiveness of the proposed Omnibus Regulation is estimated to be \$4.51 per pound NO<sub>x</sub>. The cost effectiveness is within the 80<sup>th</sup> percentile of previous CARB rulemakings.

In response to the commenter's claim of overestimated potential benefits, CARB staff has used widely accepted estimation methods from EMFAC2017, incident per ton, and quantitative risk factors from epidemiology studies. For additional details related to the health benefits see the Agency Response to Comment A.(j)ii.1.

- (i)i.2. Comment: CARB's Cost Assessment for the Omnibus Regulations (see ISOR, section IX) is understated by an order of magnitude. (See ISOR, pp. ES-15 and 16.) CARB's estimated average per-vehicle cost increase of \$6,410 (including CARB's estimated HHDD per-vehicle increased cost of \$8,478, and its estimated MHDD per-vehicle cost increase of \$6,923) are not "all-in" costs, are unreasonably low, and are belied by the ACT Research study that EMA commissioned, as well as by the independent expert report that CARB commissioned from NREL. Moreover, the ACT ZEV Rule — which impacts the same HDOH vehicles and manufacturers over the same time period (ISOR, p. I-36) — will exacerbate the per-vehicle cost increases at issue by reducing the HDOH diesel vehicle market in California year-over-year, thereby driving up the marginal cost of each CARB-compliant diesel vehicle as the market over which to allocate the increased Omnibus compliance costs continues to shrink each year starting in 2024. CARB's Cost Assessment completely fails to account for that reality. All in, CARB estimates the total costs to manufacturers at \$4.07 billion through 2050. As noted, that is based on an average per-vehicle cost increases of only \$6,410 (Notice, pp. 13-14), which is understated by an order of magnitude. (EMA, Daimler, Navistar, Volvo)

Agency Response: Although CARB staff disagrees with most of this comment (namely that CARB staff cost estimates are too low by an order of magnitude), CARB staff did make changes to the cost analysis in response to this comment and in response to the fact that the ACT Regulation completed the adoption process and hence can now be included in the legal baseline. The cost analysis for the proposed Omnibus Regulation was conducted with good engineering judgement and is inclusive of all the elements of the regulation ("all in"). As a final note, since the Board Hearing, CARB staff has updated the cost analysis in the ISOR to account for the ACT Regulation and for the 30-Day and 15-Day Notice Amendments that are incorporated in this FSOR (see Agency Response to Comment A.(i)i.1).

CARB staff believes the ACT Research study commissioned by EMA to be an inaccurate and an unreasonable representation of the proposed Omnibus Regulation costs. The compounded total costs per engine estimated in the ACT Research study misleadingly and incorrectly overstate the costs per engine by summing the costs for MYs 2024, 2027 and 2031 technologies (i.e., incorrectly computed the total MY 2031 cost as the cost of MY 2024 engine vs MY 2018 engine plus the cost of MY 2027 vs MY 2018 engine plus the cost of MY 2031 vs MY 2018 engine). The incremental cost of the engine for each stringency step in

MYs 2024, 2027 and 2031 should only be relative to the baseline technology of 2018 MY engine and not the accumulation of all three phases of the Regulation. Also, the ACT Research study assumed manufacturers would have to replace the entire aftertreatment system two times over the course of the full useful life of 2027 and 2031 MY engines, thereby tripling the costs of the aftertreatment system for these vehicles on top of using cumulative technology cost. It is important to understand that the Omnibus Regulation emissions standards for HHDD engines were modified to allow for expected additional emissions deterioration between the current 435,000 miles useful life to the longer 600,000 mile and 800,000 mile full useful life for 2027 and 2031 MY engines, respectively (see Agency Response to Comments A.(c)ii.1. and A.(c)ii.2. regarding the establishment of intermediate useful life and full useful life NOx standards for HHDD engine). Also, engine manufacturers will have several years to develop more durable systems meeting higher than initially proposed NOx standards, not considered in the ACT Research study. Thus, CARB staff does not believe assuming the entire aftertreatment system would have to be replaced even once is a reasonable assumption based on these proposed changes.

The NREL report shows that the biggest contributor to the increased per-vehicle cost comes from the indirect costs associated with the longer warranty periods. As explained in the Agency Response to Comments A.(i)i.7 and A.(i)i.8, CARB staff believes that the warranty costs from the final NREL report are not reliable and ultimately were not used in the Omnibus' warranty analysis. CARB staff provided a sensitivity cost/benefit analysis using the warranty estimates from the NREL study in section IX.F of the ISOR.

Given the unreliability of the NREL warranty costs, CARB staff instead used a systematic method to estimate the warranty and EWIR costs by using a failure rate approach that relied on warranty repair data. This approach is reasonable because it relies on actual data coming from MY 2013 warranty claims, and linearly extrapolates it to the longer amended periods. The extrapolation assumes that failures remain constant and do not reach the end-of-life where non-linear trends are typically observed. Additionally, since HD engines can last for over 850,000 miles before being rebuilt, and the warranty mileages included in the Omnibus Regulation are well below that mileage, the assumption holds true and the linear extrapolation is a reasonable approach.

After the reanalysis to account for the ACT Regulation and 30-Day and 15-Day Notice Amendments, CARB staff estimates the Omnibus Regulation to be \$2.39 billion dollars and an average increase in cost per vehicle in 2031 to be \$5,495 based on population weighted engine class or a 5.5 percent increase in cost over the lifetime of the vehicle.

- (i)i.3. Comment: CARB concedes in its Cost Assessment that “the direct and indirect costs” of the Omnibus Regulations “would likely be passed on to engine/vehicle operators.” (ISOR, p. IX-46.) CARB also notes that “the

elements contributing to increased costs include establishing more stringent emission standards over existing regulatory cycles, amendments to in-use test procedures, modifications to the durability demonstration procedure for certification, lengthened warranty periods, lengthened useful life periods, amendments to EWIR reporting and corrective action procedures, and requiring NOx data-collection and reporting.” (Id.) Notwithstanding CARB’s recognition of the anticipated aggregate impacts on the costs of new HDOH engines and vehicles in California, CARB fails to calculate or disclose the “all-in” estimated cost impacts of its Omnibus Proposal on a per-vehicle basis. That failure to provide any clear “all-in” per-vehicle cost metric — coupled with CARB’s failure even to specify the number of projected HDOH vehicle/engine sales that CARB is assuming will occur from and after the 2024 MY, which CARB is relying on in making its cost-benefit calculations — are additional fundamental shortcomings of CARB’s Cost Assessment. CARB is unfairly masking the real-world impacts of its Omnibus Rulemaking. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or analysis in response to this comment. CARB staff has conducted and presented the Omnibus Regulation’s “all-in” cost on a per engine basis (see ISOR, p. IX-51 and IX-52). Also, the cost values representing the three stages of the requirements for MY 2024, 2027, and 2031 engines are in Tables IX-34, IX-35, and IX-36 of ISOR.<sup>158</sup> The sales volumes of HDOH engines can also be found in ISOR Appendix C-3, Table I.4, titled “Projected Statewide New Medium- and Heavy-Duty Engines Sales from 2022 to 2050.” For the Omnibus Regulation ISOR, CARB staff was required to follow a legal baseline by only including completely adopted regulations. As mentioned in the Agency Response to Comment A.(i).1, CARB staff has conducted additional cost and benefits analyses to include the adopted ACT Regulation and the 30-Day and 15-Day Notice Amendments. CARB staff estimates the costs to be \$5,773; \$6,347; and \$6,057 for LHDD, MHDD, and HHDD engines meeting 2031 requirements respectively. After the reanalysis to account for the ACT Regulation and 30-Day and 15-Day Notice Amendments, the average increase in cost per vehicle in 2031 is estimated to be \$5,495 based on population weighted engine class or a 5.5 percent increase in cost over the lifetime of the vehicle (also discussed in Agency Response to Comment A.(i).2).

- (i).4. Comment: CARB attempts to buttress its fundamentally unreasonable Cost Assessment by claiming that HDOH vehicle purchasers would “experience savings” resulting from the additional vehicle repairs that would be covered under the mandated lengthened emission warranties. (ISOR, p. V-11.) That claim is incorrect and completely undercut by CARB’s admission that “the added costs associated with longer warranty periods would ultimately be

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<sup>158</sup> CARB, Public Hearing to Consider the Proposed Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments. Staff Report: ISOR, June 23, 2020. <https://ww3.arb.ca.gov/regact/2020/hdomnibuslownox/isor.pdf>

passed on to consumers in the form of an increased purchase price for the trucks.” (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or analysis in response to this comment. CARB’s regulatory cost assessment is required to reflect the total impact of the regulation, including both costs and savings. In evaluating the costs of the Omnibus Regulation’s warranty Amendments, CARB staff estimated increased upfront vehicle purchase prices as well as repair cost savings over time. Although not every individual truck owner will experience repair cost savings, on average, truck owners will gradually recoup the initial increase in purchase price as they save money on repairs over time. In the absence of the Regulation, the owners would need to start paying out-of-pocket costs for vehicle repairs at the end of the baseline warranty. Under the amended regulations with the longer warranty periods, such repairs would be covered by the manufacturer and therefore would on average provide a monetary benefit (i.e., savings) to the truck owners. Consider, for example, a MY 2027 Class 8 vehicle for which the Omnibus Regulation would lengthen the required warranty from 350,000 miles to 450,000 miles. The owner of this vehicle would reap repair cost savings for any emission-related repairs required between 350,000 and 450,000 miles because such repairs would now be required to be covered by the manufacturer warranty, whereas before the Omnibus Regulation, they would have been the responsibility of the owner to pay out-of-pocket.

- (i)i.5. Comment: Nonetheless, and “for simplicity,” CARB just assumes that vehicle purchasers would start to realize repair savings “beginning in the sixth year of vehicle ownership,” (ISOR, p. V-12), apparently because vehicle manufacturers uniformly would underestimate the real-world costs of CARB’s lengthened warranties, and so would not include sufficient increases to the purchase prices of their new HDOH vehicles. CARB offers no evidence whatsoever in support of that assumption, which CARB admittedly made “for simplicity.” And, of course, there is no such evidence that manufacturers will be unable to sufficiently cost-out the monetary impacts of CARB’s extended warranties, and fully recapture those costs through increased purchase prices for new HDOH vehicles. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or analysis in response to this comment. As acknowledged in the ISOR, CARB staff expects an upfront price increase to vehicles due to manufacturers increasing their prices to offset the additional cost to cover repairs during longer warranty periods. Additionally, CARB staff also anticipates repair cost savings to the vehicle owners from repair savings over time.

The expected failures that would need to be repaired can occur at any time of ownership, and so when they are repaired under the lengthened warranty periods it is considered an owner savings because it reduces their out-of-pocket expenses. In CARB staff’s analysis, the calculations were simplified to have

savings occur in the sixth year because there is uncertainty as to when exactly the failures would occur. CARB staff modeled repair cost savings as beginning in the sixth year because existing warranty periods last five years or a certain mileage, whichever occurs first, and hence only cover repairs needed in the first five years of ownership. Accounting for repair cost savings beginning in the sixth year of ownership delays taking credit for repair cost savings in the first five years (i.e., for vehicles that reach the warranty mileage before the age of five years and then require repairs before the age of five years) until the sixth year, thereby providing a conservative (i.e., low) estimate of savings.

- (i)i.6. Comment: In spite of CARB's failure to address in a transparent manner the full per-vehicle cost increases that its Omnibus Regulations will cause, there is a way to begin to assess what CARB's assumptions reveal about that key cost-effectiveness metric. More specifically, CARB does provide per-vehicle cost impact estimates for two of the many elements of the Omnibus Rule – the per-vehicle “technology costs,” and the per-vehicle extended warranty costs. (See ISOR, pp. IX-10 and 22.) For HHDD vehicles, those total incremental costs through 2031 add up to \$14,728 per-vehicle (\$2,466 + \$5,173 + \$6,159 + \$930). Significantly, that calculation still leaves out all per-vehicle costs associated with the Omnibus Program's new in-use testing requirements, new durability and useful life requirements, new EWIR and recall requirements, and new data-collection and reporting requirements. Thus, it is a very low and unrealistic per-vehicle cost value. Nonetheless, even though it is a fractional estimate of the aggregate “all-in” costs at issue, it is still a higher per-vehicle cost factor than the cost estimates CARB includes in the up-front sections of its ISOR. As noted, CARB's Notice of Hearing (at p. 14) and CARB's Executive Summary (at p. ES-16) posit a per-vehicle cost increase number for HHDD vehicles of just \$8,478. (See also P. IX 52.) (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or analysis in response to this comment and believes the commenter incorrectly interpreted the cost specified in the ISOR section referenced in the comment. The table on page IX-10 that the commenter is referring to lists the incremental cost for the engine technology that is expected to be used to meet the 2024, 2027, and 2031 low NOx standards. Each of the costs are incremental to the 2018 baseline scenario cost and are not to be added together to equal the total cost of the new technology as the commenter has shown in the comment. The same is true for the extended warranty incremental cost that can be found on page IX-22 of the ISOR, they are incremental to the baseline scenario. As a result, the estimated increased cost for a 2031 12/13-liter diesel engine in a HHDD configuration in ISOR is \$6,159 and the incremental cost of the extended warranty in 2031 is \$771 for a total of \$6930 not \$14,728.

The commenter's claim that CARB failed to address in a transparent manner the full per-vehicle cost increases that its Omnibus Regulation will cause is false. CARB staff presented the Proposed Amendment's all-in cost on a per engine basis (ISOR, p. IX-51 and IX-52). These values are in Tables IX-34, IX-35, and IX-36 of the ISOR representing the three stages of the Proposed Amendments in MY 2024, 2027, and 2031 engines. The tables include the total per vehicle increase in purchase price expected due to all elements of the Omnibus Regulation, including but not limited to new warranty, in-use testing requirements, new durability and useful life requirements, new EWIR and recall requirements, and new data-collection and reporting requirements. For example, as shown in Table IX-35 in the ISOR, for a 2027 HHD vehicle, the Omnibus Regulation is expected to increase purchase price \$7,423, and have a lifetime net impact on cost of \$7,819 per vehicle, which equates to 4.6 percent of the baseline vehicle cost. The sales volumes of HDOH engines are located in ISOR Appendix C-3, Table I.4 which is titled "Projected Statewide New Medium- and Heavy-Duty Engines Sales from 2022 to 2050."

In the ISOR, CARB staff was required to compare costs versus a legal baseline only including adopted regulations. At the time of the ISOR, the ACT Regulation was not adopted, and hence data from the ACT Regulation could not be used to estimate the sales of ZEVs for the Omnibus Regulation. In March of 2021, the ACT Regulation became effective. CARB staff reanalyzed the costs and benefits to reflect the ACT Regulation and the 30-Day and 15-Day Notice Amendments. The justification for the technology package and costs based on the NREL survey is provided in the Agency Response to Comment A.(i).2. Also see Agency Response to Comment A.(i).1.

After the reanalysis to account for the ACT Regulation and 30-Day and 15-Day Notice Amendments, the average increase in cost per vehicle in 2031 is estimated to be \$5,495 based on population weighted engine class or a 5.5 percent increase in cost over the lifetime of the vehicle.

- (i).7. Comment: Tellingly, in preparing its Cost Assessment, CARB staff have attempted to distance themselves from the very detailed cost assessment that CARB's retained expert consultant, NREL, developed and delivered to CARB for use in evaluating the cost-effectiveness of the Omnibus Regulations. In addition, CARB makes it more difficult than necessary to evaluate its cost-assessment methodology by highlighting increased per-vehicle costs for certain Omnibus Program elements, "Statewide" costs for others, aggregate manufacturer costs in still other instances, and purchaser costs in other cases. That amalgam of different cost metrics makes a comparison of CARB's methodology and results to those obtained by independent experts, including NREL, more challenging, but no less revealing. (EMA, Daimler, Navistar, Volvo)

- (i)i.8. Comment: In its ISOR (at p. IX-74), CARB states that while it did use certain of NREL's findings "to estimate costs associated with the technology packages needed to meet the Low-NOx Regulations, CARB staff did not use NREL's survey responses related to lengthened warranties, which were very high, over \$23,000 per-vehicle for the largest diesel trucks." CARB's efforts to discount NREL's findings (including through CARB staff's inconsistent application of "average useful life miles" and "average warranty miles" (see ISOR, p. IX-74)) are symptomatic of the understated Cost Assessment that CARB has constructed to try to support the Omnibus Rulemaking. (EMA, Daimler, Navistar, Volvo)

Agency Response to Comments (i)i.7, and (i)i.8: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. CARB staff has not attempted to distance ourselves from the cost assessment that CARB's contractor NREL prepared. On the contrary, as stated in the ISOR (p. IX-70), CARB staff used the results of the NREL study extensively to estimate the costs associated with the technology packages needed to meet the Proposed Amendments. The only element of the NREL study that CARB staff did not use for our analysis was the incremental warranty costs. CARB staff believes that the incremental warranty costs from the final NREL report are likely significantly overstated due to the differing metrics considered in the NREL report versus the metrics that were proposed under the Omnibus Regulation. For instance, NREL used a million-mile useful life period for a Class 8 truck which was far greater than the 800,000-mile useful life period as required in the Omnibus Regulation. Also, NREL was not made aware of exactly how OEM's estimate their warranty costs to fully understand what variables were factored into those estimates. As discussed in the Agency Response to Comment A.(i)ii.6, CARB staff disagrees with the assumption the aftertreatment would require several replacements over the course of the full useful life causing the inflation of estimated warranty costs. In addition, CARB staff was concerned with the very limited response rate to the survey on which NREL had to base their incremental warranty cost estimates. Therefore, on account of these reasons, NREL warranty costs are considered to be less reliable than the cost estimates derived from CARB staff's failure rate approach and ultimately were not used in CARB staff's analysis.

To better understand the regulatory cost impact had NREL warranty costs been used, CARB staff conducted a sensitivity analysis using NREL data in which the costs for the warranty-related elements were varied (i.e., lengthened warranty periods and EWIR and corrective action plan Amendments) to show how estimates of overall costs and cost-effectiveness would change. The detailed sensitivity analysis is given in section IX.F.3 in the ISOR (p. IX-73). The results showed that incorporating the incremental warranty costs from the NREL report would increase the total statewide regulatory costs and reduces the cost-effectiveness, i.e., cost per unit of NOx reductions increases by about 26 percent. Despite those calculated increases, the cost-effectiveness would have been a

reasonable value when compared to those of recent CARB rulemakings. However, in the end, due to the concerns previously described, NREL warranty costs were not used.

Different groups doing regulatory economic assessments may use different cost-assessment methodologies, and so finding a common agreed-upon base unit can be difficult. CARB staff's use of different cost metric units on an average per-vehicle, statewide, manufacturer-focused, and purchaser-focused costs are an attempt to provide the regulatory costs in a wide range of units to help with understanding and ease-of-use for comparisons. Furthermore, to better understand the warranty cost differences, the Board directed CARB staff to engage with stakeholders by participating in a cooperative Warranty Cost Study. The goals of the study are detailed in the Agency Response to Comments A.(c)iv.1 and A.(c)iv.2; overall, they are intended to help mitigate the uncertainty that manufacturers and part suppliers have regarding the costs for the longer warranty periods under first and subsequent vehicle ownerships. The study served as a fair and direct comparison of the various variables and assumptions that are factored into the incremental warranty costs.

CARB staff has conducted a detailed cost analysis of the Omnibus Regulation that includes the cost and savings estimate of sub-elements, Regulation as a whole, costs per vehicle, emissions benefits, health benefits, and cost benefit analysis. The detailed analysis can be found in Appendix C-3 of the ISOR.

As a final note, since the Board Hearing, CARB staff has updated the cost analysis in the ISOR to match the proposed Omnibus Regulation to account for the ACT Regulation and the 30-Day and 15-Day Notice Amendments that are incorporated in this FSOR (see Agency Response to Comment A.(i)j.1). After the reanalysis to account for the ACT Regulation and 30-Day and 15-Day Notice Amendments, CARB staff estimates the cost of the warranty Amendments per engine in 2031 to be \$685, \$1,167, and \$915 for the LHDD, MHDD, and HHDD vehicle classes respectively.

- (i)i.9. Comment: There is no reasonable basis for CARB's post hoc disavowal of its own designated experts. To the contrary, NREL's findings are generally consistent with the other expert report developed by ACT Research relating to the likely per-vehicle cost impacts of the Omnibus Proposals... The NREL cost study (Exhibit "C") that CARB commissioned is very instructive. As an initial matter, it confirms that accurate projections about future HDOH vehicle production and sales volumes in response to the Omnibus Rulemaking are paramount considerations. It also clearly recognizes that, when attempting to assess indirect costs, such as the potential impacts of expanded warranty and EWIR requirements, OEMs are the entities best positioned to estimate those costs, which implicitly confirms that CARB's indirect cost-assessment method – "linearly extrapolating data from the 2013 model year" (ISOR, Append. C-3, p. 49) – is not a reasonable approach... The NREL Report is

most telling, of course, in the bottom-line results it presents, results that are based on far more reasonable cost-estimation approaches than CARB's. Specifically, the NREL Report concludes that for HHDD vehicles, the per-vehicle cost for compliance with CARB's Omnibus Regulations will range from \$28,868 to \$47,042, with the higher range being the more likely outcome. It is important to understand in assessing the likely invalidity of this Omnibus Rulemaking that NREL's high-range cost estimate is fully five and a-half times higher (550% higher) than CARB's HHDD per-vehicle estimate of \$8,478. It also is important to note that NREL's conclusions regarding the all-in per-vehicle costs of the Omnibus Regulations are much more in line with ACT Research's conclusions than with CARB's.

Consequently, while NREL's \$49,318 per-vehicle cost assessment for HHDD vehicles is far more reasonable and probable than CARB's significantly understated per-vehicle value of \$8,478 (and more in line with ACT Research's findings and conclusions), the NREL cost values still do not capture the full adverse cost impacts that CARB's Omnibus Regulations would generate. That more complete assessment is reflected in the cost study that ACT Research has submitted regarding the Omnibus Low-NOx Regulations. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. In CARB staff's analysis, the warranty costs were calculated as the average incremental cost per-vehicle over the entire vehicle population. The analysis factored in the warranty purchasing business practice which considers the percentage breakdown of the HD vehicle population that would have an extended warranty and those that would not. Therefore, the incremental warranty costs represent the increase in price that an average customer would be expected to pay. In later discussions between CARB staff and industry stakeholders, it became clear that industry's approach possibly preserved that percentage breakdown of the warranty business purchasing practice in their per-vehicle price. Meaning, they determined the per-vehicle incremental costs for the segmented groups of the population and not the population as a whole. So, for customers who normally purchase an extended warranty, the per-vehicle incremental costs would not significantly increase the price they would typically pay. Whereas another customer who may not normally purchase an extended warranty would now have a larger increase to pay on the vehicle price.

The NREL report shows that the biggest contributor to the increased per-vehicle cost comes from the indirect costs associated with the longer warranty periods. As explained in the Agency Response to Comments A.(i).7 and A.(i).8, CARB staff believes that the warranty costs from the final NREL report are not reliable and ultimately were not used in the Omnibus' warranty analysis.

Given the unreliability of NREL warranty costs, CARB staff instead used a systematic method to estimate the warranty costs by using a failure rate approach that relied on warranty repair data. This approach is reasonable because it relies on actual data coming from MY 2013 warranty claims, and linearly extrapolates it to the longer amended periods. The extrapolation is a conservative approach because it assumes that failures remain constant and do not reach the end-of-life where non-linear trends are typically observed. Additionally, since HD engines can last for over 850,000 miles before being rebuilt, and the warranty mileages included in the Omnibus Regulation are well below that mileage, the assumption holds true and the linear extrapolation is a reasonable approach.

CARB staff believes the ACT Research study commissioned by EMA to be an inaccurate and an unreasonable representation of the proposed Omnibus Regulation costs. The ACT Research study assumed manufacturers would have to replace the entire aftertreatment system two times over the course of the full useful life, thereby adding significant costs to the vehicles. The Omnibus Regulation emissions standards have been adjusted for HHDD engines that considers deterioration between 435,000 miles and the longer full useful life changes that occur with 2027 and 2031 MY engines. Engine manufacturers will have several years to develop more durable systems; thus, CARB staff does not believe the entire aftertreatment system would need any replacement based on the proposed changes (for more details please see Agency Response to Comment A.(i)i.2).

Additionally, as described in Agency Response to Comment B.(c)iii.1, the Board directed CARB staff to engage with stakeholders by participating in a cooperative study designed to provide information regarding the costs attributable to the warranty-related elements of this rulemaking action to industry. After convening an industry stakeholder work group that worked over a nine-month period to analyze and study the various differences in the cost estimate methodologies used for estimating warranty costs, CARB staff concluded the Omnibus Regulation's cost estimates were well-supported and appropriate and therefore did not amend the cost estimates.

- (i)i.10. Comment: EMA retained ACT Research to conduct a comprehensive assessment of the direct and indirect costs, as assessed on a per-vehicle basis, that likely will result from CARB's implementation of the Low-NOx Regulations (Exhibit "A"). Applying a 7% discount rate to the estimated costs, the per-vehicle costs in California will range from \$57,905 for HHDD vehicles to \$51,365 for MHDD vehicles, for an average per-HD vehicle cost of \$54,635. When that per-vehicle cost number is compared against CARB's ISOR estimated per-vehicle cost number (\$8,478 for HHDD vehicles and \$6,923 for MHDD vehicles, for an average per-HD-vehicle cost of \$7,700) it is clear that CARB has understated the per-vehicle costs of its Omnibus Rulemaking by at least a factor of 7. That is even higher than the factor of 5.5

derived from a comparison of CARB's cost estimates with those that NREL derived. Either way, CARB has grossly mischaracterized the costs of this rulemaking. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. As described in the Agency Response to Comments A.(i)i.2 and A.(i)i.9, CARB staff believes the ACT Research study commissioned by EMA to be an inaccurate and an unreasonable representation of the proposed Omnibus Regulation costs. As explained in the Agency Response to Comments A.(i)i.7 and A.(i)i.8, CARB staff believes that the warranty costs from the final NREL report are not reliable and ultimately were not used in the Omnibus Regulation's warranty analysis.

The commenter states that CARB staff understates the cost per vehicle by a factor of 7 when compared to the ACT Research cost estimates. CARB staff disagrees with this statement. The compounded total costs per engine estimated in the ACT Research study misleadingly increases the costs by cumulating the costs per engine by summing the costs for MYs 2024, 2027, and 2031 requirements in the proposed Omnibus Regulation. The incremental cost of the engine should only be relative to the baseline technology in 2018 and not the accumulation of all three phases of the Regulation (for more details please see Agency Response to Comment A.(i)i.2).

- (i)i.11. Comment: National Economic Research Associates (NERA) expert report (Exhibit "B" attached to EMA) estimates and quantifies the potential health benefits from the types of low-NOx standards at issue, and includes two parts: a conceptual summary of methods and results; and a more detailed technical analysis. Based on NERA's confidence-adjusted analysis, and excluding only up to the 10<sup>th</sup>-percentile of the (unrepresentative) exposure data from the underlying epidemiology studies, and applying a 3% discount rate as opposed to a 7% discount rate, the per-truck benefits that could be derived from the types of HDOH low-NOx Regulations at issue range from approximately \$9,400 on the high-side to \$3,800 on the low-side, for an average per-truck benefit of \$6,600. Comparing that average per-truck benefit against the average per-truck cost as determined by ACT Research (\$54,500) yields a costs-to-benefits ratio (or a negative benefits-to-costs ratio) of approximately 8:1, which conclusively establishes that the Omnibus Regulations are cost-prohibitive and therefore invalid. There are no data in the rulemaking record sufficient to rebut that conclusion. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. CARB staff has three critiques of the analysis methods use in the NERA report as described in the Agency Response to Comment A.(i)ii.9. First, NERA's analysis uses an outdated emissions inventory to estimate Omnibus Regulation benefits in California.

Second, NERA's analysis does not account for vehicles that are first sold or certified in California. Finally, NERA underestimates per vehicle NOx emissions reductions for 0.02 g/bhp-hr certified engines relative to CARB's analysis.

Greater emission reductions estimated by CARB staff are not just the result of tightening the certification standard alone. The in-use component of the Omnibus Regulation is expected to close the gap between in-use (or real-world) emissions and the certification standard. In addition, emission reductions from other parts of the program were also modelled by CARB staff, including extended warranty and useful life, tightened idling standards, and the proposed new LLC certification test cycle.

It is not clear what methods were used to estimate 50 percent lower in-use NOx emissions, which was originally provided by EMA, but this dramatically underestimates emissions benefits per vehicle for the Omnibus Regulation.

As described in the Agency Response to Comments A.(i).2 and A.(i).9, CARB staff believes the ACT Research study commissioned by EMA to be an inaccurate and an unreasonable representation of the proposed Omnibus Regulation costs.

As a final note, as described in the Agency Response to Comment A.(i).1, since the Board Hearing, CARB staff has updated the cost analysis in the ISOR to match the proposed Omnibus Regulation to account for the ACT Regulation and the 30-Day and 15-Day Notice Amendments that are incorporated in this FSOR. With the updated analysis, the cost-effectiveness of the proposed Omnibus Regulation is estimated to be \$4.51 per pound NOx. The cost-effectiveness is within the 80<sup>th</sup> percentile of previous CARB rulemakings.

- (i).12. Comment: EMA has proposed a more cost-effective alternative to CARB's cost-prohibitive Omnibus Regulations... While EMA's alternative concept would be less stringent than CARB's, it is inherently more effective because it would also cover the more than 60% of VMT that are driven in California by out-of-state HHDD trucks. The substance of EMA's August 2018 alternative, which would have been implemented in 2024-2026 on a nationwide basis, not just in California, included a 25% lower NOx standard, expanded in-use testing criteria also with a 25% lower in-use standard, and a commitment to work on a 2027 national lower-NOx standard. EMA subsequently offered additional NOx control measures in a July 11, 2019, submission to CARB, through the addition of CARB's LLC and an even lower NOx standard over the existing certification test cycles. EMA's August 2018 nationwide alternative low-NOx proposal assumed 5-plus years of leadtime to develop compliant 50-state MHDD and HHDD products. Since that time, with no movement from CARB toward agreement on the pull-ahead of a nationwide alternative, EMA members have lost over one-and-a-half years of development time, making the commitment to voluntary nationwide standards

at that level by 2024 likely impossible at this stage, and making it questionable whether even less aggressive reductions could be implemented nationwide in advance of the 2024 MY.

The cost-effectiveness metric for EMA's alternative, as assessed by CARB, is \$8,644 per-ton of NOx (\$182 million cost divided by 21,056 tons), while CARB's assessment (albeit understated) of the costs related to its Omnibus Regulations is \$37,495 per-ton of NOx (\$1.073 billion cost divided by 28,617 tons). (SRIA, pp. 126, 129.) Thus, EMA's alternative nationwide program, even as assessed by CARB, is more than four times more cost-effective than CARB's. (EMA, Daimler, Navistar, Volvo)

- (i)i.13. Comment: In its ISOR, CARB notes that the nationwide 50-state alternative low-NOx program that EMA proposed to CARB in 2018 and 2019 would cost "\$3.59 billion less than the proposed amendments, about 80% less," while yielding 92.2% of the public health benefits that CARB has ascribed to the proposed amendments, an analysis that is in agreement with Ramboll's. (ISOR, pp. X-12 and X-14.) Thus, CARB admits that EMA's proposal would have been far more cost effective than what CARB is now presenting for Board approval. "The total cost-effectiveness of Alternative 2 [EMA's nationwide proposal] is modeled to be \$1.38 per pound of NOx reduced, significantly less than the proposed amendments." (ISOR, p. X-16.) "Alternative 2 would be more cost-effective than the proposed amendments." (See Response to DOF, p. 17.) Consequently, a clearly more reasonable and cost-effective regulatory alternative was available in this case, which renders the Omnibus Proposal inherently unreasonable and invalid. (EMA, Daimler, Navistar, Volvo)

Agency Response to Comments (i)i.12 to (i)i.13: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. The Alternative 2 program is based on a proposal received from Tim French, who represents EMA, during an online working group meeting held in June 2019.<sup>159</sup> The Tim French proposal is the one referred to in the comment. Under the proposed Alternative 2 program, engine manufacturers would voluntarily certify to a national FTP and RMC NOx standard that would be less stringent than the proposed standard. Presumably, California would benefit from cleaner California-certified HD vehicles and cleaner federally certified HD vehicles operating in California (over half the total HD vehicle miles traveled in California are accumulated by federally certified HD vehicles).

Under the Alternative 2 program, the national NOx emission standard for 2024 to 2026 MY engines would be 0.15 g/bhp-hr on FTP and RMC cycles, the in-use HDIUT threshold would be 0.22 g/bhp-hr, and LLC standard would be 0.7 g/bhp-hr. EMA claims an approximate reduction of 50 percent in in-use NOx

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<sup>159</sup> Letter to CARB regarding "A Representative Nationwide Alternative to CARB's Proposed Omnibus Low-NOx Rulemaking," Truck and Engine Manufacturers Association, July 11, 2019.

emissions for 2027 and subsequent MY engine emissions. CARB staff interpreted this statement to mean that the standards for FTP, RMC, and in-use HDIUT threshold would be cut in half (compared to today's standards) for the 2027 and subsequent MY engines.

CARB staff presented the analysis of the proposal from EMA, Alternative 2, in section X.B of the ISOR. Since the Board Hearing, CARB staff has updated the cost analysis in the ISOR to match the proposed Omnibus Regulation to account for the ACT Regulation and the 30-Day and 15-Day Notice Amendments that are incorporated in this FSOR (see Agency Response to Comment A.(i).1). CARB staff also updated the analysis for Alternative 2 with the updated sales volumes because of the ACT Regulation. From 2022 through 2050 calendar years, our modeling indicated Alternative 2 could achieve about 19 percent greater emission benefits than the Omnibus Regulation. It is important to note, however, that comparing the modeled benefits of Alternative 2 to those of the proposed Omnibus Regulation is misleading because of the doubts regarding enforceability and hence whether Alternative 2 would achieve any benefits at all. Although Alternative 2 could be more cost-effective and could achieve more benefits if it were fully implemented, it was rejected for several reasons. First, and most importantly, it is not clear how EMA's proposal for a voluntary national standard could be enforced in California. If CARB pursued a voluntary agreement with manufacturers in lieu of enforceable regulations and then some or all manufacturers chose not to honor the agreement, California could be left with no emission benefits. Furthermore, CARB staff believes there is an intrinsic advantage to the Proposed Amendments which requires manufacturers to deploy technically feasible, cost-effective technology with dramatically lower NOx emissions than today's HD engines as quickly as possible. The success of California's standards in 2024 and beyond will set a model for U.S. EPA to follow and make it more likely that federally certified vehicles of the future are lower emitting. Accordingly, Alternative 2 was rejected.

- (i).i.14. Comment: The over-estimated FUL for HHDD vehicles would require more complex, expensive and durable technologies, significantly increasing vehicle costs, resulting in curtailing customer' vehicle choice. Furthermore, to ensure the durability in after-treatment system for the longer FUL, diesel's fuel quality might need to be revised/changed, which, in turn, could incur additional costs to customers. (WSPA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. CARB staff believes the Omnibus Regulation useful life values for HHDD values are appropriate, not "over-estimated." As discussed in the ISOR, the longer useful life periods that the Board approved for adoption are reflective of the current usage of modern HD vehicles as observed from engine rebuild and replacement data as explained in section I.B.5.3 (p. I-27). Also, as described further in the ISOR (p. IX-8), the lengthened useful life costs are intrinsically linked with the costs associated with

increased durability of, and for, the technologies used to meet the lower Omnibus Regulation emission standards required for certifying California HD engines and vehicles. Therefore, obtaining isolated costs for the useful life is not possible, and attempts to estimate it would result in double counting of the costs.

While the lack of specific concerns about particular fuel quality parameters in the comment precludes a more direct response, CARB staff welcomes further data as it may become available on potential exposure vs. emissions component aging relationships related to specific fuel quality parameters. However, CARB staff notes that CARB's Full Useful Life Aged technology demonstrations on two different engine platforms were performed with market available diesel fuel and lubricants which provided opportunities for serious issues should they exist to manifest. CARB staff is unaware of enabling requirements in other public Low NOx demonstrations individually reported by Navistar, Bosch, AVL, Achates Power or the ongoing work by U.S. EPA where any of these necessitated boutique fuels or lubricants (special sulfur level test fuel had been a requirement for 2007/2010 catalyzed aftertreatment development before ULSD was widely available). Additionally, to understand the actual in-use fuel in California, CARB staff reviewed field samples of diesel and alternative diesels recently collected in California by state inspectors including 415 samples assessed for sulfur content and 437 samples assessed for metals content whose potential variability had been previously raised as a possible concern. These datasets characterizing the California fuel pool for diesel-powered engines were found to be well within expected ranges based on ASTM D975 diesel fuel specifications and ASTM 6751 recommendations for biodiesel B100 blendstocks as applicable. CARB staff also arranged for analysis and reviewed 27 biodiesel blend stock samples U.S. EPA had collected nationally. CARB staff has similarly reviewed the most recent three years of industry reported biodiesel BQ-9000 production quality data. These additional datasets likewise did not highlight particular concerns with variability or deviation from recommendations.

- (i).15. Comment: We know that California has an ozone problem and that NOx emissions from trucks are a contributing factor. We believe that further NOx reductions can and should be had. Indeed, we proposed a cost-effective way forward to do just that. Unfortunately, the staff rejected our proposal.

The Board should not adopt the staff's recommendation. We stand ready to work with you and the staff to implement a credible program. For all of the reasons set forth in our comments, the staff's proposal is not it. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. As described in the Agency Response to Comment A.(i).vi.4, from 2022 through 2050 calendar years, CARB staff's modeling indicated Alternative 2 (EMA's proposal) could achieve about 19 percent greater emission benefits than the Proposed Amendments. It is

important to note, however, that comparing the modeled benefits of Alternative 2 to those of the Proposed Amendments is misleading because of the doubts regarding enforceability and hence whether Alternative 2 would achieve any benefits at all. Although Alternative 2 could be more cost-effective than the Proposed Amendments and could achieve more benefits if it were fully implemented, it was rejected for several reasons. First, and most importantly, it is not clear how EMA's proposal for a voluntary national standard could be enforced in California. If CARB pursued a voluntary agreement with manufacturers in lieu of enforceable regulations and then some or all manufacturers chose not to honor the agreement, California could be left with no emission benefits. Furthermore, CARB staff believes there is an intrinsic advantage to the Proposed Amendments pushing manufacturers to deploy technically feasible, cost-effective technology with dramatically lower NOx emissions than today's HD engines as quickly as possible. The success of California's standards in 2024 and beyond will set a model for U.S. EPA to follow and make it more likely that federally certified vehicles of the future are lower emitting. Accordingly, Alternative 2 was rejected.

- (i)i.16. Comment: MECA has estimated that the incremental direct hardware costs of the technologies demonstrated at Southwest to meet the 2027 NOx limits and the longer durability and warranty requirements in 2031 at \$3,100 to \$4,800 across all weight classes. These values are very close to what CARB has reported in the ISOR. We expect these costs will come down over time based on established industry experience and we are confident that by 2027 suppliers and their OEM customers are likely to find even lower cost pathways to meet these standards. (MECA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. CARB staff appreciates MECA's analysis and comparison to CARB staff's cost estimates. CARB staff also assumes cost decreases as a part of the "learning curve" described in Chapter IX of the ISOR. The commenter's incremental cost estimates are similar to the costs estimated by both CARB staff and ICCT in the Agency Response to Comment A.(i)ii.4.

#### **(i)ii. Standardized Regulatory Impact Assessment (SRIA)**

- (i)ii.1. Comment: CARB's SRIA (like the ISOR) presents an incomplete and inaccurate analysis. As noted, the new lower-NOx standards, new test cycles and new in-use requirements, coupled with the increases in FULs, warranty periods, and extended warranty and recall requirements, likely will lead OEMs to implement a series of significant cost pass-through actions to mitigate the significant regulatory-compliance obligations and risks. That is especially true given the multiple new technologies and aftertreatment control systems that must be developed to meet the near-zero NOx levels at issue. Cost impacts for first owners, beyond the increased direct costs, also will

include increases for longer warranties, extended warranty and recall protection, partial or full aftertreatment system replacement(s) during extended FULs, and additional inspection and maintenance of emission-related parts. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. CARB staff acknowledges in both the SRIA (p. 36) and in the ISOR (p. V-11) that there would be an expected cost pass-through due to the longer warranties which will lead to increased upfront vehicle purchase prices. Additionally, as discussed above in the Agency Response to Comment A.(i)i.8, CARB staff does not share the same expectation of having replacements of the aftertreatment system during the longer useful life. Based on SWRI results, CARB staff expects that the systems would be durable through 435,000 miles. Furthermore, considering the Omnibus Regulation emissions standards allows for some deterioration between 435,000 and the longer 800,000 mile full useful life, along with the fact that manufacturers will have over a decade to develop durable systems, leaves a low probability of aftertreatment system replacements. Therefore, CARB staff has not included the estimated cost of aftertreatment system replacements in the cost analysis for the Omnibus Regulation.

Emission control systems are expected to become more durable making it less likely that components will reach failure rates that exceed the recall threshold. Also, the recall threshold increases as vehicles get older (4 percent for years 1-5, 5 percent for years 6-7, and 7 percent for years 8-10) to account for longer warranty periods.

Regarding the cost impacts of additional inspection and maintenance of emission-related parts, there were no Amendments requiring an increase to the maintenance frequency. Vehicle owners are expected to continue doing their required maintenance as specified by the vehicle manufacturer. Likewise, as noted in the Agency Response to Comment A.(c)i.2, CARB staff expects that the upcoming HD I/M program would work in conjunction with the longer Step 2 warranty periods because many of these HD I/M-related repairs would occur under the longer warranty periods. The Step 2 warranty provisions would help ensure that it would be the manufacturers, and not vehicle owners, who would pay for problems caused by poor design and durability that the HD I/M program detects.

Additionally, CARB staff expects there to be a benefit to the first owners for their trucks to have a higher residual value due to having a longer warranty period. Getting further information regarding the extent of this residual value was one of the goals outlined for the Warranty Cost Study. Please see the Agency Responses to Comments A.(c)iv.1 and A.(c)iv.2 for more details on the study.

As a final note, since the Board Hearing CARB staff has updated the cost analysis to include the 30-Day and 15-Day Notice Amendments and an update to the legal baseline for the recent adoption of the ACT Regulation, as discussed further in the Agency Response to Comment A.(i).1.

- (i)ii.2. Comment: In the SRIA, which was prepared earlier in 2020, CARB bases its estimates of the likely engine “hardware” costs of its proposed Low-NOx Regulations on a preliminary “literature review” that NREL conducted in February 2019. (SRIA, pp. 46-47.) That is an obviously inadequate and unreliable data source. As discussed above, NREL has conducted a far more thorough cost analysis, which was submitted to CARB in March of 2020. CARB should have used those updated (albeit still understated) NREL numbers and analyses to prepare a new and revised SRIA, but CARB has not done so, which (again) is inconsistent with CARB’s administrative rulemaking obligations. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. The SRIA is a “snapshot” of the Omnibus Regulation’s proposal which provides stakeholders the opportunity to comment on CARB staff’s cost analysis for major regulations as the proposal is being developed. Therefore, the costs reflected in the SRIA are based on CARB staff’s Proposed Amendments at that time and not on the final proposal. In the ISOR (pp. IX-1 to IX-7), CARB staff identified changes made since the release of the SRIA because CARB staff’s proposal and economic impact analysis had evolved. The first of these changes was to incorporate NREL’s report on costs associated with developing and integrating emission control technologies to achieve a 0.02 g/bhp-hr NOx standard. These included estimated costs associated with the engine system, increasing durability and meeting the lengthened useful life requirements, additional OBD hardware, and aftertreatment technology packages. CARB staff met its rulemaking obligations for submittal of the SRIA in accordance with CCR, title 1, sections 2000-2004 and SB 617 (Chapter 496, Statutes of 2011).

- (i)ii.3. Comment: Not surprisingly, there are fundamental problems with CARB’s cost analysis in the SRIA. Among them, CARB fails to account for the fuel penalties that will be associated with the proposed new low-NOx standards in 2024, which likely will be at least 2%. Faced with those fuel penalties, manufacturers will be compelled by the current Phase 2 GHG Regulations to install additional vehicle and/or engine technologies to make up that fuel-economy deficit, which will result in additional costs, complexity, weight, and potential performance impacts. Yet those costs are not considered anywhere in CARB’s analysis. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. As discussed in the SwRI Low NOx Demonstration Program – Stage 3 report (p. 131) and ISOR

(p. IX-9), the SwRI Low NOx testing program demonstrated that the Stage 3 engine achieved 0.02 g/bhp-hr NOx only slightly above target with no penalty to CO2 and fuel consumption. The Stage 3 engine demonstrated the technologies needed to meet the 2027 and 2031 NOx standard that included the use of CDA, which improves NOx emission control at low engine loads and also provides reductions in GHG emissions.

CARB staff also does not expect there would be any GHG emission penalty to meet the 0.05 g/bhp-hr NOx standards for 2024-2026 MY engines. However, because meeting the 0.05 g/bhp-hr NOx standard does not incorporate the use of CDA technology, it may make it more difficult for those engines to simultaneously meet the more stringent 2024 Phase 2 GHG standards. Thus, CARB staff conservatively added the Phase 2 GHG technology cost estimate to further reduce GHG emissions by one percent. This is reflected in the cost analysis as an additional cost of \$501 for HHDD engines and \$100 for medium-duty, LHDD, and MHDD engines for the 2024-2026 MYs. The additional costs are included in Table IX-4 of the ISOR. Please see additional Agency Responses to Comments in A.(a)iii. Fuel Economy and GHG Emissions Related to the 2024 MY Standards.

- (i)ii.4. Comment: CARB also fails in its SRIA to account for the fact that truck fleet operators in California likely will engage in wide-scale “pre-buy/no-buy” strategies and will purchase out-of-state vehicles to avoid the substantial cost and product reliability impacts of the proposed regulations. Those likely alterations in vehicle-purchasing strategies will reduce significantly the already limited NOx benefits that CARB has ascribed to the Omnibus Regulations. CARB has dismissed that possibility by assuming (wrongly) that per-vehicle costs will increase by only 2.5-6.0%, based on the NREL “literature review” (SRIA, pp. 33, 44)... In sharp contrast, and as previously noted, ACT Research conducted an actual comprehensive survey of all leading OEM’s to assess the likely direct-cost impacts of CARB’s Omnibus program, and determined that the following per-vehicle direct-cost impacts will result from CARB’s proposal (as of 2027): 2027 MY HHDD Vehicles \$7,738 and MHDD Vehicles \$9,056. CARB’s HD vehicle direct-cost estimates in the SRIA are understated by a factor of ranging from 3 to 6. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. CARB staff acknowledged in the ISOR that the Omnibus Regulation might result in California fleets holding on to their existing vehicles longer, purchasing used vehicles in lieu of new vehicles in California, purchasing more used, out-of-state vehicles, or purchasing vehicles ahead of when the standards take effect. While CARB staff did not quantify these impacts due to the uncertainty associated with these potential impacts, CARB staff did a sensitivity analysis, discussed in more detail below in the Agency Response to Comments A.(i)iii.5 and A.(i)iv.7. The

sensitivity analysis showed that the benefits of the Omnibus Regulation would still be significant, cost-effective, and worth pursuing.

Regarding the per-vehicle direct-cost impacts, the SRIA is a “snapshot” of the Omnibus Regulation proposal. The costs reflected in the SRIA are based on the Proposed Amendments at that time and not on the final proposal. CARB staff’s cost analysis for the fully developed proposal in the ISOR and cost appendix relied on several resources for the cost analysis. This included NREL’s final report which surveyed manufacturers for technology costs, CARB warranty claims data, and parts/repair prices (parts + labor) obtained from an independent HD repair facility, EWIR reports, and online searches. NREL provided low, average, and high-cost technology packages, and low, average, and high-cost estimates for each package. CARB staff selected the average cost for the average technology package in its analysis. Because the NREL report used assumptions for California sales volumes of HD engines/vehicles and stricter useful life requirements than what was required in the final proposal, CARB staff scaled the survey responses to match the proposal presented to the Board.

CARB staff believes the commenter’s cost estimates with ACT Research are overstated. A critique of the ACT Research study is stated in the Agency Response to Comments A.(i)j.8 through A.(i)j.10. ICCT published an independent cost analysis: Estimated cost of diesel emissions-control technology to meet the future California low NOx standards in 2024 and 2027. ICCT reports \$2,585 and \$3,239 for MHDD and HHDD engines meeting 2027 requirements respectively, which is far less than the inaccurate estimates presented in the ACT Research report.

As a final note, since the Board Hearing, CARB staff has updated the cost analysis in the ISOR to account for the ACT Regulation, the 30-Day, and 15-Day Notice Amendments (see Agency Response to Comment A.(i)j.1). CARB staff estimates the costs to be \$6,114 and \$6,737 for MHDD and HHDD engines meeting 2027 requirements, respectively. CARB staff estimates the costs to be \$6,347 and \$6,057 for MHDD and HHDD engines meeting 2031 requirements, respectively.

- (i)ii.5. Comment: When indirect costs are factored in, CARB’s estimates in the SRIA are even more understated. That understatement results from the fact that CARB assumes (again incorrectly) that manufacturers will not fully adjust the costs of their HHDD and MHDD vehicles to recoup the full projected costs that will result from CARB’s proposals to extend emission warranties and regulated FULs, and from the increased compliance liabilities that will stem from the amended warranty and defect reporting requirements (SRIA, pp. 36-37, 94). CARB’s assumption is not reasonable. It is unreasonable to assume (as CARB also did in its ISOR) that manufacturers will choose to absorb the quantumly increased costs of the Omnibus Regulations. Based on consistent historical experience, and as a matter of sensible business practice,

manufacturers will calculate and fully recoup those regulatory costs through corollary vehicle-price increases. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. The commenter is incorrect in stating CARB staff assumed that manufacturers will not fully adjust the costs of their HHDD and MHDD vehicles to recoup the full projected costs that will result from CARB's proposals and from increased compliance liabilities. On the contrary, CARB staff repeatedly states in both the SRIA<sup>160</sup> and ISOR<sup>161</sup> that it is expected that the added costs associated with the requirements of the Proposed Amendments, which include the longer warranty periods, would be passed on to the consumers in the form of an increased purchase price for the vehicles. In addition, CARB staff also acknowledges that there would be some potential savings, on average, to the vehicle buyers as they would gradually recoup some of the initial increase in purchase price as they save money on repairs. This is also clearly explained in both the SRIA and ISOR. Overall, CARB staff considers the existing cost analysis to be fully comprehensive in examining both the potential costs and the cost savings.

- (i)ii.6. Comment: One specific example of the understated costs in CARB's SRIA can be found in CARB's discussion regarding the proposed extension of the FUL periods. While CARB has frequently stated that the longer FUL requirements will compel manufacturers to improve the durability of emissions-related components to meet the new requirement, CARB fails to consider any increase in cost from the design changes associated with those component enhancements. That is unreasonable. Even assuming just a 10% increase in component-part costs, when that percentage is applied to approximately \$10,000 worth of existing components, the direct cost impact would be \$1,000.

Not all components, however, will be capable of supporting the extended FUL requirements without a scheduled replacement within the FUL periods. That will almost certainly be true for some of the new "Stage 3" prototype components or systems deployed to comply with the dramatically lower NOx standards and in-use requirements. CARB acknowledges as much in the proposed regulation by identifying six major emissions-related components that they intend to allow to be replaced under CARB's minimum maintenance provisions. Yet CARB does not assign any indirect cost assumptions to support any scheduled component replacements. Notwithstanding that omission, CARB's own data indicate that the replacement of just a single

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<sup>160</sup> CARB. "Original SRIA Submitted to DOF." Appendix C-1 to the Staff Report for the Public Hearing to Consider the Proposed Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments. pp. 36, 43, 92, 101

<https://ww2.arb.ca.gov/sites/default/files/classic/regact/2020/hdomnibuslownox/appc1.pdf>

<sup>161</sup> CARB. Public Hearing to Consider the Proposed Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments. Staff Report: ISOR, June 23, 2020 pp. V-11, IX-23, IX-46, IX-47

<https://ww2.arb.ca.gov/sites/default/files/classic/regact/2020/hdomnibuslownox/isor.pdf>

major emissions-related component costs on average \$3,374 (see SRIA, p. 65, fn.76). Scheduled replacement of three systems within the extended FUL – not at all unlikely under a FUL requirement of 12 years and 800,000 miles – could easily amount to more than \$10,000 in additional indirect costs. In that regard, a major OEM reports that the cost of parts and labor to replace the aftertreatment and NOx sensors on today’s HDOH products ranges from \$14,200 to \$18,100. Future aftertreatment systems developed to comply with the very stringent proposed low-NOx standards will carry even greater costs. When considering the cost of improved designs to extend the life of many aftertreatment components, along with the replacement cost for other future aftertreatment-system components, it is clear that CARB’s SRIA assumption of \$309 for extended FUL costs falls well short of reality. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. The manufacturer responses in the NREL cost survey and report include elements such as extended useful life values and California specific sales volumes. These responses received and reported account for the extended useful life applied to the engine cost estimates. CARB staff used these survey results inclusive of the extended useful life in the cost analysis in the SRIA and ISOR.

CARB staff disagrees with this comment and refers the commenter to the SRIA (pp. 46-51) for a detailed explanation of the factors included in the compliance costs. The expected costs in the SRIA were broken down for each element of the Omnibus Regulation, of which, was a portion attributed to compliance with meeting the emissions standards. Those costs associated with meeting the standards did in fact take into consideration the costs related to the design changes associated with component enhancements by factoring in estimates for the upgrades to engine hardware, costs to upgrade the aftertreatment system, research and development costs, and additional testing time compared to the 2018 technology baseline.

CARB staff disagrees that multiple component replacements will be necessary, based on the testing done in SwRI study. In those tests, there was no need for the replacement of the aftertreatment components at 435,000 miles. The Omnibus Regulation emissions standards have been adjusted for HHDD engines that considers deterioration between 435,000 miles and the longer full useful life changes that occur with 2027 and 2031 MY engines. Additionally, CARB staff expects that there will be inherent ongoing improvement in parts durability because manufacturers will have several years to work towards developing durable systems. Overall, the components that are likely to be used to comply with the Proposed Amendments are expected to be evolutionary and not revolutionary, and so it is reasonable to assume that scheduling component replacements is not necessary. Finally, the SRIA analysis was an initial attempt to quantify the incremental cost increase due to the longer useful life, but under

further review during the continued development of the ISOR, CARB staff recognized that those costs were linked to the overall costs associated with durability and compliance with the emissions standards, and so could not be directly isolated (see ISOR p. IX-25).

Regarding minimum maintenance schedules, current regulations allow manufacturers to schedule maintenance at minimum intervals in order to demonstrate that the emission standards would be met through full useful life, except for components or systems designated as “Not Replaceable.” In current practice, engine manufacturers do not typically schedule maintenance that requires the replacement of critical emissions-related parts within the useful life of their HD engines, with a few exceptions, such as for DEF filters. CARB staff assumes that replacement maintenance of major components would occur at the same rate as they currently are replaced which means that components are expected to be designed to be more durable for the longer proposed useful life periods. To assume that more frequent replacements would occur would result in an overestimation of the proposed lengthened warranty costs. However, in discussions with stakeholders there were concerns about new technologies being used to meet the lower emission standards and the uncertainty of their durability over the longer useful life periods. In response, CARB staff is proposing under the 30-Day Notice Amendments that manufacturers be given the option for more flexibility in scheduling more frequent maintenance for emission-related components and systems in years when emission standards become more stringent.<sup>162</sup> The new scheduled maintenance option is expected to provide manufacturers with more time to analyze the components and systems to ensure compliance at the lower standards for the lengthened useful life periods. Please also see Agency Response to Comment A.(i)iv.4.

- (i)ii.7. Comment: One additional example of the SRIA’s significant understatement of costs relates to CARB’s estimate of a per-vehicle R&D cost of \$250. That is the scale of amortized R&D expense OEMs currently bear when developing 50-state products. When considering the high likelihood that any manufacturer choosing to develop a diesel product compliant with CARB’s Omnibus Regulations would be selling that product only in California, the more accurate R&D cost estimate, amortized over California volumes, would be in the range of \$23,000 to \$26,000 per vehicle as of 2031, as confirmed in the ACT Research study.

In contrast, ACT Research has calculated the following aggregate per-vehicle cost increases that will result in California from CARB’s proposed Low-NOx Regulations. ACT’s detailed analyses demonstrate that CARB has underestimated the aggregated per-vehicle costs of its Omnibus Low-NOx Regulations by a factor of 6 or 7 in the SRIA. The net result is that the

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<sup>162</sup> This does not include “Not Replaceable” components because of their relatively high price and severe emission impact under failure. Such components are currently not allowed to be scheduled for repair or replacement during the useful life period unless the manufacturer pays for the repair or replacement.

projected aggregate costs of CARB's Omnibus Low-NOx Regulations will vastly exceed the reasonably projected aggregate benefits, rendering those regulations invalid under California law, and unenforceable because they will not qualify for the necessary federal preemption waiver under the CAA.<sup>163</sup> (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. CARB staff disagrees with the commenter that the aggregated per-vehicle costs of the Omnibus Regulation will exceed the estimated benefits. The per-vehicle R&D cost of \$250 used in the SRIA was obtained from early NREL estimates before NREL survey results from manufacturers were available. This was the best available information that CARB staff had at the time. Subsequently, CARB staff updated the R&D costs in the ISOR and cost analysis to an average cost of \$357 per vehicle using the NREL survey results from responding manufacturers. The NREL survey expresses these results are for California-only HD vehicle sales volumes. It should also be noted that there are other states have begun their rulemaking process to adopt California's Omnibus Regulation, as states that are authorized under section 177 of the CAA. Thus, R&D cost estimated by CARB staff is likely overestimated as this cost can be distributed across a greater volume of California-certified engines sold by the manufacturer in other states.

CARB staff believes the ACT Research study commissioned by EMA to be an inaccurate and an unreasonable representation of the proposed Omnibus Regulation costs. The compounded total costs per engine estimated in the ACT Research study misleadingly increase the costs by cumulating the costs per engine by summing the costs for MYs 2024, 2027, and 2031 requirements in the proposed Omnibus Regulation. The incremental cost of the engine should only be relative to the baseline technology in 2018 and not the accumulation of all three phases of the Regulation (for more details please see Agency Response to Comment A.(i).2). The ACT Research study assumed manufacturers would have to replace the entire aftertreatment system two times over the course of the full useful life, thereby adding significant costs to the vehicles. The Omnibus Regulation emissions standards have been adjusted for HHDD engines that considers deterioration between 435,000 miles and the longer full useful life changes that occur with 2027 and 2031 MY engines. Engine manufacturers will have several years to develop more durable systems; thus, CARB staff does not believe the entire aftertreatment system would need any replacement based on the proposed changes (for more details please see Agency Response to Comment A.(i).2). Finally, the ACT Research study does not detail how they arrived at their R&D costs ranging from \$23,000 to \$26,000.

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<sup>163</sup> ACT Research has prepared a supplemental analysis of CARB's SRIA, and has confirmed that the SRIA fails to account for the full R&D, FUL, extended warranty, and pre-buy/no-buy cost impacts of the proposed Omnibus Regulations (Exhibit "D".)

Since the Board Hearing, CARB staff has updated the cost analysis in the ISOR to match the proposed Omnibus Regulation to account for the ACT Regulation and the 30-Day and 15-Day Notice Amendments that are incorporated in this FSOR (see Agency Response to Comment A.(i).1). CARB staff estimates the costs to be \$6,347 and \$6,057 for MHDD and HHDD engines meeting 2031 requirements respectively.

CARB staff disagrees with the commenter's statement that the Omnibus Regulation will not be eligible to obtain a waiver from the provisions of section 209(a) of the federal CAA. The federal CAA authorizes the U.S. EPA to adopt emission standards for new motor vehicles, and generally preempts states and their local governments from adopting or enforcing separate standards. However, California is the only state that is authorized to, in the first instance, adopt separate new motor vehicle and new motor vehicle emission standards, provided that it obtains a waiver from the U.S. EPA.

Section 209(b) of the CAA specifies that the Administrator of the U.S. EPA must grant a waiver to California if California has determined that its standards will be, in the aggregate, at least as protective of public health and welfare as applicable federal standards, unless the Administrator finds that (1) the state's protectiveness determination is arbitrary and capricious, (2) California does not need separate state standards to meet compelling and extraordinary conditions, or (3) the state's standards and accompanying enforcement procedures are not consistent with section 202(a) of CAA.

U.S. EPA has historically interpreted consistency with CAA section 202(a) using a two-pronged test: (1) that there is sufficient lead time to permit the development of technology necessary to meet the standards and other requirements, giving appropriate consideration to the cost of compliance in the time frame provided, and (2) that the California and federal test procedures are sufficiently compatible to permit manufacturers to meet both the state and federal test requirements with one test vehicle or engine.

In *Motor & Equipment Manufacturers Ass'n (MEMA I)* 627 F.2d 1095, 1111 (D.C. Cir. 1979), the U.S. Court of Appeals for the District of Columbia Circuit found that:

Section 202's "cost of compliance" concern, juxtaposed as it is with the requirement that the Administrator provide the requisite lead time to allow technological developments, refers to the economic costs of motor vehicle emission standards and accompanying enforcement. [Citations] It relates to the timing of a particular emission control regulation rather than to its social implications. Congress wanted to avoid undue economic disruption in the automotive manufacturing industry and also sought to avoid *doubling or tripling* the cost of motor vehicles to purchasers. It therefore requires that emission

control regulations be technologically feasible within economic parameters. Therein lies the intent of the “cost of compliance.”<sup>164</sup>

The *MEMA I* court made clear that the “cost of compliance” evaluation is distinct from a cost-effectiveness evaluation, in which U.S. EPA compares the air quality benefits that will from a regulation’s implementation to the economic costs incurred by stakeholders and society at large. A cost-effectiveness evaluation is not to be performed as part of a waiver/authorization analysis.<sup>165</sup>

Moreover, assuming, arguendo, that EMA has accurately assessed the increased prices of HHD and medium-duty vehicles resulting from this rulemaking action, those price increases are nevertheless less than the doubling or tripling of vehicles prices that would preclude issuance of a waiver to California. As set forth at page IX-51 of the ISOR, CARB staff assumes a base purchase price for a HHD vehicle powered by a 2031 and newer MY engine of roughly \$171,000, and for a MHD vehicle powered by a 2031 and newer MY engine of roughly \$104,000. EMA contends the rulemaking action will increase the prices of HHD and MHD vehicles by \$58,000 and \$51,000 in the 2031 MY, respectively,<sup>166</sup> which corresponds to a maximum price increase of 49 percent. EMA further contends that accounting for fleet “pre-buys” of HD vehicles will increase vehicle prices by up to an additional 36 percent,<sup>167</sup> which corresponds to a maximum price increase of 67 percent.

- (i)ii.8. Comment: Returning to the value of the benefits at issue, the first step in assessing aggregate benefits is estimating the total tons of NOx (and secondary PM2.5) that will be reduced due to the proposed regulations. CARB’s estimates in that regard are inconsistent and incorrect. At page 34 of the SRIA, CARB states that its proposal will “reduce NOx emissions by approximately 134,000 tons statewide between the years 2022 through 2040.” The corresponding figure in the SRIA (Figure B-1) shows estimated NOx reductions of approximately 50,000 tons between 2024 and 2040, a much lower figure. CARB also provides a third value in Table B-1 (SRIA, p.35), which indicates total NOx reductions of 109.7 tons. Thus, it is unclear which estimate CARB thinks is correct, and even the most conservative projection in Figure B-1 (50,000 tons) is overstated as explained below. Using one of its multiple estimates of tons-NOx reductions, CARB calculates total monetized health-related benefits of approximately \$3.15 billion as of 2032. (SRIA, p. 42.) CARB’s monetized benefit calculations in its SRIA are both unclear and incorrect. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. On page 34 of the

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<sup>164</sup> *MEMA I*, 627 F.2d at 1118. (Emphasis added).

<sup>165</sup> *Id.*, at 1114, fn. 40, and 1116.

<sup>166</sup> EMA 60-day comment letter at p. 9.

<sup>167</sup> *Id.* at p. 15

SRIA, the 134,000 tons of NOx emission reductions refers to the cumulative sum of emission reductions calculated for each year from 2022 through 2040. Figure B-1 on the same page is the visual representation of those NOx emission reductions but in tpd for each year from 2022 through 2040. Table B-1 shows those tpd NOx emission reductions in tabular format from 2022 through 2032. These all represent the same NOx emission reductions but are expressed in different formats. CARB staff disagrees that the monetized benefit calculations in SRIA are unclear or incorrect. On page 38 through 42 of the SRIA, CARB staff went step-by-step through the calculations for the monetized health benefits. First, the projected NOx emission reductions and secondary PM2.5 emission reductions resulting from NOx emission reductions were converted to avoided mortality and morbidity incidents from 2022 through 2032 under the Omnibus Regulation. As stated on pages 38 and 39, CARB relies on the same health studies for this evaluation as U.S. EPA when quantifying the health risk from exposure to PM2.5. Next, the health outcomes were monetized by multiplying each incident by a standard value derived from the economic studies in accordance with U.S. EPA practice. The valuations for avoided premature mortality, avoided cardiovascular hospitalizations, avoided acute respiratory hospitalizations, and avoided emergency room visits were summed to show the total statewide health benefits resulting from criteria emission reductions due to the proposed Omnibus Regulation. However, CARB staff understands that the presentation of the different formats of the emission reductions in the SRIA could be confusing for some. Therefore, in the ISOR, for consistency, the emission reductions and health benefits are shown for the time period from 2022 through 2050.

Since the Board Hearing, CARB staff has updated the cost analysis in the ISOR to match the proposed Omnibus Regulation to account for the ACT Regulation and the 30-Day and 15-Day Notice Amendments (see Agency Response to Comment A.(i).1). Based on the updated analysis, the Proposed Amendments are estimated to have a total NOx benefit of 225,763 tons between 2022 and 2050. As a result of these emission reductions, the Proposed Amendments are expected to reduce the total number of incidents of premature mortality, cardiovascular hospitalization, acute respiratory hospitalization, and emergency room visits by 4,494 for 2022 through 2050. This would be equivalent to monetized health benefits of approximately \$23.4 billion.

- (i)ii.9. Comment: CARB's truncated health benefits analysis in its ISOR is similarly unfounded. In the ISOR, CARB states that its effort to develop quantitative estimates of potential health benefits is based exclusively on the benefits potentially attributable to the reductions in secondary PM2.5 that could result from the implementation of the Low-NOx Regulations. However, CARB's ISOR does not specifically quantify the expected reductions in ambient levels of PM2.5 due to the implementation of the new low-NOx standards. (See ISOR, section VI.) Similarly, in Appendix "C," (at p. 86, n. 13), CARB reiterates that all of the monetized health benefits that it has calculated for

this rulemaking are derived from its projected reductions in ambient secondary PM2.5. But nowhere in the ISOR does CARB set forth or articulate what those year-by-year reductions in secondary PM2.5 are expected to be starting in 2024. That critical omission, yet again, completely frustrates and undermines the notice and comment process for this rulemaking, which renders this rulemaking invalid on those grounds as well.

Notwithstanding CARB's failure to quantify the projected reductions in secondary PM2.5 it is ascribing to the Low-NOx Regulations, CARB posits \$36.8 billion in aggregate monetized health benefits as of 2050, principally due to avoided incidences of premature mortality. (Notice, p. 22.) CARB's mortality estimates are substantially overstated (as detailed in NERA's report), especially given the reduced tons of NOx that actually will be achieved due to the significant pre-buy/no-buy consequences at issue. In addition, CARB's utilization of 95<sup>th</sup>-percentile epidemiological [concentration-response] C-R values, its reliance on unspecified and likely ill-suited epidemiology studies, and its failure to include any uncertainty range all demonstrate that NERA's quantitative health benefit estimates are far more accurate.<sup>168</sup>

As detailed above, NERA has conducted a comprehensive benefits analysis of CARB's Omnibus Low-NOx Regulations. The bottom-line results of NERA's analysis are that CARB's proposal will result in aggregate NOx reductions in California of approximately 16,450 tons as of 2032 (not 50,000 tons as CARB has projected for 2040), with a corresponding monetized health-related benefit (due to reduced secondary PM2.5 impacts) of approximately \$15,000 per ton (See NERA Report (Exhibit "B")), "Technical Details of Analysis and Assumptions," pp. 31, 33.) That yields an aggregate monetized health-related benefit of approximately \$247 million, which is lower-than CARB's aggregate benefits estimate as of 2032 (\$3.15 billion) by a factor of more than 12. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. In response to the comment about the "failure to quantify the projected reductions in secondary PM2.5," and "year-by-year reductions in secondary PM2.5" CARB staff would like to provide a little more detail on the incidence-per-ton (IPT) methodology used in the health analysis. NOx emissions are a precursor to the formation of secondary PM2.5 including ammonium nitrate (NH4NO3). For IPT methodology, CARB staff uses year-by-year NOx emission to estimate health impacts related to the formation of secondary PM for regulatory scenarios, when year-by-year modeled concentrations are not estimated.

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<sup>168</sup> CARB's health benefit calculations are internally inconsistent as well. For example, in the SRIA, CARB postulates 334 avoided incidences of premature mortality as of 2032. (SRIA, p. 41.) In the ISOR, CARB postulates 357 incidences of avoided premature mortality as of 2032. (ISOR, p. V-10.)

As described in the Agency Response to Comment A.(j)iii.1, the benefits of the proposed Omnibus Regulation are not overstated. CARB staff uses the accepted methodology for the emissions reductions with EMFAC to IPT methods used in the health benefit analysis.

CARB staff disagrees with the commenter's claim that NERA's analysis is superior to CARB staff's and critiques the results of the NERA report, which has three major shortcomings.

First, NERA's analysis uses an outdated emissions inventory to estimate the Omnibus Regulation benefits in California. EMFAC is the primary and official information source for on-road vehicle emissions in California. Each EMFAC update incorporates the latest information from real-world emissions testing, vehicle activity (e.g., idling hours, speed distributions, etc.) and vehicle populations from the California DMV. CARB utilized EMFAC2017, which was released at the end of 2017, for the Omnibus Regulation analysis because it was the most recent version available at the time. On the other hand, NERA's analysis is based on MOVES2014, which was released in 2014. Unlike EMFAC2017, it does not have the latest California-specific HD emission rate, population, or activity data. In particular, CARB staff carefully accounted for California first sold HD populations using the "FIRST SOLD" field in DMV to apply to EMFAC2017, because the Omnibus Regulation only applies to vehicles that are first sold in California (i.e., California-certified). Furthermore, MOVES2014 has modelling methods that differ from EMFAC. Due to these differences, baseline emissions, and therefore emissions reductions, are inconsistent between the two inventory models. Thus, the 16,453 tons per year NO<sub>x</sub> reduction listed in 2032 for California in Appendix A of Exhibit B is based on outdated, inappropriate information for California and cannot be directly compared to emissions benefits based on EMFAC2017.

Second, NERA's analysis does not account for vehicles that are first sold or certified in California. The Omnibus Regulation only applies to vehicles that are first sold in California (i.e., California-certified) and therefore NO<sub>x</sub> emissions reductions should only be modeled for California-certified vehicles. For vehicles registered in California, CARB carefully accounted for California first sold HD populations using the "FIRST SOLD" field in DMV. CARB does not have such information on out-of-state sold vehicles, so these vehicles were assumed to all be first sold out-of-state. There is a significant percentage (63 percent) of HD vehicles (especially HHD tractors) that are originally sold outside of California and then registered as used vehicles in California, after they hit 7,500 miles. More information on this method can be found in Appendix F for the ACT ISOR.<sup>169</sup> Exhibit B does not specify whether or not NERA accounted for this. The reduction numbers presented in Appendix A would be overestimated if NERA assumed that all California-registered trucks would achieve emission reductions from Omnibus Regulation.

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<sup>169</sup> <https://ww3.arb.ca.gov/regact/2019/act2019/appf.pdf>

Finally, NERA underestimates per vehicle NOx emissions reductions for 0.02 g/bhp-hr certified engines relative to CARB's analysis. CARB staff conducted a thorough analysis of emissions benefits for the Omnibus Regulation, which considered how each element of the program would impact HD vehicle running, start, and idle emission rates. This analysis utilized the most recent in-use diesel emission rates data for 0.2 g/bhp-hr certified vehicles. Further details can be found in Appendix D of the Omnibus ISOR.<sup>170</sup>

Additionally, NERA assumed 50 percent reduction in per vehicle in-use NOx emissions (all emission modes in MOVES) for cleaner 0.02 g/bhp-hr certified relative to the baseline 0.2 g/bhp-hr certified vehicles, which is significantly lower than CARB staff's estimate. CARB staff estimated a more significant reduction in per vehicle in-use running exhaust NOx emissions, with a range of 53-80 percent depending on the age of the fleet. Note that older fleets tend to have greater deterioration (i.e., more vehicles with some type of emissions-related malfunction), so they have proportionately less emissions reductions from a tightened NOx standard than newer fleets with less deterioration. Also note that the running exhaust mode is responsible for the majority of HD vehicle emissions relative to other modes.

Greater emission reductions estimated by CARB staff are not just the result of tightening the certification standard alone. The in-use component of the Omnibus Regulation is expected to close the gap between in-use (or real-world) emissions and the certification standard. In addition, emission reductions from other parts of the program were also modeled by CARB, including extended warranty and useful life, tightened idling standards, and LLC.

It is not clear what methods were used to estimate 50 percent lower in-use NOx emissions, which was originally provided by EMA, but it clearly underestimates the emissions benefits per vehicle for the Omnibus Regulation relative to CARB's analysis.

As stated in the Agency Response to Comment A.(i)iii.5, while CARB staff did not quantify the impacts due to the uncertainty associated with the pre-buy/no-buy scenario, CARB staff did a sensitivity analysis of the pre-buy/no-buy scenario. CARB staff's analysis indicated that the benefits of the proposed Omnibus Regulation would be significant, cost-effective, and worth pursuing regardless of the pre-buy/no-buy scenario.

As a final note, since the Board Hearing, CARB staff has updated the cost analysis in ISOR to match the proposed Omnibus Regulation to account for the ACT Regulation and the 30-Day and 15-Day Notice Amendments (see Agency Response to Comment A.(i)j.1). The Proposed Amendments are estimated to have a total NOx benefit of 225,763 tons between 2022 and 2050. As a result of

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<sup>170</sup> <https://ww3.arb.ca.gov/regact/2020/hdomnibuslownox/appd.pdf>

these emission reductions, the Proposed Amendments are expected to reduce the total number of incidents of premature mortality, cardiovascular hospitalization, acute respiratory hospitalization, and emergency room visits by 4,494 for 2022 through 2050. This would be equivalent to monetized health benefits of approximately \$23.4 billion.

- (i)ii.10. Comment: On the other side of the benefits-to-costs ratio, ACT Research has estimated that the aggregate costs of CARB's proposal (using per-vehicle costs and estimated new vehicle purchases in California, but without assessing any pre-buy/no-buy impacts) amount to approximately \$907 million for HHDD vehicles and \$384 million for MHDD vehicles, for a total cost of approximately \$1.3 billion.

When ACT's aggregate cost figure is compared to NERA's aggregate per-ton benefits figure (again, without accounting for the likely pre-buy/no-buy impacts), the resultant cost-to-benefits ratio (or negative benefits-to-costs ratio) is approximately 4.5. Thus, by this per-ton metric, the likely aggregate costs of CARB's proposal would exceed its potential aggregate benefits by at least a factor of 4.5. Using the per-vehicle metric discussed above, the more likely result is that the costs of the Omnibus Regulations will exceed their putative benefits by a factor of 8. (See pp. 9, 21, above.) (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. As described in the Agency Response to Comment A.(i)i.9, CARB staff believes the ACT Research study commissioned by EMA to be an inaccurate and an unreasonable representation of the proposed Omnibus Regulation costs. As discussed in the Agency Response to Comment A.(i)i.2., the total cost per engine in the ACT Research study misleadingly and incorrectly sums the costs for MYs 2024, 2027, and 2031 requirements in the proposed Omnibus Regulation. The ACT Research study assumed manufacturers would have to replace the entire aftertreatment system two times over the course of the full useful life, thereby adding significant costs to the vehicles. The Omnibus Regulation emissions standards have been adjusted for HHDD engines that considers deterioration between 435,000 miles and the longer full useful life changes that occur with 2027 and 2031 MY engines. Engine manufacturers will have several years to develop more durable systems; thus, CARB staff does not believe the entire aftertreatment system would need any replacement based on the proposed changes (for more details please see Agency Response to Comment A.(i)i.2). Thus, CARB staff does not agree it is a reasonable assumption that the entire aftertreatment system would need to be replaced twice over the useful life of an engine. CARB staff does not accept the cost estimates in the ACT due to unreasonable representation of per engine costs and the excessive replacement of aftertreatment components as described in the Agency Response to Comments A.(i)i.9 and A.(i)i.2 respectively. CARB staff estimates the Omnibus Regulation to cost 4.5 times the Alternative 2 as shown in Table I.B.1 of this

document. Although Alternative 2 costs less than the Omnibus Regulation it was rejected as described in section I.B of this document.

The NERA report provides an inaccurate estimation of the emission benefits and CARB staff has three critiques of the analysis methods used in the NERA report as described in the Agency Response to Comment A.(i)ii.9. First, NERA’s analysis uses an outdated emissions inventory to estimate the Omnibus Regulation benefits in California. Second, NERA’s analysis does not account for vehicles that are first sold or certified in California. Finally, NERA underestimates per vehicle NOx emissions reductions for 0.02 g/bhp-hr certified engines relative to CARB’s analysis.

Also of note, since the Board Hearing, CARB staff has updated the cost analysis in the ISOR to match the proposed Omnibus Regulation to account for the ACT Regulation and the 30-Day and 15-Day Notice Amendments (see Agency Response to Comment A.(i)j.1).

The commenter claims incorrectly that the cost of the Omnibus Regulation will greatly outweigh the benefit. On the contrary, the projected monetized health benefit is nearly 10 times the expected cost at \$23.4 billion while the projected cost is \$2.39 billion. To expand on the cost benefit discussion, the cost-effectiveness as calculated by using the benefit-cost ratio is \$9.87 and, as stated in Agency Response to Comment A.(i)j.11, the cost-effectiveness in dollars per pound of NOx avoided is \$4.51. The estimated Regulation cost is \$2,388 million and, as explained in the Agency Response to Comment A.(i)vi.1, the total cost savings to the consumer is \$353 million. In addition, the avoided NOx over the life of the Regulation is 225,763 tons.

**Table IV.A.(i)ii.10.1 Projected Monetized Benefits of the Regulation**

Total Cost of the Regulation [Million]	Total Savings of the Regulation [Million]	Total NOx Benefits [Tons]	Cost-Effectiveness [\$/Ton]	Cost-Effectiveness [\$/lb]	Monetized Health Benefit [Million]	Cost-Effectiveness (Cost-Benefit Ratio)
\$2,388	\$353.1	225,763	\$9,016	\$4.51	\$23,447	\$9.87

- (i)ii.11. Comment: [T]hese troubling upside-down cost-benefit results will be exacerbated by the impacts of the recently adopted ACT Rule, as evidenced by the slide that CARB included in its April 23, 2020 presentation regarding the 2020 Mobile Source Strategy. That slide shows that CARB’s market-sales penetration forecast for HDOH diesel vehicles certified to the Omnibus Regulation is only 23% as of 2031, with much of the market displaced by the new mandated sales of ZEV trucks. Accordingly, the anticipated dynamics in the HD vehicle market in California over the next 10 years — given the expected impacts of the ACT Rule, the Truck and Bus Rule, and the

significant pre-buy/no-buy response from fleets — effectively preordain that the costs of the Omnibus Regulation will far exceed any monetized benefits. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments in response to this comment. The slide that the commenter refers to is from the informational update to the Board on the 2020 Mobile Source Strategy presented on April 23, 2020. The slide shows the expected range of technology mixes needed for the HD truck sector to meet California's air quality and climate goals over time. CARB staff projects that a mix of low NOx HD vehicles and HD ZEVs and accelerated turnover would be needed in 2031 with a penetration target goal of 23 percent for low NOx HD vehicles, 21 percent for HD ZEVs and accelerated turnover. The target goal of 23 percent does not indicate that CARB staff expects the market penetration of low NOx HD vehicles to be limited to that percentage. Rather, it demonstrates that the 2020 Mobile Source Strategy for HD vehicles needs to be a multi-pronged approach to meet the targeted air quality and climate goals.

As stated in the ISOR (p. V-1), the California DOF requires the main impact analysis to be calculated relative to the legal baseline scenario which only accounts for existing regulations. The Truck and Bus Regulation is one of those existing regulations, so it was included in the baseline calculations. At the time of CARB staff's analysis, the ACT Regulation was not approved by the Office of Administrative Law which is why it was not included in the primary impact analysis. However, CARB staff recognized that both the ACT Regulation and the proposed Omnibus Regulation impacted the same class of vehicles and engines during the same timeframe which would affect the baseline scenario calculations. Therefore, CARB staff determined the potential impact of the ACT Regulation on the proposed Omnibus Regulation by examining the baseline as if the ACT Regulation were included with existing regulations. Figure V-1 in the ISOR shows that in 2031 the benefits of the proposed Omnibus Regulation with an ACT-Adjusted baseline scenario would be approximately 20 percent less than the benefits estimated with the legal baseline scenario. While the expected benefits would be less using an ACT-Adjusted baseline, the monetized health benefits under the proposed Omnibus Regulation using an ACT-Adjusted baseline would still exceed the cost impacts. As noted above, the projected monetized benefit of the Omnibus Regulation after accounting for the ACT Regulation is nearly 10 times the expected cost.

As stated in the Agency Response to Comments A.(i)iii.5 and A.(i)ii.4, while CARB staff did not quantify the impacts due to the uncertainty associated with the pre-buy/no-buy scenario, CARB staff did a sensitivity analysis of the pre-buy/no-buy scenario. CARB's analysis indicated that the benefits of the proposed Omnibus Regulation would be significant, cost-effective, and worth pursuing regardless of the pre-buy/no-buy scenario. The Agency Response to Comment A.(i)iv.7 discusses the sensitivity analysis in more detail. In the sensitivity analysis for pre-buy/no-buy, the total NOx reductions are projected to

be 206,312 tons between 2022-2050 at a cost of \$3.6 billion, savings of \$528 million, and a cost-effectiveness of \$7.50/lb NOx.

- (i)ii.12. Comment: CARB’s ISOR and SRIA do not account for the significant pre-buy/no-buy impacts that the Omnibus Regulations will cause. (Notice, pp. 17, 20-21; SRIA, pp. 33, 44.) That is a material omission. The HD commercial vehicle truck market is very sensitive to the introduction of new technology-forcing emissions regulations. The most recent example of that is when EPA and CARB implemented a 90% reduction in the PM standard for 2007 MY and later HD engines, which required the introduction of diesel particulate filters into the HD marketplace. In parallel, NOx standards were reduced by 50%. HD vehicle purchasers, wary of the cost and reliability implications of the major new HDOH technology launches, significantly accelerated their vehicle-replacement purchasing cycles in 2005 and 2006 to avoid purchases of the new technology vehicles in 2007 – the classic manifestation of a pre-buy/no-buy response to new aggressive emissions regulation. More specifically, in the Class 8 market, vehicle purchases ramped up in 2005 and 2006, with the result that 40% more vehicles were sold in 2006 (284,000 units) than in 2004 (203,000). In 2007, the market dropped by a full 47%, to just 151,000 units. Among the other adverse consequence of that pre-buy/no-buy response, air quality benefits were delayed, and massive layoffs ensued at vehicle assembly plants and powertrain production sites, with similar cascading effects throughout the HDOH supply chain.

Notwithstanding CARB’s dismissal of this critical issue, it is possible to quantify those likely “fleet behavior” impacts, and EMA did so through its work with ACT Research. As noted above, ACT’s quantification analysis shows that, at a minimum, there will be an initial pre-buy representing 39% of the market for new HHDD vehicles in the two years before the 2027 MY standards take effect, followed by a secondary pre-buy representing approximately 14% of the market for new HHDD vehicles in the two years before the purchase-price impacts of the extended warranty and useful life provisions take effect in the 2031 MY. (ACT Report, p. 16, Table 8.) And that is even before factoring in the additional pre-buys due to the coinciding Truck and Bus Rule vehicle-purchase deadline. CARB’s failure even to attempt such a quantification establishes that its cost-effectiveness analysis, including as stated in its SRIA, is insufficient to serve as an adequate basis for this rulemaking. The pre-buy/no-buy phenomenon in advance of the 2024 MY will be especially significant since 2023 is the deadline under the Truck and Bus Regulation for all HDOH vehicles to meet the 2010 emission standards. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or analysis in response to this comment. As stated in the Agency Response to Comments A.(i)iii.5 and A.(i)ii.4, while CARB staff did not quantify the impacts due to the uncertainty associated with the pre-buy/no-buy scenario,

CARB staff did a sensitivity analysis of the pre-buy/no-buy scenario. CARB staff's analysis indicated that the benefits of the proposed Omnibus Regulation would be significant, cost-effective, and worth pursuing regardless of pre-buy/no-buy effects. The Agency Response to Comment A.(i)iv.7 discusses the sensitivity analysis in more detail. Additionally, the pre-buy/no-buy argument was thoroughly addressed by CARB staff in response to EMA's pre-hearing comments in section 7-6 of Attachment B to Resolution 20-23.<sup>171</sup> Although the proposed Omnibus Regulation does not explicitly model a pre-buy scenario, CARB staff contends that the model used to analyze the Proposed Amendments' impact, EMFAC2017, already accounts for a "pre-buy" scenario in 2023 due to the Truck and Bus Regulation. As noted in Chapter IX of ISOR, "The final compliance date for the Truck and Bus Regulation is January 1st, 2023. As of that date, HD vehicle owners are required to fully turn over their fleet to 2010 standard compliant engines." Therefore, any HD vehicle owners purchasing trucks to comply with the Truck and Bus Regulation to meet the 2023 deadline are unlikely to pre-buy additional trucks before the proposed Omnibus Regulation would take effect in 2024. If an additional pre-buy did occur, more engines meeting a 0.2 g/bhp-hr NOx standard would be sold which would decrease the expected emission reductions and cost of the Proposed Amendments. Overall, the proposed Omnibus Regulation would still be cost-effective and provide significant air quality benefits to California.

### **(i)iii. Direct Costs for Low NOx and PM Standards**

- (i)iii.1. Comment: Indicative of CARB's unreasonable lack of rigor in preparing its Cost Assessment is the fact that CARB has ignored all of the costs associated with the new proposed 50%-lower PM standard. On that issue, the only thing that CARB states is the following "CARB staff therefore assumes that the cost for reducing PM emissions would be absorbed by the engineering cost required to optimize NOx emissions (included in Table IX-4) and that there would be no additional cost to meet the proposed PM standard." (ISOR, p. IX-15.) While it is true that "NOx and PM emissions in diesel engines are closely tied together," they are inversely so. Thus, manufacturers cannot simply "absorb" the cost of reducing PM emissions in their efforts to reduce NOx as part of a "calibration" exercise. Indeed, reducing NOx makes the effort to reduce PM all the more challenging and expensive. CARB's unsupported assumption to the contrary exemplifies the inherently deficient nature of its Cost Assessment. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. As described in section IX-2 of the ISOR, analysis of 2018 MY HD diesel engine PM certification

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<sup>171</sup> Attachment B to Resolution 20-23. Response to Comments on the Environmental Analysis for the Proposed Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments. August 26, 2020. <https://ww2.arb.ca.gov/sites/default/files/classic/regact/2020/hdomnibuslownox/res20-23.pdf>

levels show that 93 percent of the certified engines have emission certification levels below the proposed PM standard of 0.005 g/bhp-hr. These engines can continue to use their existing filters to meet the proposed standard and thus no additional cost would be imposed to meet this standard. The remaining 7 percent of the certified engines have PM certification levels above the 0.005 g/bhp-hr but below the current 0.01 g/bhp-hr. The remaining engines would need some additional calibration work to reduce PM emissions and meet the proposed PM standard.

NOx and PM emissions in diesel engines are closely tied together, and calibration to optimize NOx emissions would also involve calibration to optimize PM emissions. CARB staff believes that the cost for reducing PM emissions would be absorbed by the engineering cost required to optimize NOx emissions and that there would be no additional cost to meet the proposed PM standard.

- (i)iii.2. Comment: Using that same unreasonable 2013 benchmark, CARB also makes the blanket and wholly unsupported assumption that, extending out from the 2024 MY and beyond, fully 70% of all emission-related engine recalls will be addressed through a simple “software reflash” that will never cost more than \$400, notwithstanding all of the new emissions-related engine and aftertreatment hardware that CARB’s Low-NOx Regulations will require. (See ISOR, pp. IX-27 and 32.) That cost assumption, like the others CARB has relied on, is simply not reasonable. (EMA, Daimler, Navistar, Volvo)

Agency Response: No change was made in response to this comment. CARB staff has observed that historically many failures including hardware related failures can be resolved through software reflashes. This can include cases where parts are being unnecessarily replaced due to OBD system detecting false failures or a software error that prevents hardware from performing correctly resulting in a hardware failure. CARB staff has observed that software issues are able to correct both issues. Based on recalls CARB approved from 2011-2018, software related reflashes have accounted for approximately 70 percent of recalls for HD engines. This trend is expected to continue as it is generally less costly and often times more effective for manufacturers to address faults through software reflashes rather than hardware changes. Based on information and repair invoices gathered from service stations it is typical for vehicle owners to pay under \$400 for a reflash. This estimate includes labor costs. It is expected that new technology that will be introduced will not be drastically different from existing emissions-related engine and aftertreatment hardware.

- (i)iii.3. Comment: Technology costs provided in the ISOR document are projected based on the NREL’s cost survey and analysis published in March 2020. (Refer to section IX.1.1.) It is important to note that NREL received a total of only five survey responses from a mix of advanced engine technology and emission control technology trade organizations, Tier 1 suppliers, and engine OEMs. In fact, due to their nature, trade organizations may not have first-

hand data on technology costs. A survey with such small sample size results in a significant uncertainty in the cost analysis, raising concerns about the validity of the survey and the reliability of the data provided to justify technology package cost. Recommendation: CARB should reconsider the cost implication of the proposed Amendment taking into account the significant uncertainty in the NREL's technology cost analysis. (WSPA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. The NREL survey allowed advanced engine technology and emission control technology trade organizations, Tier 1 suppliers, and engine OEMs to reply and present cost estimates for low NOx engines able to meet the requirements of the proposed Omnibus Regulation. ICCT also conducted a study and presented cost estimates to meet the proposed Omnibus Regulation based on the current baseline technology scenario.<sup>172</sup> In the ICCT report, incremental cost increases to meet the proposed Omnibus Regulation were about half of the incremental per engine costs estimated by CARB and presented in the Agency Response to Comment A.(i)ii.4. Although the future is difficult to predict, overall, because the NREL survey cost results CARB staff used were based on the best data available and were between the very low cost and very high cost estimates provided by ICCT and ACT, respectively, CARB staff believes they represent a reasonable projection.

- (i)iii.4. Comment: In addition to assessing the FTP/RMC-SET fuel-penalty results, CARB also would need to evaluate any low-NOx technology over real-world driving routes to demonstrate that the technology would not result in an additional real-world fuel penalty as well. Any real-world fuel penalty would result in significant increases in the total cost of ownership of any vehicle with such low-NOx technology. In that regard, since EPA showed in its Phase 2 GHG analysis that an additional fuel-savings phase-in of 13-25% is worth about \$90,000 per tractor within the first seven years of tractor ownership, a 1.3-2.5% fuel penalty, by the same analysis, would cost tractor-operators about \$9,000 per tractor.

Because of the additional Stage 1B/2 fuel penalties and the resulting potential infeasibility of the Phase 2 GHG standards, CARB should not consider any fuel-penalizing low-NOx technologies as support for the feasibility of the proposed 2024 MY low-NOx standards. Examples of fuel-penalizing NOx technologies include, but are not limited to, increasing EGR, retarding fuel injection timing, and adding post-injection fuel or mini-burners (as used for the SwRI prototype) to heat SCR as a thermal management strategy. Moreover, and as a practical matter, vehicle purchasers in California are not likely to buy HHDD and MHDD vehicles with those types of negative cost and complexity impacts to recover lost fuel-efficiencies (not to mention the other significant cost impacts, as detailed above). (EMA, Daimler, Navistar, Volvo)

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<sup>172</sup> More information can be found here: <https://theicct.org/publications/cost-emissions-control-ca-standards>

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. CARB staff disagrees, with the comments from industry have suggested there would be a GHG emission penalty to meet the more stringent NOx standards. Early technology assessments conducted by SwRI have presented a fuel penalty of approximately 1 percent to meet the low NOx standards for MY 2024 through 2026. More recently, a low NOx demonstration program was completed by SwRI using a Stage 3 engine with advanced emission controls. The Stage 3 engine and aftertreatment system were tested on the cycles mentioned above, LLC, and a variety of other operations to ensure the demonstrated results represent real-world emission reductions and GHG emissions. Based on the SwRI Stage 3 report, CARB staff concluded there would not be a GHG emission penalty for 2027 and subsequent MY engines. The Stage 3 Final Report states:<sup>173</sup>

The Stage 3 engine produced these reductions in NOx while at the same time maintaining GHG emissions at levels that were comparable to the Baseline 2017 engine. CO2 emissions were the same as the Baseline engine for FTP and RMC-SET cycles, and showed an increase of roughly one percent on LLC (which has very low fuel consumption to start with). In addition, on the Phase 2 GHG cycles, the Stage 3 engine produced CO2 levels either comparable to or lower than the Baseline engine over a wide variety of vehicle configurations and application classes. This was due primarily to the use of CDA, which provided the flexibility needed to both meet Low NOx and mitigate any negative CO2 impacts. CDA technology was not widely projected by EPA to be used for meeting Phase 2 GHG standards in 2027, therefore the technology remains available to be used to enable meeting Low NOx while maintaining a path to meeting Phase 2 GHG standards. It should also be noted that while both the Baseline and Stage 3 engines met the nitrous oxide (N2O) standard, the Stage 3 engine produced significantly lower N2O levels, due to the use of LO-SCR, and this is also beneficial from a GHG standpoint.

Although CARB staff does not expect any GHG emission penalty to meet the proposed 0.05 g/bhp-hr NOx standards for 2024-2026 MY engines, meeting the 0.05 g/bhp-hr NOx standard may make it more difficult for manufacturers to simultaneously meet the 2024 Phase 2 GHG standards, given the current lead time. Therefore, CARB staff conservatively assumed a one percent increase in GHG emissions to account for possible losses due to additional emission controls needed to meet the 2024-2026 NOx standard. Using U.S. EPA's Phase 2 GHG Regulation technology cost estimates, CARB staff determined the incremental technology costs per vehicle to reduce GHG emissions by

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<sup>173</sup> Sharp, Christopher. "Further Development and Validation of Technologies to Lower Oxides of Nitrogen Emissions from Heavy-Duty Vehicles, Low NOx Demonstration Program – Stage 3," Southwest Research Institute, ARB Contract 16MSC010, SwRI@ Project Number 03.23379, Final Report, April 16, 2021. <https://www.arb.ca.gov/lists/com-attach/79-hdomnibus2020-Uj4AaQB2Aj8FbAhw.pdf>

one percent.<sup>174</sup> The resulting GHG technology costs for 2024-2026 MY engines are \$501 for 12/13-liter diesel engines and \$100 for 6/7-liter diesel engines. This is much lower than the \$9,000 cost mentioned by the commenter.

As stated in the Agency Response to Comment A.(i)iii.5, while CARB staff did not quantify the impacts due to the uncertainty associated with the pre-buy/no-buy scenario, CARB staff did a sensitivity analysis of the pre-buy/no-buy scenario. CARB's analysis indicated that the benefits of the proposed Omnibus Regulation would be significant, cost-effective, and worth pursuing regardless of the pre-buy/no-buy scenario.

- (i)iii.5. Comment: The proposed 2027 MY standards are similarly problematic, over and above their associated prohibitive costs. CARB envisions that manufacturers will use advanced CDA systems, an EGR cooler bypass, and the aftertreatment configuration depicted below to meet the proposed suite of 2027 requirements (which include a 0.02 g/bhp-hr NO<sub>x</sub> standard, and correspondingly lower LLC, idle-NO<sub>x</sub>, and in-use 3B-MAW standards). As an initial matter, the complexities and costs of the envisioned 2027-compliant systems, as depicted above, will cause very significant pre-buy/no-buy responses in California, resulting in market conditions that likely will not support the manufacture and sale of CARB-compliant products. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the cost analysis in response to this comment. As shown in the analysis in section IX of the ISOR, the incremental increase to the cost to make an engine compliant with the proposed Omnibus Regulation would be relatively small to the baseline cost of a vehicle. Since the Board Hearing, CARB staff has updated the cost analysis in the ISOR to match the proposed Omnibus Regulation to account for the ACT Regulation and the 30-Day and 15-Day Notice Amendments (see Agency Response to Comment A.(i)j.1). CARB staff estimates the costs to be \$6,114 and \$6,737 for MHDD and HHDD engines meeting 2027 requirements respectively. CARB staff estimates the costs to be \$6,347 and \$6,057 for MHDD and HHDD engines meeting 2031 requirements respectively. After the reanalysis to account for the ACT Regulation and 30-Day and 15-Day Notice Amendments, CARB staff estimates the average increase in cost per vehicle in 2031 to be \$5,495 based on population weighted engine class or a 5.5 percent increase in cost over the lifetime of the vehicle.

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<sup>174</sup> "Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles – Phase 2 Final Rule," United States Environmental Protection Agency and United States Department of Transportation National Highway Traffic Safety Administration, October 2016 (EPA-HQ-OAR-2014-0827; NHTSA-2014-0132). <https://www.gpo.gov/fdsys/pkg/FR-2016-10-25/pdf/2016-21203.pdf>

As stated in the Response to the Environmental Analysis (EA),<sup>175</sup> even though pre-purchases would not result in emissions above California Environmental Quality Act (CEQA) baseline evaluated for the Regulation, CARB staff provides the following response for informational purposes. CARB staff acknowledged in the ISOR that the proposed Omnibus Regulation might result in California fleets holding onto their existing vehicles longer, purchasing used vehicles in lieu of new vehicles in California, or purchasing used out-of-state vehicles. CARB staff also considered that the Omnibus Regulation could cause some fleets to purchase vehicles ahead of the effective date of the standards (i.e., via the “pre-buy” phenomenon). In the ISOR, due to the uncertainty associated with these potential impacts, as well as the difficulty quantifying them, CARB staff did not quantify these impacts. As noted in Chapter IX of the ISOR, CARB staff searched literature focused on the impact of regulatory costs on HD vehicles, engine prices, and the “pre-buy” phenomenon. Several studies have explored the relationship between general cost increases and the purchase of out-of-state new or used trucks or engines and found that there is a very wide range of estimates for how increased costs may impact purchasing behavior. The estimates are highly uncertain and may change markedly in the span of only several years due to the dynamics of industry and modern global economics.

Although the Omnibus Regulation does not explicitly model the occurrence of a “pre-buy” effect where fleets increase purchases just before the Regulation would take effect in 2024 and then decrease sales immediately after, the model used to analyze the impacts of the Omnibus Regulation, EMFAC2017, already accounts for a pre-buy in 2023 due to the California Truck and Bus Regulation. As noted in Chapter IX of the ISOR, “The final compliance date for the Truck and Bus Regulation is January 1<sup>st</sup>, 2023. As of that date, heavy-duty vehicle owners are required to fully turn over their fleet to 2010 standard compliant engines.” In order to comply with the Truck and Bus Regulation, California fleets will have just recently purchased trucks to comply with the Truck and Bus Regulation in the run-up to the January 1, 2023 deadline. Consequently, fleets that otherwise might have waited to purchase trucks in 2024 or 2025, instead purchase trucks just before 2023, resulting in the increased new (“age 0”) population of in-state trucks in California in 2023 and decreased population of age 0 trucks in 2024. In essence, EMFAC2017 already models a pre-buy just before the Omnibus Regulation would take effect in 2024, and hence all the emission benefit and cost analyses in the Staff Report already include this pre-buy effect.

As stated above, CARB staff did not explicitly model an additional pre-buy effect due to the Omnibus Regulation either in the Staff Report for the Omnibus Regulation or in the SIP Strategy EA because CARB staff recognizes that nationally, pre-buy has occurred in the past when emission standards changed significantly. CARB staff believes an additional pre-buy in California before the

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<sup>175</sup> Attachment B to Resolution 20-23. “Response to Comments on the Environmental Analysis for the Proposed Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments.” August 26, 2020. <https://ww2.arb.ca.gov/sites/default/files/classic/regact/2020/hdomnibuslownox/res20-23attbrtc.pdf>

Omnibus Regulation would take effect, in 2024, is unlikely due to the impacts of the Truck and Bus Regulation. That is, fleets that just performed accelerated turnover to meet the requirements of the Truck and Bus Regulation deadline on January 1, 2023 would be unlikely to immediately purchase additional trucks in 2023 to avoid the proposed Omnibus Regulation requirements.

Further, CARB staff believes if an additional pre-buy did occur, it would cause more 0.2 g/bhp-hr NO<sub>x</sub> engines to be sold, which would cause decreased costs and also decreased benefits. However, even if such an additional pre-buy occurred, the benefits of the Omnibus Regulation would be significant, cost-effective, and worth pursuing.

- (i)iii.6. Comment: Another issue not addressed by CARB is packaging the multi-component Stage 3 prototype aftertreatment system into a HDOH vehicle. One OEM that has assessed some of the relevant packaging issues has found that when parallel SCR paths are configured in a single “can,” they cannot be packaged into Class 4 and 5 truck configurations. Additionally, one of the approaches to address the deterioration of catalysts (discussed above) is to increase the catalyst size, which would compound the packaging problems. Consequently, CARB needs to (but has failed to) account for the significant and costly frame redesigns that will be required to package the envisioned Stage 3 aftertreatment system, including the likely effects on payload, curb weight, and safety. CARB should update its Cost Assessment to reflect those necessary additional cost increases.<sup>176</sup> (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the cost analysis in response to this comment. MECA submitted a presentation to the Omnibus Regulation comment log that includes a slide on how HD exhaust control technology has evolved since 2010.<sup>177</sup> The reduction of the aftertreatment size has been significant. As the commenter stated, the aftertreatment configuration used in Stage 3 is a prototype. This prototype configuration is being used to demonstrate the feasibility of an aftertreatment system to meet the Omnibus Regulation NO<sub>x</sub> standard. CARB staff believes that the manufacturers of aftertreatment systems, together with vehicle manufacturers, will have enough time to make evolutionary changes that will not require redesign of vehicles. Therefore, CARB staff does not expect the cost increases mentioned in the comment above will be incurred by vehicle manufacturers, and the cost increases were not included in the Omnibus Regulation cost analysis.

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<sup>176</sup> In the case of Class 8 chassis, the installation of the twin parallel SCR systems would be especially problematic for back-of-cab (BOC) vertical installations (for chassis where it is not possible to mount the exhaust system under or between the frame rails). The inability to configure the envisioned aftertreatment systems in BOC vehicle applications will render the Low-NO<sub>x</sub> standards inherently infeasible for those vehicles.

<sup>177</sup> Brenzy, Rasto. “Technology for Meeting the Low NO<sub>x</sub> Omnibus Regulations for Heavy-Duty Trucks.” MECA comment letter submitted on August, 24, 2024. See slide 4 of MECA’s presentation: <https://www.arb.ca.gov/lists/com-attach/25-hdomnibus2020-UTxcP1lwUGJXfwl5.pdf>

**(i)iv. Direct Costs for Lengthened Warranty and Useful Life, and EWIR**

- (i)iv.1. Comment: The Omnibus Regulations also include the adoption of regulatory amendments to transform the current EWIR requirements into a strict liability program. More specifically, under the contemplated amendments, any exceedance of the “screened” 4% warranty claims-rate threshold for emissions-related components would trigger either extended warranties for the parts at issue or mandatory recalls, or both, without regard to the potential emissions impacts that might be related to the emissions-related components and warranty claims at issue. That strict liability program and the need for corrective action would “be based solely on warranty failure rates.” (Appendix 2, p.4.) While CARB does not attempt to quantify the aggregate costs of moving to that type of a strict liability EWIR program, those costs could easily amount to tens of millions of dollars for individual manufacturers, and likely would prove to be cost-prohibitive, especially considering the limited (if any) corresponding monetized health benefits. In cases where CARB proposes to require both a recall and extended warranties, the manufacturer would be doubly penalized. Indeed, CARB understands that its proposed changes to the EWIR program will cause substantially increased EWIR claim and corrective actions (Notice, p. 17). (EMA, Daimler, Navistar, Volvo)

Agency Response: No change was made in response to this comment. Please see the Agency Response to Comment A.(d)j.1 which explains how the Amendments establish a performance standard, and the Agency Response to Comment A.(d)iii.3 which explains why the corrective action requirements are necessary and not doubly punitive. The commenter’s claim that CARB does not attempt to quantify the aggregate costs of EWIR program Amendments is false. In fact, CARB staff did indeed quantify costs for the new recall and extended warranty requirements and incremental costs for adopting the recall and EWIR Amendments (See ISOR, p. IX-33 and IX-39).

As an additional note, since the Board Hearing, CARB staff has updated the cost analysis to include the 30-Day and 15-Day Notice Amendments and an update to the legal baseline for the recent adoption of the ACT Regulation in the Agency Response to Comment A.(i)j.1.

- (i)iv.2. Comment: The more stringent 2024 warranty reporting and corrective action provisions and the proposed lengthening of emissions warranty and useful life periods in 2027 and 2031 are other areas of significant concern for Cummins. The proposed changes will further raise the costs of vehicles, which negatively impacts technology adoption and the corresponding environmental benefits. For example, CARB proposes mandatory recalls and extended warranty for certain components based solely on failure rate, even in cases with no emissions impact, starting MY 2024. CARB also proposes to

nearly double emissions warranty and useful life periods in terms of mileage, along with doubling current warranty years, in two steps to be phased in by MY 2031. Together these changes will increase the initial purchase price of the vehicle as manufacturers seek to re-coup the costs of providing mandatory longer coverage, incorporating changes to improve component durability (if possible), or paying for replacements when component improvements are not possible. Changing these requirements at the same time as introducing new technology to meet new NOx standards will further exacerbate vehicle price increases.

CARB should not finalize the proposed changes to emissions warranty reporting, corrective actions, warranty periods, and useful life periods. CARB should instead first conduct a comprehensive study to assess the cost implications, including impacts on new technology adoption, of these changes which could have the unintended consequence of discouraging emissions improvements if customers cannot afford to buy new vehicles. Cummins is committed to working with CARB to evaluate other more cost-effective alternatives. (Cummins)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. For the Omnibus Regulation, CARB staff developed a thorough and detailed cost analysis that explores the costs and cost savings to the vehicle owner (which include costs and cost savings information specifically for EWIR and extended warranty Amendments along with an explanation of the methodology used to determine the costs and cost savings). CARB staff therefore has confidence in its underlying analysis, and thus sees no need to revise the Omnibus Regulation requirements. However, in response to the concerns raised by the stakeholders at the August 2020 Board Hearing, the Board directed CARB staff to engage with the stakeholders by participating in a cooperative Warranty Cost Study to assess the warranty costs associated with the longer periods. As mentioned in the Agency Response to Comments A.(c)iv.1 and A.(c)iv.2, the Warranty Cost Study outlines a set of goals to help the industry to be better able to plan for compliance with the Omnibus Regulation. Primarily it aimed to mitigate the uncertainty that manufacturers and suppliers have regarding the costs for the longer warranty periods under first and subsequent vehicle ownerships. After convening an industry stakeholder work group that worked over a nine-month period to analyze and study the various differences in the cost estimate methodologies used for estimating warranty costs, CARB staff concluded the Omnibus Regulation's cost estimates were well-supported and appropriate and therefore did not amend the cost estimates.

As an additional note, since the Board Hearing, CARB staff has updated the cost analysis to include 30-Day Notice Amendments and an update to the legal baseline for the recent adoption of the ACT Regulation in the Agency Response to Comment A.(i)1.

- (i)iv.3. Comment: CARB similarly assumes that the longer mandated emissions warranties “will ensure that manufacturers, not vehicle owners, will pay for problems caused by poor design and durability [of emissions-related components] that CARB’s HD I/M program detects,” and that the extended warranties “[W]ould also protect HD vehicle owners from paying out-of-pocket expenses to replace emission-related components that are supposed to remain durable throughout the useful life of the engine.”. The lengthened warranties will shift some of those repair costs to the manufacturers.” (ISOR, pp. ES-14, 11-17.) Again, those are manifestly incorrect and unjustified assumptions. Manufacturers will be highly motivated to ensure that all costs associated with CARB-mandated extended warranties are thoroughly assessed and built-in to the initial purchase price of the new HDOH vehicles and engines that are covered by CARB’s new extended mandates. Accordingly, the full “all-in” costs of those longer warranties almost certainly will be passed through to vehicle owners, not simply absorbed by manufacturers as CARB incorrectly assumes. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. As stated in the Agency Response to Comment A.(i)j.3 and in ISOR on p. IX-17, CARB staff acknowledges that the costs associated with the longer warranty period would be passed on to the vehicle purchasers through an increased purchase price for the vehicles. This expectation comes from historical observations of regulatory influences on prices, as well as discussions with OEMs during this rulemaking process. When taking a more comprehensive look at the cost impacts on the vehicle owners, it is important to consider how their out-of-pocket expenses for repairs will be reduced under a longer warranty period. CARB staff expects that, *on average*, vehicle buyers would gradually recoup the initial purchase price increase due to the warranty Amendments since they would not have to pay for as many out of warranty repairs. Additionally, some vehicle buyers commonly finance their vehicle purchase, and for the increased purchase price due to the warranty period, they would incur a corresponding increase in the transaction costs associated with financing. For these vehicle buyers, the increased transaction costs are not expected to be completely offset by the savings benefits expected by the extended warranty mileage.

Furthermore, as explained in the Agency Response to Comment A.(c)i.2, CARB staff expects that the upcoming HD I/M program (required by Senate Bill 210) would work in conjunction with the longer Step 2 warranty periods. The proposed HD I/M Regulation is currently in development, and so its associated costs are not factored into the Omnibus Regulation costs. In addition, CARB staff expects that putting the Omnibus warranty requirements on manufacturers may drive competition in the market, wherein manufacturers would compete with each other to improve the robustness of their emission control systems, minimize their own

warranty costs, and reduce their upfront purchase price to make their products more attractive to customers.

- (i)iv.4. Comment: Another unreasonable aspect of CARB’s Cost Assessment methodology is that it relies on the warranty claims rates, emissions-component failure rates, repair rates, and engine/aftertreatment-part recall rates that were associated with 2013 MY engines, and then “extrapolates those 2013 rates” to assess the likely defect, repair and recall rates anticipated for the envisioned and highly-complex 2024 MY and 2027 MY engine and aftertreatment systems, as represented by the low-NOx prototype engines being developed at SwRI under its research contract with CARB. (See ISOR, pp. IX-19, 26, 28, and 32.) That is not a reasonable “extrapolation” methodology given the significant differences between 2013 MY engine and aftertreatment technologies, and the anticipated 2024/2027 MY engine and aftertreatment technologies. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the cost analysis in response to this comment. CARB staff’s approach to analyzing the warranty costs relied on using the latest complete 5-year set of emissions warranty reported data, which at the time of the analysis, was for MY 2013. When considering the technologies that are expected to be utilized to meet the Omnibus Regulation standards for the 2024 and 2027 MYs, CARB staff expects that for the most part the technologies would be very similar to the existing technologies that are currently being used on engines. Based on the work done under the SwRI contract, CARB staff expects that the required technologies will mostly be evolutionary and not revolutionary (i.e., minor improvements to calibration and design of today’s DPF/SCR designs, rather than some completely new technology). Some expected changes, like heated dosing, are new but generally no revolutionary technology is expected to be used to meet the lower Omnibus Regulation standards. Additionally, CARB staff expects that the parts are less likely to fail because of improved parts durability since 2013. Therefore, CARB staff considers the use of MY 2013 data for the cost analysis to be reasonable.

In CARB staff’s discussions with stakeholders there were concerns raised regarding the overall emissions system performance when using new technologies to meet the lower emissions standards, and the uncertainty of their durability over the longer useful life periods. In consideration of these concerns, CARB staff proposes to allow for more flexible maintenance intervals to the manufacturers that may need new scheduled maintenance. Under the 30-Day Notice Amendments, the provisions in § 86.094-25 of the “California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles,” and the “California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Otto-Cycle Engines and Vehicles” will add language that addresses the flexible maintenance.

- (i)iv.5. Comment: Further, by the time the 2027 and 2031 requirements are in full effect, and all of the engine hardware, fuel consumption impacts, extended emissions warranty and recall impacts, and other costs associated with CARB staff's proposals are added up, it is apparent that CARB's "Step 2" proposal also would be infeasible, in addition to being cost-prohibitive, as already discussed. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the cost analysis in response to this comment. The feasibility of the Proposed Amendments is discussed in the Agency Response to Comments in section A, subsections (a), (b), (c), (d), (e), (f), and (g) of this document. The proposed Omnibus Regulation is feasible and cost-effective, as described initially in ISOR Appendix C-3.<sup>178</sup>

As a final note, as described in the Agency Response to Comment A.(i)i.1, since the Board Hearing, CARB staff has updated the cost analysis in the ISOR to match the proposed Omnibus Regulation to account for the ACT Regulation and the 30-Day and 15-Day Notice Amendments. The cost-effectiveness of the proposed Omnibus Regulation is estimated to be \$4.51 per pound NOx. The cost-effectiveness is within the 80<sup>th</sup> percentile of previous CARB rulemakings.

- (i)iv.6. Comment: Finally, CARB conjectures that California warranties on out-of-state vehicles will increase their value and thereby benefit their owners who sell the vehicles after having incurred higher up-front costs of purchasing the vehicle versus comparable non-California certified vehicles. There are numerous issues with this last claim including that CARB provides no quantification of the upfront costs to out-of-state buyers and operators. Instead, CARB assumes that there will be some cost-recovery of these costs when a vehicle owner sells a depreciated used vehicle solely on the basis that it holds a California warranty. But this obviously does not: (a) account for vehicles that are not subsequently sold; (b) vehicles that are sold past the time that a warranty applies. Nor is there any analysis of used-vehicle purchasers "willingness to pay" for the conjectured benefit of a California versus federal warranty. (Allison)

Agency Response: CARB staff did not make any changes to the cost analysis in response to this comment. HD vehicles originally sold in California can be subsequently resold and reregistered outside of California, and often either return to California, or travel in and out of California, during their normal course of operation. As explained in the Agency Response to Comment A.(c)iii.3, the removal of the California registration requirement for the warranty applicability is meant to address those types of situations and to allow the warranty to remain attached to the vehicle.

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<sup>178</sup> CARB. "Further Detail on Costs and Economic Analysis." Appendix C-3 to the ISOR. <https://ww2.arb.ca.gov/sites/default/files/classic/regact/2020/hdomnibuslownox/appc3.pdf>

The cost assessment for the warranty Amendments is intended to quantify the monetary impact that the regulation would have on vehicle buyers in California. Also, because the Regulation is for new and not used engines and vehicles, the costs were quantified as an increment to the initial purchase price. Therefore, there is no need for CARB staff to quantify the used vehicle costs for out-of-state buyers. Furthermore, vehicles that are not subsequently sold by the first owners are not relevant for consideration because they would not be affected by the registration requirements. Vehicles that are sold after the warranty has expired are also not relevant to the analysis, because they would not be affected by the registration requirements.

In ISOR (p. III-54) CARB staff argued that having the warranty remain with the vehicle incentivizes timely repairs for faulty emission-related components, so that when the vehicles eventually do operate in California, they will have lower emissions. CARB staff considers it reasonable that vehicles having some residual warranty attached would have a higher resale value than those without. As explained in the Agency Response to Comments A.(c)iv.1 and A.(c)iv.2, as directed by the Board, CARB staff conducted a Warranty Cost Study where it sought to gather available data for HD vehicles to quantify the residual warranty value to the second and subsequent owners. This was done using a survey of vehicle fleets to gain further insight into the inherent value arising from the lengthened warranty periods for California-certified vehicles.

CARB staff conducted an online survey and collected 694 responses from fleet owner/operators and 5 dealers. The survey results indicated that the remaining residual warranties do add value to vehicles sold in the secondary market, averaging approximately \$2,000 for 2 years/200,000 miles of residual warranties and \$4,000 for 4 years/400,000 miles. The survey did not evaluate the impact of different year-to-mile ratios (e.g., 6 months/200,000 miles). Also, approximately half of the fleet owner/operators responding to the survey expected to hold on to their vehicles longer as warranty periods will be extended. These results suggest that higher initial purchase prices are likely to be distributed over longer time periods or passed on to the subsequent owners to some extent, which lessens the impact the Omnibus Regulation warranty Amendments are likely to have on first owners.

- (i)iv.7. Comment: Cost increases related to the longer emissions warranty and useful life periods are difficult to quantify as manufacturers must still explore and evaluate possible 2027 engine architectures. Validation models and cost projections rely on historical data for existing components and development experience for new technologies. However, the proposed new requirements for emissions warranty and useful life extend beyond the mileage and time periods covered by most historical data and far exceed the experience that can be accumulated during the typical three- to four-year product development cycles for these products. Further exploration of technology choices and costs is needed.

It is the initial purchaser, a variety of end-user customers from fleets to municipalities to small businesses, who will be penalized by these cost increases and will see their business models disrupted as they consider many factors including impacts to their total cost of ownership and re-sale values, while weighing alternatives such as holding on to their older vehicles longer or buying used vehicles. They may choose to forgo buying new vehicles, which will slow adoption of new technologies and reduce the envisioned emissions benefits. (Cummins)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. At the direction of the Board, CARB staff conducted a Warranty Cost Study that addressed these concerns as it sought to work with stakeholders to assess the warranty costs associated with the longer periods. CARB staff expects that the results of the study will help industry plan for compliance with the Omnibus Regulation. For more details on the study please see the Agency Response to Comments A.(c)iv.1 and A.(c)iv.2.

In the ISOR, CARB staff acknowledged that the Omnibus Regulation might result in California fleets holding onto their existing vehicles longer, or purchasing used vehicles in lieu of new vehicles in California, or purchasing more used, out-of-state vehicles. CARB staff also considered that the Omnibus Regulation could cause some fleets to purchase vehicles ahead of when the standards take effect (i.e., via the “pre-buy” phenomenon). In the ISOR, due to the uncertainty associated with these potential impacts, as well as the difficulty quantifying them, CARB staff did not quantify these impacts. Although CARB staff did not explicitly model the impacts of a pre-buy due to the Omnibus Regulation, CARB staff believes if an additional pre-buy did occur, it would cause more 0.2 g/bhp-hr NOx engines to be sold, which would cause decreased costs and also decreased benefits of the Regulation. As described in the Agency Response to Comment A.(i)iii.5, even if such an additional pre-buy occurred, the benefits of the Omnibus Regulation would be significant, cost-effective, and worth pursuing.

Similarly, CARB staff investigated scenarios where fleets would keep their vehicles for longer durations and refrain from purchasing new vehicles via a “no-buy” phenomenon. In that analysis, CARB staff considered a scenario where 20 percent of the projected sales volumes would decrease as a result of a no-buy situation and the emissions were modeled for fleets keeping their engines for longer periods of time. In the case described, total NOx reductions are projected to be 206,312 tons between 2022-2050 at a cost of \$3.6 billion, savings of \$528 million, and a cost-effectiveness of \$7.50/lb NOx.

- (i)iv.8. Comment: CARB’s projected cost for lengthened warranty and EWIR amendments are estimated at \$933 million (Table IX-18) and \$276 million (Table IX-29), respectively. However, the cost savings from them are only \$581 million and \$69 million, as shown in Table V-7. Based on these figures customers are not able to fully recover the warranty and EWIR cost. In

addition, it is not clear whether CARB considers any discount for the future costs and savings associated with the lengthened warranty.

Recommendation: CARB should provide a clear justification of customer benefit from extending the warranty. (WSPA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. As explained in the Agency Response to Comments A.(i).3, CARB staff agrees that the vehicle buyers would not fully recover the increase to the vehicle purchase price that comes from the longer warranty periods and EWIR requirements. However, the cost increase would be partially offset, on average, by the eventual savings benefits over time. The costs associated with the longer warranty periods and EWIR requirements do not factor in any discount for the future costs and savings because all the estimates were consistently done in 2018-dollar values.

The customer benefit from the longer warranty periods and EWIR requirements can be conceptually understood from offering a greater incentive to owners to fix non-performance-related malfunctions that otherwise might not get repaired if the owner had to bear the cost for the repair. Additionally, it would offer some owner protection from having to pay to replace emission-related components that are supposed to remain durable throughout the useful life of the engine. Monetarily speaking, the benefits associated with longer warranty periods are estimated to be equal to the total incremental repair costs as shown in Table IX-16 in the ISOR, and would be gradually, partially recouped as owners save money on repairs over time.

- (i)iv.9. Comment: CARB’s “justification” for its unilateral imposition of EWIR-related strict liability boils down to its assertion that having to demonstrate a meaningful emissions impact from a potentially defective component part “has required CARB to expend excessive resources and unduly limited both the scope and timing or recalls.” (ISOR, p. III-66.) Based solely on that “justification,” CARB proposes to shift all of the attendant costs of substantially expanded recall liability onto manufacturers, even in cases where no material adverse emissions consequences could result. The magnitude of the resultant costs to manufacturers – which will be passed along to vehicle owners through proportionally increased purchase prices – makes this element of the Omnibus Regulations, among others, cost-prohibitive and unreasonable.

The EWIR change at issue, the proposed conversion to a strict liability program, is being done solely as a matter of convenience for CARB, without any real regard to the cost impacts on manufacturers and vehicle purchasers. Rather, CARB simply claims that “currently, identifying potentially defective emission control components by warranty reporting requirements, and the process of negotiating corrective action with manufacturers and determining the emissions impact of a component failure is lengthy,” and that CARB does

not want to deal anymore with having to assess whether any emissions impacts are at issue. “Hence, amendments to the current EWIR requirements are needed to make it easier for CARB to force recalls.” (ISOR, p. ES-7; II-19; II-20.)

Objecting to having to discern whether emissions-related components with higher warranty claims rates could actually impact emissions performance “because it can be a lengthy process” is an insufficient justification for imposing tens of millions of dollars of costs per manufacturer. Indeed, making recalls “easier” for CARB is not, by itself, a sufficient basis for a rulemaking, nor is it equivalent to making the requisite showing of cost-effectiveness. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. The EWIR Amendments are not a new “strict liability program.” The EWIR program is an in-use program that ensures that manufacturers meet the obligation of emission-related components lasting throughout the useful life period which is considered during the certification process.

In addition, the Omnibus EWIR Amendments were not proposed solely because having to discern whether emissions-related components with higher warranty claims rates could impact emissions performance “can be a lengthy process.” Instead, as discussed extensively in the ISOR, the Omnibus EWIR Amendments would improve the current program to ensure that it is more effective, and that corrective action is taken in a timely manner when failure rates exceed corrective action thresholds.

The costs associated with the program should already be accounted for by manufacturers as they design and build their vehicles. Manufacturers perform durability demonstrations to ensure that parts will be durable throughout the useful life. Manufacturers should not be experiencing many failures that exceed the corrective action threshold. Parts failing at a rate higher than the corrective action threshold are indicative of a poor and inaccurate durability demonstration. Finally, CARB staff understands that in some cases the cost of a recall may outweigh the emissions benefit, which is why an extended warranty is the prescribed form of corrective action for the vast majority of emission-control components.

As an additional note, since the Board Hearing CARB staff has updated the cost analysis to include the 30-Day and 15-Day Notice Amendments and an update to the legal baseline for the recent adoption of the ACT Regulation, as discussed further in the Agency Response to Comment A.(i).1.

#### **(i)v. Costs Related to a Pre-Buy/No-Buy Scenario**

- (i)v.1. Comment: CARB acknowledges the impacts that its previously adopted Truck and Bus Rule (along with the ACT Rule) will have on shrinking the market for the purchase and sale of new HDOH diesel vehicles from and after the 2024 MY, but completely fails to account for that fact in its Cost Assessment. Specifically, CARB notes as follows: “Small business fleets throughout California will likely comply with the Truck and Bus Regulation via accelerated turnover (i.e., by purchasing new trucks or newer used trucks). Because such business fleets would have just recently purchased trucks to comply with the Truck and Bus Regulation, they would not likely immediately purchase trucks with new 2024 or subsequent MY engines.” (ISOR, p. IX-53.) CARB also recognizes that the Omnibus Regulations “could encourage California and out-of-state fleets operating in California to hold onto their existing vehicles longer or to consider purchasing used vehicles in-state or out-of-state in lieu of new vehicles in California.” (ISOR, pp. IX-67 and 68.) Nonetheless, CARB makes no efforts whatsoever in its Cost Assessment (or in its benefits assessment) to quantify the likely impacts of the anticipated pre-buy/no-buy response to the Omnibus Regulations. That is a fundamental shortcoming of CARB’s cost-benefit analysis. (EMA, Daimler, Navistar, Volvo)
- (i)v.2. Comment: CARB also never lists the sales volumes of new California-certified HDOH engines and vehicles that CARB is projecting will occur starting in the 2024 MY and continuing out year-over-year through 2050, the end date for CARB’s cost projections. Perhaps that is because CARB realizes that any such projections are likely to be overstated due to the anticipated pre-buy/no-buy impacts of its Omnibus Regulations (coupled with the equivalent pre-buy impacts stemming from the 2023 vehicle-purchase deadline established under CARB’s Truck and Bus Rule), and the progressively shrinking market for HDOH diesel engines and vehicles that simultaneously will result from the increasing HDOH ZEV-sales mandates under the recently-adopted ACT Rule. That rule will cut the HDOH diesel truck market roughly in half by 2032, if not sooner. Thus, CARB’s omission of the HDOH sales projections on which it is relying in preparing its Cost Assessment is both telling and significant. On that point, all that CARB asserts is that its Cost Assessment is based on “the EMFAC future vehicle sales projections,” without specifying what those projections are. (See ISOR, pp. IX-12, 13, 24, and 29.) That is not enough to make a sustainable record for this rulemaking. (EMA, Daimler, Navistar, Volvo)
- (i)v.3. Comment: Importantly, ACT Research also conducted a detailed analysis of the pre-buy/no-buy vehicle-purchasing practices that California-based HD vehicle fleet-operators will engage in to try to avoid the adverse cost and other impacts of the Omnibus Regulation. As set forth in Table 8 of the ACT Report, CARB’s Omnibus Regulation will result in an initial two-year “pre-buy” equivalent to 39% of the California HHDD vehicle market, followed by a

second two-year pre-buy in advance of 2031 that will be equivalent to 14% of the HHDD vehicle market — a total of approximately 133,000 “pre-bought” HHDD vehicles. A pre-buy of that magnitude would eliminate a correspondingly large percentage of CARB’s assumed emission-reduction benefits of the Omnibus Regulation, and would cause an approximate 36% (31% plus 5%) additional increase in the per-vehicle costs of the proposed regulations. (See ACT Report, pp 20-21.) Thus, when factoring-in the likely pre-buy/no-buy impacts, it is clear that CARB has understated the likely per-vehicle cost impacts of its proposed Low-NOx Regulations by nearly an order-of-magnitude. (EMA, Daimler, Navistar, Volvo)

Agency Response to Comments A.(i)v.1 through A.(i)v.3: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment.

The sales volumes for the proposed Omnibus Regulation were published in ISOR Appendix C-3, Table I.4, titled “Projected Statewide New Medium- and Heavy-Duty Engines Sales from 2022 to 2050.”

CARB staff analyzed the effects of increasing price of products could cause a decrease in demand and perhaps pre-buy by some fleets. CARB staff’s research on supply and demand and price elasticity suggests that for every 1 percent increase in cost there could be a decrease in demand of 2 percent to 6 percent. To avoid paying for higher priced low NOx vehicles, consumers may decide to keep their existing vehicles longer, or purchase used vehicles or “new” federally certified vehicles out-of-state. In fact, some fleets are already doing this now to avoid paying higher sales tax and registration fees. CARB staff conducted a sensitivity analysis on the effects of a pre-buy/no-buy cost scenario. In the mechanics of a pre-buy/no-buy scenario, it is assumed that there will be a decrease in the purchase of low NOx vehicles and therefore a decrease in both cost and emission benefits of the regulation. Using a scenario where 20 percent of the projected sales volumes decrease as a result of a no-buy the total NOx benefits would be 206,312 tons for the period from 2022 through 2050 with a cost of \$3.6 billion, savings of \$528 million, and a cost-effectiveness of \$7.50 per pound of NOx. The pre-buy/no-buy argument was comprehensively addressed by CARB staff in response to EMA’s pre-hearing comments in section 7-6 of Attachment B to Resolution 20-23. As such, it was concluded that even if a pre-buy scenario occurred, the benefits of the Omnibus Regulation would still be significant, cost-effective, and worth pursuing.

In the SRIA, which was prepared in early 2020, CARB staff performed the cost analysis based on the modeled baseline to account for the proposed ACT Regulation as both the proposed ACT Regulation and the proposed Omnibus Regulation would impact the same class of vehicles and engines during the same timeframe. However, the DOF indicated in their comments on CARB’s submitted SRIA that CARB must base the main cost analysis on the legal

baseline and hence should not have included the proposed ACT Regulation in the baseline. In response to DOF's comments, CARB staff provided a cost and benefit impact analysis based on a legal baseline excluding the ACT Regulation in a level of detail similar to that in the SRIA as an attachment to the Public Notice released June 9, 2020. The ACT Regulation was effective in March of 2021 and it is now appropriate to include the ACT Regulation in the legal baseline.

Also, since the Board Hearing, CARB staff has updated the cost analysis in the ISOR to match the proposed Omnibus Regulation to account for the ACT Regulation and the 30-Day and 15-Day Notice Amendments (see Agency Response to Comment A.(i).1). The implementation of the ACT Regulation reduced the projected HD engine sales volumes by 40 percent of values listed in Appendix C-3 of the ISOR.

One of the commenters mentions the impact of the "pre-buy" phenomenon due to the Truck and Bus Regulation and the proposed Omnibus Regulation. In the Agency Response to Comment A.(i).5, CARB staff explains that the "pre-buy" phenomenon will most likely be driven by the Truck and Bus Regulation deadlines and to a lesser extent the proposed Omnibus Regulation effective date. In addition, CARB staff could not find any studies that evaluate the impact of prior vehicle related regulations on the "pre-buy" phenomenon. Studies that account for in-state vehicle price increase causing out-of-state vehicle purchases varied widely making the data provided in the studies useless for the Regulation analysis. Furthermore, if the commenter has an analysis or report from a reputable source that indicates the Regulation will cause a substantial "pre-buy" response, then they should have submitted this information along with their comments for CARB staff to evaluate and respond to.

As stated in the Agency Response to Comment A.(i).5, while CARB staff did not quantify the impacts due to the uncertainty associated with the pre-buy/no-buy scenario. CARB staff is also aware of how a pre-buy/no-buy scenario will impact both ZEV sales and combustion engines sales. CARB staff did a sensitivity analysis of the pre-buy/no-buy scenario. CARB's analysis indicated that the benefits of the proposed Omnibus Regulation would be significant, cost-effective, and worth pursuing regardless of the pre-buy/no-buy scenario.

- (i)v.4. Comment: Just as significant, the anticipated pre-buys and corresponding no-buys will have correspondingly negative impacts on the already limited emission reductions that CARB is ascribing to the Omnibus Regulations (i.e., just 7.0 tpd NOx in the South Coast as of 2031). Those negative impacts amount to an additional factor supporting the comparative cost-effectiveness of EMA's alternative proposal for a nationwide low-NOx proposal starting in 2024. (EMA, Daimler, Navistar, Volvo)

- (i)v.5. Comment: Unfortunately, neither the significant costs of this regulation nor the resulting market upheaval have been realistically accounted for in CARB's analysis. One need only look back to the 2006-2007 "pre-buy/no-buy era" to see how a technology-forcing PM standard and related concerns about the cost and reliability of diesel particulate filters led to a 47% decline in national Class 8 truck sales in 2007 after reaching an historical high of 284,000 trucks sold in 2006. As past is prologue, one can expect another pre-buy in response to California's new Low NOx standard again in 2022 and 2023 sparked not only by technology-forcing lower NOx emission levels in 2024, but also by the state's existing Truck and Bus Regulation. This latter regulation, requiring all trucks in the state to meet 2010 emissions standards by 2023 will help improve the average fleet age in the state and reduce NOx emissions, but it will simultaneously "lock in" 2023 clean diesel technology among California fleets (due to SB1, by which fleets cannot face a mandatory turnover for 13 years or 800,000 miles). Oddly enough the ramifications of the Omnibus NOx Regulations will not only have the unintended consequence of locking in the number of operating trucks with 2010 NOx emission levels on the road, it will also drastically weaken the expected penetration of ZEVs as stipulated under the ACT Regulation passed by CARB in June of this year. (Volvo)
- (i)v.6. Comment: Under the ACT Rulemaking, HHDD and MHDD vehicle manufacturers must convert a portion of their sales in California to ZEVs beginning in 2024, with increasing percentages through 2035. CARB's contemporaneous mandate for increasing percentage sales of ZEV trucks will progressively shrink the market and sales volumes for low-NOx diesel trucks built to comply with the Omnibus Regulations, which in turn will increase their marginal costs since there will be fewer trucks among which manufacturers' increased regulatory-compliance costs can be spread and allocated. That will further suppress the demand for new low-NOx trucks in California, which will add further impetus to the regulatory forces (including pre-buy/no-buy impacts) that could limit HDOH vehicle offerings in California, or drive MHDD and HHDD vehicle manufacturers out of the California market altogether. In addition, CARB's overlapping HDOH Regulations will more than double manufacturers' necessary R&D investments, which also will need to be spread over a smaller and smaller percentage of sales in each HDOH vehicle category, making it impractical if not impossible for manufacturers to recoup those multiplicative R&D investments. The overall results for the HDOH market in California will be untenable. (EMA, Daimler, Navistar, Volvo)
- (i)v.7. Comment: As CARB adopts policy encouraging a large pre-buy by fleets in 2022 and 2023, the subsequent dearth of in-state diesel truck sales in 2024 will not only curtail the number of the newest ultra-low NOx diesels on the road, it will also undercut ZEV sales required under the ACT's sales volume mandate. (Volvo)

- (i)v.8. Comment: Certain engine manufacturers tell us that they will be unable to produce compliant engines for the 2024-2026 timeframe. For any manufacturer who may comply, it is expected that the higher costs associated with engine purchase and operation--together with concerns regarding reliability-- will force fleets to keep older, higher polluting equipment on the road longer.

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It is clear from discussions with our customers that they will hold onto older equipment longer, purchase new equipment in-state prior to 2024, or purchase used equipment out-of-state. They intend to do so to avoid any increased purchase costs or maintenance protocols related to the standards contained in the Omnibus Low-NOx rule. This will especially be true for small, locally based commercial equipment owners who are not engaged in for-hire or private freight transport.

Each of these pre-buy/no-buy scenarios will have significant ramifications for our industry, the state's fragile economy, and air quality overall. At worst, we expect to lay off or furlough some of our valuable employees, which will result in direct losses of local and state sales tax revenue just when California is likely to need it most. (TDAC)

Agency Response to Comments (i)v.4 through (i)v.8: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to these comments. As described in the Agency Response to Comment A.(i)j.2, CARB staff believes the ACT Research study commissioned by EMA to be an inaccurate and an unreasonable representation of the proposed Omnibus Regulation costs. ACT Research estimates for pre-buy projections are tied to unreasonable incremental increases in the vehicle purchase price of five times that of the Proposed Amendments estimate. Therefore, for the reasons noted in the Agency Response to Comment A.(i)j.2, the projected pre-buy sales estimates by ACT Research were not used by CARB staff.

As stated in the Agency Response to Comment A.(i)k.5, while CARB staff did not quantify the impacts due to the uncertainty associated with the “pre-buy/no-buy” scenario, CARB staff did a sensitivity analysis of the “pre-buy/no-buy” scenario. CARB’s analysis indicated that the benefits of the proposed Omnibus Regulation would be significant, cost-effective, and worth pursuing regardless of the “pre-buy/no-buy” scenario. In a sensitivity case where approximately 30 percent of the projected 2024 through 2050 calendar year sales were displaced due to the 6 percent decrease in demand caused by the 5.5 percent projected increase in purchase price (see Agency Response to Comments A.(i)v.1 through A.(i)v.3 and A.(i)j.2), the benefits of the proposed Omnibus Regulation would be significant, cost-effective, and worth pursuing regardless of a the “pre-buy” phenomenon.

As described in the Agency Response to Comment A.(i)iv.7, CARB staff looked into scenarios where fleets would keep their vehicles for longer durations and refrain from purchasing new vehicles via a “no-buy” phenomenon. In that analysis, CARB staff considered a scenario where 20 percent of the projected sales volumes would decrease as a result of a “no-buy” situation. The emissions were modeled for fleets keeping their vehicles for longer periods of time. In the case described above, between 2022 and 2050, NO<sub>x</sub> reductions are estimated to be 206,312 tons, the cost is estimated to be \$3.6 billion, the savings is estimated to be \$528 million, and the cost-effectiveness is estimated to be \$7.50 per pound of NO<sub>x</sub>.

Also, since the Board Hearing, CARB staff has updated the cost analysis in the ISOR to match the proposed Omnibus Regulation to account for the ACT Regulation and the 30-Day and 15-Day Notice Amendments (see Agency Response to Comment A.(i)j.1). CARB staff also updated the analysis for Alternative 2 (which is equivalent to EMA’s proposal mentioned in the comment above) with the decreased vehicle sales volumes because of the ACT Regulation. The cost-effectiveness of Alternative 2 is estimated to be 4.51 times greater than the proposed Omnibus Regulation. As described in the Agency Response to Comments A.(i)j.12 to (i)j.13, although Alternative 2 could be more cost-effective and could achieve more benefits if it were fully implemented, it was rejected for several reasons. First, and most importantly, it is not clear how EMA’s proposal for a voluntary national standard could be enforced in California. If CARB staff pursued a voluntary agreement with manufacturers in lieu of enforceable regulations and then some or all manufacturers chose not to honor the agreement, California could be left with no emission benefits. Furthermore, CARB staff believes there is an intrinsic advantage to the proposed Omnibus Regulation by requiring manufacturers to deploy technically feasible, cost-effective technology with dramatically lower NO<sub>x</sub> emissions than today’s HD engines as quickly as possible. The success of California’s standards in 2024 and beyond will set a model for U.S. EPA to follow and make it more likely that federally certified vehicles of the future are lower emitting. Accordingly, Alternative 2 (i.e., EMA’s proposal) was rejected

CARB staff disagrees the proposed Omnibus Regulation is not cost-effective. As mentioned in the Agency Response to Comment A.(i)iv.5, after taking into account the ACT Regulation and the 30-Day and 15-Day Notice Amendments, the cost-effectiveness of the proposed Omnibus Regulation is estimated to be \$4.51 per pound NO<sub>x</sub>. The cost-effectiveness is within the 80<sup>th</sup> percentile of previous CARB rulemakings.

A commenter stated that “certain engine manufactures tell us they will be unable to produce compliant engines for the 2024-2026 timeframe.” To address this issue, CARB staff made changes to the Regulation allowing for legacy engines to be sold in the 2024-2026 timeframe under certain conditions (please see the Agency Response to Comments in section C.(m)i.

To evaluate the economic effect of the Regulation, CARB staff used the Regional Economic Models, Inc. (REMI) Policy Insight Plus Version 2.2.8 to estimate the macroeconomic impacts of the Amendments on the California economy (please see Agency Response to Comments A.(i)vi.3 and A.(i)vi.4.

**(i)vi. Cost to Businesses**

- (i)vi.1. Comment: As such, the significant additional costs that this proposed HD Low NOx Omnibus Regulation will impose upon trucking companies are deeply distressing. By CARB's own calculation in its Staff Report, this proposed rule in total will cost truck manufacturers over \$4 billion (for years 2022-2050)... Specifically, according to CARB, a 2031 MHDD vehicle will cost "\$6,923 higher than it otherwise would be," and 2031 LHDD vehicles and HHDD vehicles will cost \$6,041 and \$8,478 more, respectively.

While CARB's estimated costs are already alarming, EMA in its written comments to CARB on this Heavy-Duty Low NOx Omnibus Regulation, state that "CARB has grossly underestimated the costs associated with nearly all aspects of the proposed far-reaching Omnibus Regulation, and has materially overestimated their potential benefits." Specifically, EMA commissioned a comprehensive cost study and determined that this proposed rule would result in an approximate cost increase of \$58,000 for 2031 HHDD vehicles and an increase of \$51,000 for 2031 MHDD vehicles.

Even more troubling, these massive cost increases for truck owners come as CARB is formulating additional new onerous requirements for truck owners due to the passage of SB 210 (Leyva) in 2019, which directs CARB to develop and implement a comprehensive HD I/M program that will make vehicle owners responsible for maintaining their engines and aftertreatment systems in order to register them in California.

For the reasons listed above, we urge you to reconsider reducing the costs of this HD Low NOx Omnibus Regulation for truck owners – particularly in light of the additional large costs associated with other CARB rules already imposed, and to be imposed, upon them – or alternatively identify and develop effective new funding sources to help these truck owners offset these massive cost increases. (CTTA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. CARB staff believes the comment grossly overstates the expected cost increases due to the Omnibus Regulation. Since the Board Hearing, CARB staff has updated the cost analysis in the ISOR to match the proposed Omnibus Regulation to account for the ACT Regulation and the 30-Day and 15-Day Notice Amendments (see Agency Response to Comment A.(i)j.1). The updates dramatically reduced the cost of the

Regulation. The Proposed Regulation would impose approximately \$2.39 billion in cost and \$353 million in savings to California businesses from 2022 through 2050. CARB staff estimates the costs to be \$5,773; \$6,347; and \$6,057 for LHDD, MHDD, and HHDD engines meeting 2031 requirements respectively. After the reanalysis to account for the ACT Regulation and 30-Day and 15-Day Notice Amendments, CARB staff estimates the average increase in cost per vehicle in 2031 to be \$5,495 based on population weighted engine class or a 5.5 percent increase in cost over the lifetime of the vehicle.

CARB staff disagrees with the comments regarding underestimating of costs and over estimation of benefits for the proposed Omnibus Regulation. Evidence in ISOR Appendix C-3, Appendix D, and Appendix E shows that meticulous considerations and good engineering judgment were used to estimate the costs, inventory benefits, and health benefits for the proposed Omnibus Regulation. As mentioned in the Agency Response to Comments A.(i)i.9 and A.(i)i.11, the analysis conducted by ACT and NERA have problems with their methodology making the costs extremely overestimated and the benefits extremely discounted.

CARB staff believes the ACT Research study commissioned by EMA to be an inaccurate and an unreasonable representation of the proposed Omnibus Regulation costs. The compounded total costs per engine estimated in the ACT Research study misleadingly increases the costs by cumulating the costs per engine by summing the costs for MYs 2024, 2027, and 2031 requirements in the proposed Omnibus Regulation. The ACT Research study assumed manufacturers would have to replace the entire aftertreatment system two times over the course of the full useful life of a HHDD engine, thereby adding significant costs to the vehicles. To help reduce the chance that a vehicle will fail emission testing due to a deterioration of the aftertreatment system, the Omnibus Regulation emissions standards have been relaxed for 2027 and 2031 MY HHDD vehicles. The relaxed standards start after the vehicle has reached 435,000 miles.<sup>179</sup> Also, engine manufacturers will have several years to develop more durable systems before the new requirements are effective, thus, CARB staff does not believe the entire aftertreatment system would need any replacement based on the proposed changes (for more details please see Agency Response to Comment A.(i)i.2).

CARB staff has three critiques of the analysis methods use in the NERA report as described in the Agency Response to Comment A.(i)ii.9. First, NERA's analysis uses an outdated emissions inventory to estimate Omnibus Regulation benefits in California. Second, NERA's analysis does not account for vehicles that are first sold or certified in California. Finally, NERA underestimates per

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<sup>179</sup> CARB. Public Hearing To Consider the Proposed Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments: Staff Report: ISOR, Table III-3 on p. III-8. January 23, 2020. <https://ww2.arb.ca.gov/sites/default/files/classic/regact/2020/hdomnibuslownox/isor.pdf>

vehicle NOx emissions reductions for 0.02 g/bhp-hr certified engines relative to CARB's analysis.

With regards to the comment on HD I/M, the development of the HD I/M program is beyond the scope of this Regulation.

- (i)vi.2. Comment: We also request that CARB perform an economic analysis on the failure to incentivize or mandate advanced clean truck technologies that are currently commercialized and how the failure of doing so may actually slow or eliminate progressive industry investment in advanced clean technology strategies prior to regulatory requirements.

In other words, if CARB continues to demonstrate a policy bias for a single technology outcome, CARB should fully acknowledge the real life-threatening risks that are associated with such a strategy. Specifically, history demonstrates that ZEV programs often experience delays, cost barriers, technology advancement barriers, logistic barriers, energy delivery and infrastructure barriers, etc. and those potential risks should be provided to and considered by the Board so that it is fully aware of the potential public health consequences of failing to advance policies that deploy commercially available advanced lifesaving strategies today. (LNC, AFS)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. CARB staff did not make an economic analysis for failure to incentivize or mandate advanced clean truck technologies that are currently commercialized and how failure of doing so may actually slow or eliminate progressive industry investment in advanced clean technology strategies prior to regulatory requirements. Such an analysis is beyond the scope of the Omnibus Regulation. For an economic analysis and technology readiness of Advanced Clean Truck technologies, please see the regulatory documents associated with the ACT Regulation.

- (i)vi.3. Comment: Today, we bring to your attention to an urgent matter that threatens our dealers and their customers, our valuable employees and their families, as well as the state's air quality objectives. Specifically, the Omnibus Low-NOx Rule will: negatively impact new commercial vehicle sales as fleets will elect to hold on to their vehicles longer, decrease fleet turnover, and increase emissions; cause fleets to purchase used vehicles from out-of-state and subsequently export sales, jobs, and tax revenue; and place in-state only fleets at a disadvantage versus out-of-state fleets, harming California's small businesses the most. In addition, CARB's economic analysis does not take into account any real competitiveness or cost issues that fleets and dealers will face with a California engine standard. (TDAC)
- (i)vi.4. Comment: The proposed CARB rule will complicate the ability of fleet customers to effectively compete with fleets based out-of-state. Competitors

from out-of-state, which already enjoy a lower cost of doing business due to a variety of California-imposed mandates, will gain a further competitive advantage. As a result, out-of-state fleets operating in California will likely garner a larger market share as California-based fleets struggle with higher equipment and operational costs. (TDAC)

Agency Response to Comments (i)vi.3 and (i)vi.4: CARB staff appreciates the dealer concerns expressed by commenter TDAC and acknowledges that the Omnibus Regulation standards are significant and may cause some manufacturers to change their product offerings in California and some fleets to change their buying plans, especially during the period when California standards differ from federal standards. However, for the reasons discussed below, CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment. REMI Policy Insight Plus Version 2.2.8 was used to estimate the macroeconomic impacts of the Proposed Amendments on the California economy. REMI is a structural economic forecasting and policy analysis model that integrates input-output, computable general equilibrium, econometric and economic geography methodologies. More details on the methodology can be found in the original SRIA submitted to DOF in Appendix C-1. CARB staff considered the macroeconomic impact of the proposed Omnibus Regulation on total employment in California across all industries to investigate the impacts on businesses and to competitiveness using the REMI model. The Proposed Amendments would result in a slightly negative employment impact from about 2022 to 2050. The total change in employment between 2022 to 2050 is expected to decrease by 29,404. The average change in employment between 2022 to 2050 is estimated to decrease of 1,000 per year. CARB staff expects the change in employment due to the Proposed Amendments would represent no more than 0.01 percent decrease of baseline California employment in any year.

CARB staff's analysis predicts that as the requirements of the Proposed Amendments would go into effect, affected sectors would likely experience increases in production costs and hence slightly slower employment than they otherwise would experience under baseline conditions. The largest decrease in employment would manifest in the manufacturing, construction, transportation, and retail and wholesale trade sectors, which are estimated to realize an increase in production costs due to the increased HD vehicle prices driven by the Proposed Amendments.

CARB staff considered whether some California state fleets would be competitively advantaged or disadvantaged compared to out-of-state fleets involved in interstate transportation of goods. California emission standards would be more stringent than federal standards beginning with 2024 MY engines and, thus, California-certified vehicles would be slightly more expensive than federally certified vehicles, resulting in about a 0.5 to 9.9 percent increase in purchase price and about a 0.4 to 9.7 percent increase in net lifetime cost compared to federally certified vehicles. As a result, it is possible that California

fleets involved in interstate transport may be competitively disadvantaged compared to out-of-state fleets purchasing cheaper federally certified vehicles. However, because the cost per mile increase is expected to be small, \$0.02 per mile, compared to the amount charged to move freight, and because California and out-of-state fleets operating in California have the option of holding onto their existing vehicles slightly longer or purchasing used vehicles in-state or out-of-state in lieu of new vehicles in California, CARB staff is not certain whether such a competitive disadvantage would occur.

Overall, although the REMI analysis above gives CARB staff a general understanding of the expected impacts of the proposed Omnibus Regulation on California competitiveness, CARB staff concluded it is not possible to precisely quantify impacts on California competitiveness. CARB staff was unable to obtain complete information on business level responses to regulatory costs due to the highly competitive nature of the transportation industry. In addition, CARB staff searched the literature and concluded that empirical research focused on the impact of regulatory costs on HD vehicle and engine prices does not exist. A number of studies have explored the relationship between general cost increases and the likelihood of out-of-state or used vehicle and engine purchases. These studies found that there is a very wide range of estimates for how increased costs may impact purchasing behavior,<sup>180,181</sup> the estimates are highly uncertain, and that these estimates may change markedly in the span of only several years due to the dynamics of industry, and modern global economics.

- (i)vi.5. Comment: We ask the Board to instead direct staff to conduct a comprehensive study to assess the cost and market implications of these potential changes and compare those to the impacts of other alternatives that achieve the same objectives. (Cummins)

Agency Response: CARB staff did not make any changes to the Proposed Amendments or cost analysis in response to this comment because CARB staff has already done what the commenter suggested.

CARB staff considered two alternatives to the Omnibus Regulation.<sup>182</sup> Alternative 1 evaluated the feasibility and benefits of accelerating the timeline of the Regulation requirements by two years. Alternative 1 was primarily rejected because it is not feasible for the manufacturers to develop and certify engines

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<sup>180</sup>Amanda C. Askin, G. E. Barter, T. H. West, D. K. Manley, "The Heavy-Duty Vehicle Future in the United States: A Parametric Analysis of Technology and Policy Tradeoffs," *Energy Policy*, Volume 81, Science Direct, 2015. Pages 1-13, ISSN 0301-4215, <https://doi.org/10.1016/j.enpol.2015.02.005>.  
<https://www.sciencedirect.com/science/article/pii/S0301421515000683>

<sup>181</sup> Greene, David L., "TAFV Alternative Fuels and Vehicles Choice Model Documentation," Oak Ridge National Laboratory, July 2001.

<sup>182</sup> CARB. Public Hearing to Consider the Proposed Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments: Staff Report: ISOR, Table III-3 on p. III-8. January 23, 2020. Section X: Consideration of Alternatives in the ISOR.  
<https://ww2.arb.ca.gov/sites/default/files/classic/regact/2020/hdomnibuslownox/isor.pdf>

earlier than the schedule proposed by the Omnibus Regulation.<sup>183</sup> Alternative 2 considered by CARB staff was to work out an agreement with the engine manufacturers to produce less stringent but cleaner engines than produced today nationally and on a 2024 MY time schedule.<sup>184</sup> This alternative would have reduced costs to California fleets, albeit national fleets would have been impacted with higher engine prices, and would have produced greater environmental benefits but this alternative was rejected because of lack of assurance and the ability to enforcement a national agreement with the manufacturers as described in the Agency Response to Comments A.(i).12 to A.(i).13. CARB staff believes that the adoption of the proposed Omnibus Regulation requires the introduction of cleaner engine and emission aftertreatment technology as quickly as possible to obtain the needed emission reductions to improve air quality in California.

## **(j) Comments Related to Emissions and Health Benefits**

### **(j)i. State and District Attainment Goals**

- (j)i.1. Comment: Cost-effectiveness determinations also must take any corresponding benefits into account. In that regard, and as detailed below, CARB’s SRIA, like the ISOR, also fails to account in a reasonable manner for the benefits (and costs) of the Proposed Omnibus Regulations.

As an initial matter, since the proposed low-NOx standards and other Omnibus requirements will not take effect until the 2024 and 2027 MYs, they will not help to avoid the upcoming ozone-nonattainment determination for the SoCAB as of 2023 (additional ozone reductions of 108 tpd are still necessary by 2023 to reach attainment with the 80 parts per billion (ppb) ozone standard in the SoCAB). Moreover, as depicted in CARB’s ISOR, in order to meet the 75 ppb ozone standard in 2031, the SoCAB will require additional NOx reductions of 154 tpd, since the NOx “carrying capacity” in the SoCAB will drop from 141 tpd in 2023 to approximately 96 tpd in 2031. When that drop (45 tpd) is added to the 2023 shortfall of 108 tpd, the net result is that the SoCAB will need total additional NOx reductions of 153 tpd as of 2031. By comparison, the ISOR asserts that the projected NOx benefits from the Omnibus Regulations will be 23.2 tpd Statewide, and 7.0 tpd in the South Coast as of 2031. (Notice, p.12). (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. CARB staff disagrees with the

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<sup>183</sup> CARB. Public Hearing to Consider the Proposed Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments: [Staff Report](#); ISOR, Table III-3 on p. III-8. January 23, 2020. Section X.A: Alternative 1: Accelerated Timeline in the ISOR

<sup>184</sup> CARB. Public Hearing to Consider the Proposed Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments: [Staff Report](#); ISOR, Table III-3 on p. III-8. January 23, 2020. Section X.B: Alternative B: Voluntary National Program in the ISOR

commenter's assertion that since the Omnibus Regulation, by itself, will not achieve enough NOx reductions for SoCAB ozone attainment in 2023, the cost-effectiveness determinations in the SRIA are invalid. The Omnibus Regulation is part of a suite of measures in the SIP that will allow California to meet its air quality reduction goals. Some of the near-term emission reductions will be attained through a combination of current control programs, new proposed measures for on-road and off-road vehicles, and through the use of incentive programs. One current HD engine control measure noted to achieve significant near-term reductions is the Truck and Bus Regulation. In addition, accelerating the penetration of cleaner technologies, such as low-NOx trucks, through existing incentive programs would result in near-term emission reductions. Existing incentive programs include the Carl Moyer Program, Clean Vehicle Rebate Project, and Hybrid Truck and Bus Voucher Incentive Program. To advance zero-emission trucks, the recently adopted ACT Regulation will require vehicle manufacturers to sell a certain percentage of zero-emission trucks.

In the SRIA, CARB staff acknowledged that for MYs 2022 and 2023 the emission benefits are not expected to be significant because manufacturers need enough time to implement the requirements of the Omnibus Regulation. Insufficient lead time for implementation could cause engine manufacturers to stop selling product in the California market for several years and possibly extending the use of dirtier engine technology. Therefore, the Omnibus Regulation emission requirements are spaced several years apart, giving manufacturers time to develop and certify their emission control technology. In addition, the Omnibus Regulation is part of a suite of measures in the SIP, that in combination, will help SoCAB reach ozone attainment in 2031.

- (j)i.2. Comment: EMA's comments claim that CARB has taken no steps and has provided no evidence in the rulemaking record to demonstrate that its proposed Low-NOx Regulations will be effective at reducing ozone levels in the SoCAB.

More recently, Ramboll has assessed whether the recent significant COVID-related reductions in ozone-precursor emissions, specifically NOx, have led to actual corresponding reductions in ozone. As detailed in Ramboll's supplemental report (attached hereto as Exhibit "F.1",) notwithstanding NOx reductions of approximately 20% when comparing June 2019 with June 2020 (months that had similar meteorology), ozone levels were similar at the key "design value" monitoring in the SoCAB (and actually were slightly higher in downtown Los Angeles). Ramboll's supplemental analysis confirms that ozone levels in the SoCAB are, at best, currently unresponsive even to significant 20% reductions in ambient NOx levels, reductions that are well beyond those that could be achieved through implementation of the proposed Low-NOx Regulations.

Ramboll's analysis and findings confirm that the proposed Low-NOx Regulations likely will not be effective in reducing ozone levels in the SoCAB. Just as important, CARB has done nothing to establish any different conclusion. The complete lack of evidence of the actual efficacy of CARB's proposed Low-NOx Regulations is another factor establishing their invalidity. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB disagrees with this comment. The NOx reductions from the Omnibus Regulation are a subset of the emission reductions accounted for in the 2016 State Strategy for the State Implementation Plan (2016 State SIP Strategy).<sup>185</sup> The 2016 State SIP Strategy has sufficiently large NOx and volatile organic compound (VOC) reductions to meet the ozone levels needed in the SoCAB as demonstrated by the model simulations in 2016 Air Quality Management Plan of SCAQMD.<sup>186 187</sup>

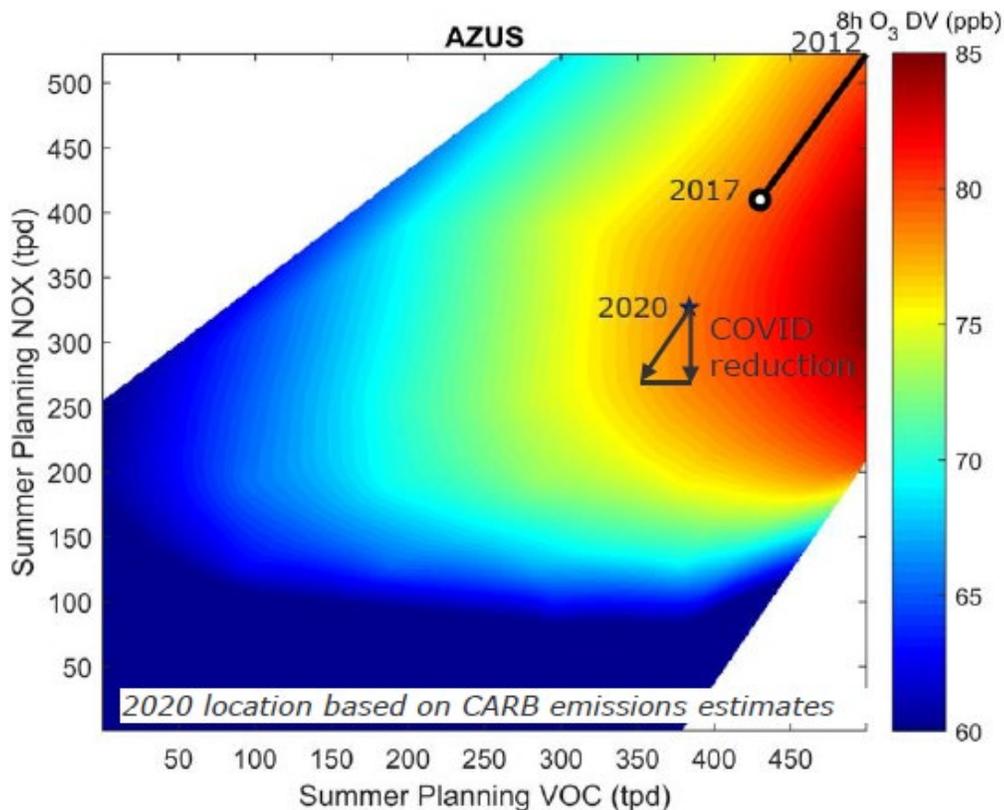
Contrary to the EMA's claim, Ramboll's preliminary analysis presented in Exhibit F.1 supports the need for strategic reduction in both NOx and VOC emissions as targeted in the 2016 State SIP Strategy. As shown in the ozone isopleth plot presented by Ramboll, copied below as Figure IV.A.(j)i.2.1, reduction in NOx emissions alone in a VOC-limited region can result in no change or a slight increase in ozone. For example, the vertical arrow represented as "COVID reduction" where significant reduction of NOx emissions occurred due to reduced traffic without significant reduction in VOC emissions would result in little change in the ozone concentration represented by the color scale. That is why VOC controls must accompany NOx controls in VOC-limited regions in order to reduce ozone and nitrate PM emissions while avoiding the NOx disbenefit (i.e., increase in ozone).

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<sup>185</sup> CARB. [2016 State Strategy for the State Implementation Plan for Federal Ozone and PM2.5 Standards](#) (State SIP Strategy). March 7, 2017

<sup>186</sup> "Final 2016 Air Quality Management Plan," South Coast Air Quality Management District, March 2017. <https://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2016-air-quality-management-plan/final-2016-aqmp/final2016aqmp.pdf?sfvrsn=15>

<sup>187</sup> "Final 2016 Air Quality Management Plan, Appendix V: Modeling & Attainment Demonstrations," South Coast Air Quality Management District, March 2017. <https://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2016-air-quality-management-plan/final-2016-aqmp/appendix-v.pdf?sfvrsn=10>



**Figure IV.A.(j)i.2.1 Ozone isopleth plot for Azusa (Copied from EMA’s comment Exhibit F.1)**

Since the 2016 State SIP Strategy contains a wide range of measures primarily targeting NOx (e.g., the Omnibus Regulation) and VOC (e.g., Consumer Product Regulations) emissions, the 2016 State SIP Strategy as a whole is designed to reduce ozone throughout the SoCAB.<sup>188</sup> <sup>189</sup> In other words, one cannot isolate the effects of NOx-focused regulations on ozone without holistically accounting for the overall reduction in NOx and VOC emissions through various control measures contained in the 2016 State SIP Strategy.

A recent study about the impacts of traffic reductions associated with the COVID-19 pandemic on air quality in the SoCAB reported that NOx declined by approximately 27 percent whereas concentrations of ozone showed inconsistent changes across the SoCAB; ozone concentrations decreased in the western part

<sup>188</sup> “Final 2016 Air Quality Management Plan,” South Coast Air Quality Management District, March 2017. <https://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2016-air-quality-management-plan/final-2016-aqmp/final2016aqmp.pdf?sfvrsn=15>

<sup>189</sup> “Final 2016 Air Quality Management Plan, Appendix V: Modeling & Attainment Demonstrations,” South Coast Air Quality Management District, March 2017. <https://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2016-air-quality-management-plan/final-2016-aqmp/appendix-v.pdf?sfvrsn=10>

of the SoCAB and generally increased in the downwind areas.<sup>190</sup> Although the extent of VOC emission reduction during the time period is less certain, it is thought to be minor as on-road vehicles account for only about one fourth of the total VOC emissions in the SoCAB. The study concluded that additional reductions of VOC emissions from area and non-mobile sources in combination with NOx reduction from mobile sources are needed, which is consistent with the 2016 State SIP strategy as discussed above.

Finally, it should be noted that the benefits of NOx emission reductions are not limited to a reduction in ozone formation. Nitrate PM is produced through the oxidation of NOx. Therefore, we have to reduce NOx emissions to further control PM emissions. The health benefit calculations in the Omnibus Regulation ISOR estimate that 3,900 premature deaths and 3,150 hospitalizations could be avoided as a result of reducing nitrate PM formation based on CARB's proposal. NOx is a key precursor not only of ozone and PM, but also other compounds with health and environmental concerns. These include nitrogen dioxide (NO<sub>2</sub>), nitric acid, nitrous acid, peroxyacetylnitrate, nitro-polycyclic aromatic HC, regional haze, and nitrate deposition with subsequent fertilization and eutrophication of soils and surface waters. Many studies indicate that PM, in particular, but also NO<sub>2</sub>, nitric acid, and other nitrogen-containing pollutants have adverse health impacts, sometimes even greater than ozone episodes. Therefore, NOx control is also important for the large health benefits from reductions in other NOx-related pollutants.

- (j)i.3. Comment: In the Bay Area, diesel PM from HD trucks disproportionately impacts low income communities and communities of color. Additionally, studies have shown that these communities are those that are most vulnerable to the effects of climate change. The BAAQMD believes that the best way to address emissions from trucks is to aggressively pursue the deployment of ZEVs. (BAAQMD)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. CARB staff does not dispute the points made by the commenter regarding the communities affected by HD truck diesel PM and climate change. The Board approved the Omnibus Regulation, including provisions for ZEV manufacturers to get emission credits for producing and selling ZEVs in California. Further, the Board had previously approved the ACT Regulation which accelerate the use of ZEVs in the medium- and HD vehicle sectors and puts California on the path for a ZEV fleet. Putting these regulations in place now allows manufacturers time to develop robust products for the market, build out manufacturing facilities, and have infrastructure in place ensuring the transition to ZEVs will be rapid and successful. During the transition from vehicles with combustion engines to ZEVs, it is necessary to introduce more

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<sup>190</sup> "Impacts of Traffic Reductions Associated With COVID-19 on Southern California Air Quality," Parker, H. A., Hasheminassab, S., Crouse, J. D., Roehl, C. M., Wennberg, P. O., Geophysical Research Letters 2020, 47, (23), e2020GL090164.

stringent standards on combustion engines to help mitigate their criteria emissions impacts. Also, these same engines are subject to Phase 2 GHG requirements, which further drives down climate emissions out through the 2027 MY engines. These two programs will improve air quality, especially in disadvantaged communities and throughout California as we transition to sustainable and inherently clean ZEVs.

- (j)i.4. Comment: In fact, the AB 617 plan adopted by this Board, for the West Oakland community requires significant emissions reductions from drayage and on-road trucks as early as 2025 in order to meet community health goals. Therefore, it makes little sense to us that you're delaying the implementation of more aggressive standards for trucks that will support the deployment of cleaner equipment in communities like West Oakland. And we would request that you consider imposing lower NOx standards in the pre-2024 time frame. (BAAQMD)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. To address immediate and near-term vehicle emission reductions, CARB staff has been implementing various HD emission control programs. One such program, the Truck and Bus Regulation, requires replacing older high polluting HD vehicles with new lower-emitting vehicles, resulting in significant emission reductions from this sector. Another program, the Air Quality Improvement Program, reduces emissions through voluntary incentive measures such as the Clean Vehicle Rebate Project, truck and bus vouchers, and the Truck Loan Assistance Program.

In addition, CARB staff is currently developing the HD I/M program. This program would ensure that emission control systems on HD vehicles are properly functioning and remain low-emitting throughout their entire operating life. CARB staff's HD I/M rulemaking is tentatively scheduled to go before the Board at the end of 2021, with a proposed start to implementation in 2023.

Many of the proposed reduction measures adopted in the West Oakland Community Action Plan that are under CARB jurisdiction are scheduled to be in the implementation phase until 2024. The step 1 (first phase) Proposed Amendments are implemented in 2022 which is the earliest that HD manufacturers can achieve changes to their engines and certify engines to the Omnibus Regulation standards. Therefore, the Omnibus Regulation standards cannot be implemented any earlier than the current schedule and some of the Proposed Amendments will be implemented two years before many of the West Oakland Community Action Plan measures are implemented, as explained in more detail in the Agency Response to Comment A.(j)i.1.

- (j)i.5. Comment: [T]he Valley Air District recommends that CARB consider additional measures and incentives for achieving the near-term fleet turnover and emissions reductions required to meet the air quality and public health

goals of the San Joaquin Valley. Adopting new emissions standards is an essential component of CARB's strategy to significantly reduce emissions in the San Joaquin Valley and protect public health by reducing pollution from the operation of HD trucks. Given currently available and rapidly developing zero and near-zero HD truck technologies, the Valley Air District urges CARB to adopt an Omnibus package that identifies additional regulatory and incentive-based opportunities for accelerating fleet turnover in a manner that is most broadly and expeditiously achievable by fleets that operate in the San Joaquin Valley and California. In addition to the proposed Omnibus regulatory package, CARB's commitment to develop and adopt a new HD I/M program that takes advantage of the latest on-board diagnostics technologies will also be crucial to the Valley's air quality attainment efforts. (SJVAPCD)

- (j)i.6. Comment: One of the most important sectors of emissions in our region and throughout California is heavy-duty trucking. And our new PM plan is clear in calling for significant new reductions through aggressive State commitments to significantly reduce emissions from trucks. This commitment includes a new California truck standard combined with an aggressive strategy to replace nearly 33,000 additional heavy-duty trucks, primarily with near zero-emissions technology, with these important reductions happening by the near term federal deadline of 2024.

We're concerned that the current proposal falls short of the State's commitments to reduce air pollution in valley communities in that short time frame. While we support the proposed establishment of new standards that will no doubt help the San Joaquin Valley, our comment letter does include some recommendations for your consideration, in the spirit of accelerating of emissions reductions, including advancing key dates for regulatory and optional standards, increase the incentive-funding opportunities, and considering additional approaches for establishing effective regulatory incentives. In short, we need reductions sooner. (SJVAPCD)

Agency Response to Comments (j)i.5 and (j)i.6: CARB staff did make changes to the Proposed Amendments based on these comments. In the 30-Day Notice Amendments, CARB staff modified the original proposal to include a new Optional Low NOx standard of 0.010 g/bhp-hr two years earlier, from MY 2024 to MY 2022 engines. This action will further encourage the accelerated development of cleaner engines and provide further incentive funding support for these cleaner engines.

To accelerate the fleet turnover, the Omnibus Regulation has a provision that can be found in Chapter III, section A.7 of the ISOR which describes a California-only credit pool (i.e., CA-ABT). Starting with MY 2022 an incentive for manufacturers to produce and certify HD ZEVs to generate NOx credits will be provided. The CA-ABT will incentivize the sales of HD ZEVs earlier than would be required by CARB's adopted ACT Regulation. In addition, certain provisions of the Omnibus

Regulation will complement the ACT Regulation by ensuring that the portions of manufacturers' internal combustion engine families will be emitting at the lowest possible NOx emission standard as soon as possible. Another incentive mechanism in the Omnibus Regulation for early introduction of cleaner-than-required HD engines is the Early Compliance Credit Multipliers. Engine manufacturers would have an opportunity to accumulate larger amounts of emission credits by producing HD engines that meet future MY requirements.

Another adopted CARB regulation is the Truck and Bus Regulation, which requires fleets to replace older engine technology with newer cleaner engine technology by 2023.

In addition, CARB staff is currently developing another near-term reduction program, a comprehensive HD I/M program that would ensure emission control systems on HD vehicles are properly functioning and remain low-emitting throughout their operating life. CARB staff's proposal to the Board is tentatively scheduled for the end of 2021 with a proposed implementation in 2023.

A commenter stated that their agency has an aggressive mobile source PM reduction strategy. CARB staff has also included in the Omnibus Regulation a more stringent HD engine PM standard of 0.005 g/bhp-hr that ensures manufacturers continue to use the most efficient PM control technology for 2024 and subsequent MY engines. Further, reducing NOx, as the Omnibus Regulation does, provides secondary PM reduction benefits. Nitrate PM is produced through the oxidation of NOx in the atmosphere. Therefore, reducing NOx emissions will reduce secondary PM formation in the atmosphere. Overall, CARB staff believes that the Omnibus Regulation, along with other measures outlined in the SIP, will help air quality agencies meet their ozone and PM emission reductions goals.

In comment A.(j)i.6 above, the commenter mentions that they have made recommendations regarding accelerating emission reductions, changing regulatory compliance dates, and improving incentive funding and opportunities. Since CARB staff has not integrated the commenter's recommendations, the commenter believes that the Omnibus Regulation "falls short." CARB staff has addressed these recommendations in the Agency Responses to Comments in A.(a)xii.2, A.(e)vii.1, and A.(l)vi.8.

- (j)i.7. Comment: Unless California starts requiring the purchase of low-NOx trucks today, we will miss our near-term State and federal attainment goals, fall short of our 2031 State and federal attainment goals, and fall short of the Governor's public goal of removing diesel trucks from California roads by 2030. So, what is CARB doing about clean air in the next seven years? The Western Propane Gas Association appreciates your work in the area, and hopes the Board will amend the Regulation, so that near-term emission reductions are achieved now and well before 2027. (WPGA)

- (j)i.8. Comment: The proposed regulation will not drive early adoption of low-NOx trucks... We request amendments to the regulation, so near-term emissions reductions are achieved now and well before the year 2027. (Clean Energy)

Agency Response to Comments (j)i.7 and (j)i.8: No change was made in response to these comments. The Proposed Amendments fulfill one of the most important HD engine measures in CARB's SIP by requiring low NOx certification standards and other requirements for new HDEs, but this measure was not expected to achieve significant near-term emission reductions. However, to achieve some additional near-term emission reductions, CARB staff proposed optional provisions to encourage early production of cleaner-than-required engines through the generation of NOx credits as well as credit multipliers in the CA-ABT program. For additional information on the credit generation and credit multipliers, please see the Agency Response to Comments A.(l)iii.9 and A.(l)iii.10.

In the SIP, near-term reductions are envisioned to be achieved through a combination of current control programs and new proposed measures for on-road light-duty vehicles, on-road HD vehicles, and off-road sources. One current HD engine control measure noted to achieve significant near-term reductions is the Truck and Bus Regulation. In addition, accelerating the penetration of cleaner technologies, such as low-NOx trucks, through existing incentive programs is expected to result in large near-term emission reductions. Existing incentive programs include the Carl Moyer Program, Clean Vehicle Rebate Project, and Hybrid Truck and Bus Voucher Incentive Program. To advance zero-emission trucks, the recently adopted ACT Regulation will require vehicle manufacturers to sell a certain percentage of zero-emission trucks. Finally, CARB staff is developing the Advanced Clean Fleets Regulation, to require large fleets to purchase zero-emission trucks.<sup>191</sup>

- (j)i.9. Comment: With the 2016 Mobile Source Strategy calling for 900,000 low NOx trucks on California's roads by 2030, the proposed regulation will not come close to meeting this goal, while the documentation thus far released by CARB for the 2020 update to the Mobile Source Strategy does not include any reference to this goal. Put another way, unless California starts requiring the purchase of low NOx trucks today, we will miss our near-term state and federal attainment goals, fall short of our 2031 state and federal attainment goals, and fall short of the Governor's public goal of removing diesel trucks from California's roads by 2030. (LNC, AFS)

Agency Response: No change was made in response to the comment. In the 2016 Mobile Source Strategy, the Cleaner Fuels and Technologies scenario highlighted a mix of cleaner technologies, low-carbon fuels, and vehicle efficiencies that promote the transformation of California's transportation system.

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<sup>191</sup> Parties interested can follow regulatory developments and the public process of the Advanced Clean Fleets rulemaking here: [Advanced Clean Fleets | California Air Resources Board](#)

Although not intended to be a specific forecast of the future, one scenario modeled for on-road fleet transformation included 900,000 low NOx trucks by 2030.

Produced almost five years later, the 2020 Mobile Source Strategy provided an update of the adopted control measures, those in progress, and those still to be adopted. In particular, HD vehicle measures were updated to reflect the Omnibus, ACT, and HD I/M Regulations starting in 2024 and the federal 0.02 g/bhp-hr NOx standard starting in 2027; 100 percent of MY 2035 and newer vehicles registered in California would be ZEV, where feasible; and the accelerated turnover of older trucks. These HD strategies along with incentive programs to promote and accelerate the use of clean technologies along with measures in the light-duty and off-road sectors will enable the State to achieve the technology trajectories identified through scenario planning and, consequently, meet California's air quality goals.

- (j)i.10. Comment: The package before you falls short of what the San Joaquin Valley needs and fails to allow clean low NOx natural gas fleets from being all-in to deliver near-term emissions reductions. (Clean Fleets)

Agency Response: No change was made in response to this comment. Since the Proposed Amendments apply to new HDEs rather than to in-use HDEs, the near-term emission reductions projected for the Proposed Amendments will be limited in the near-term while emission reductions in 2031 and 2050 are projected to be significant. For near-term emission reductions, the 2020 Mobile Source Strategy highlights the necessity for incentive programs to promote and accelerate the use of clean technologies to meet the state's pre-2030 air quality goals and set the state on the trajectory to attain future goals.<sup>192</sup>

Finally, the commenter's assertion that the Omnibus Regulation "fails to allow clean low NOx NG fleets from being all-in to deliver near-term emissions reductions" is not factual. The Proposed Amendments are manufacturer requirements rather than an in-use fleet requirement and hence do nothing to disallow clean low NOx NG fleets from any action.

- (j)i.11. Comment: The ACT presentation in June on slide 16 tells the same story. There will be very little reductions prior to 2031. So, what does that mean for attainment in 2023, 2024 and 2030 -- and as far as 2031, if benefits of both of these rules happen after that? More importantly, what does that mean for community health for the rest of this decade? Based on recent Board discussions, we had hoped that the Omnibus Regulation was going to achieve near-term -- significant near-term reductions, but that's not the case and it leaves me asking what efforts will reduce truck emissions this decade and what efforts will reduce health impacts from truck emissions this decade.

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<sup>192</sup> CARB. Revised Draft 2020 Mobile Source Strategy. April 23, 2021.  
[https://ww2.arb.ca.gov/sites/default/files/2021-04/Revised\\_Draft\\_2020\\_Mobile\\_Source\\_Strategy.pdf](https://ww2.arb.ca.gov/sites/default/files/2021-04/Revised_Draft_2020_Mobile_Source_Strategy.pdf), 2021.

We would like to see some consideration for near-term reductions from trucks. (SoCalGas)

- (j)i.12. Comment: As the staff presentation noted, a lot of these reductions don't materialize till 2031, which is a long time from now to wait for some reductions. (CNGVC)
- (j)i.13. Comment: At the June Board hearing, our industry was assured that the Omnibus Rule would accelerate ultra low-NOx trucks that meet a 0.02 gram standard in the near term. Unfortunately, we disagree. The proposed regulation does not and will not accomplish near-term emissions reductions as drafted. In fact, staff's projected NOx emissions from this regulation delivers literally zero NOx tpd between now and 2023, despite an ozone deadline for regional air districts. In 2024, both the South Coast and the San Joaquin Valley will each achieve a paltry 0.1 tpd, which may explain why staff chose to highlight the benefits of the rule in 2031. (Clean Energy)
- (j)i.14. Comment: The first major ozone deadline under the federal Clean Air Act is January 1, 2023, and yet the Staff Report focuses on the 2031 Ozone Standard as if the first deadline is nonexistent. (AFS, LNC)
- (j)i.15. Comment: [I]f you look at the emission benefits table in the presentation, first off, it ignores 2023 and 2024 attainment dates completely, which is troubling. But also your staff's own analysis shows that most of the emission reductions happen after 2031. (SoCalGas)
- (j)i.16. Comment: California faces particularly extreme ozone attainment challenges in the South Coast and San Joaquin Air Basins. The first major ozone deadline under the federal Clean Air Act is January 1st, 2023, and yet the regulation focuses on the 2031 ozone standard, as if the first deadline is non-existent. (WPGA)
- (j)i.17. Comment: While representing critically important steps, the collective set of rules, together with ACT rules, will likely still not be enough to fill the shortfall in emissions reductions needed to fully achieve SIP and climate goals. More work on this remains. (CEERT)

Agency Response to Comments (j)i.11 through (j)i.17: No change was made in response to these comments. Also, please see Agency Response to Comments A.(j)i.7 and A.(j)i.8. California's strategy to meet the federal NAAQS is laid out in CARB's 2016 SIP, California's official and legally binding plan of air quality measures. The Proposed Amendments constitute one of the most significant measures in the SIP, responsible for nearly half of the entire NOx emission reduction commitment in the entire plan, 52 tpd out of 111 total tpd NOx, in SoCAB in 2031. Therefore, the Proposed Amendments are a critical component

of California's strategy to achieve California's air quality goals, attain the NAAQS, and protect the health and well-being of Californians.

As adopted by the Board, the Proposed Amendments apply to new HDEs that will be produced and sold by engine manufacturers. Sufficient lead time for the implementation of the new low NOx certification requirements is necessary for manufacturers to design, test, and certify emission control technologies on their engines. Emission benefits will occur as the fleet turns over to the new low NOx engines, and thus near-term reductions will be limited, as acknowledged in Chapter VI of the ISOR. Thus, the SIP did not assign significant near-term emission benefits to the Proposed Amendments but rather estimated large benefits in the 2031 and later timeframe.

For near-term emission reductions and 2023 attainment deadlines, the SIP identified a number of current control programs and new proposed measures for on-road light-duty vehicles, on-road HD vehicles, and off-road sources. In particular, a large portion of near-term emission reductions was expected to be achieved by further deployment of cleaner technologies, such as through incentive programs to accelerate the penetration of clean technologies. Existing California incentive programs described in the SIP include the Carl Moyer Program, Clean Vehicle Rebate Project, Enhanced Vehicle Modernization Program, Hybrid Truck and Bus Voucher Incentive Program, the Low Carbon Transportation Investments, and the California Energy Commissions Alternative and Renewable Fuel and Vehicle Technology Program. Through these programs, California has provided over \$3 billion in incentives and funding over the years to encourage cleaner technologies, demonstrating our commitment to near-term emission reductions.

Comments regarding the ACT Regulation and the ACT June Board Hearing are beyond the scope of the Proposed Amendments.

#### **(j)ii. Other Comments**

- (j)ii.1. Comment: Appendix "E" of the ISOR explains that CARB has opted to use a simplified (and unspecified) "incident-per-ton (IPT)" method to calculate avoided incidences of cardiopulmonary mortality due to exposure to secondary PM2.5 (ammonium nitrate (NH4NO3)), and that the IPT method is premised on the core assumption (unproven) that "changes in [secondary PM2.5] emissions are approximately proportional to changes in health outcomes," even at the current statewide ambient levels of PM2.5. CARB also assumes that it is appropriate to utilize 95<sup>th</sup>-percentile confidence intervals.

CARB offers no support in the ISOR or the SRIA for those core assumptions. Nor does CARB specify, among other things: (i) the amount of assumed year-by-year reductions in secondary PM2.5 that will result from the

implementation of the Omnibus Regulations; (ii) whether those assumed year-by-year reductions in secondary PM2.5 take into account the impacts of any pre-buy/no-buy response to the Omnibus Regulations, or the impacts of the Truck and Bus Rule and the ACT Rule; (iii) the specific epidemiological studies on which CARB is relying to calculate a C-R function or relative risk (R-R) function for secondary PM2.5, and why those specific studies were selected; (iv) the quantitative risk factors (QRF) derived from the C-R or R-R functions, and how those QRFs were derived; (v) whether any adjustments were made to the QRF- or R-R-derived incidences of cardiopulmonary mortality to account for any differences in the PM2.5 exposure levels experienced by the epi-study populations, on the one hand, and the prevailing and projected levels of ambient secondary PM2.5 in California from and after 2024, on the other; and (vi) the range of uncertainties that relate to any derived QRFs or R-Rs, and to any derived mortality estimates, and how those uncertainties were accounted for CARB provides none of those necessary assumptions and background information in the ISOR or in the SRIA, which makes it impossible to conduct any reasonable review of the validity of CARB's "simplified" health-benefits methods and calculations.

Notwithstanding those substantive omissions, CARB does concede that it did not take into account most of the key uncertainties that impact the scaling and quantification of health benefits (including the interpolation and estimation of exposures to secondary PM2.5, socioeconomic status, and smoking rates), such that "the reported uncertainty ranges in [the reported] health impacts understate the true uncertainty." (ISOR, Append. "E," p. 2.) CARB's health benefits analysis is therefore inherently unsupported and suspect, and wholly insufficient to support this rulemaking, as further revealed by the comprehensive analysis that NERA has conducted regarding the likely range of quantified health benefits that could result from the type of HDOH Low-NOx Regulations at issue. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments, emissions modeling, or health benefits modeling based on this comment. In response to the comment that "the IPT method is premised on the core assumption (unproven) that "changes in [secondary PM2.5] emissions are approximately proportional to changes in health outcomes," even at the current statewide ambient levels of PM2.5," CARB staff would like to explain the health benefits methodology that was used to estimate health benefits for the Omnibus Regulation and to point to references listed in the ISOR. As described in Appendix E, CARB staff used the IPT methodology to evaluate the Low NOx Omnibus Regulation to estimate health benefits, a method that has been used previously for numerous regulations. CARB's IPT methodology was developed through a public process in 2010 and, as discussed in the Omnibus ISOR, is described further in CARB's ISOR for the Truck and Bus Regulation adopted in

the same year.<sup>193</sup> As discussed in the Omnibus Regulation ISOR, CARB uses the IPT methodology for estimating the health benefits from changes in emissions.<sup>194</sup> As discussed in the Omnibus ISOR, the IPT method is based on an approach developed by U.S. EPA.<sup>195,196,197</sup> This method is used to estimate benefits of reduction in primary PM<sub>2.5</sub> emitted directly from sources, and secondary PM<sub>2.5</sub> NH<sub>4</sub>NO<sub>3</sub> formed from NO<sub>x</sub>, when modeled concentrations are not estimated. Using this approach, the relationship between changes in emissions and changes in health outcomes is assumed to be approximately proportional, and this is described in the aforementioned Truck and Bus Regulation ISOR as well as in CARB’s methodology documentation.<sup>193,194</sup>

In response to the comment about what are the “assumed year-by-year reductions in secondary PM<sub>2.5</sub> that will result from the implementation of the Omnibus Regulations,” CARB staff would like to provide a little more detail on the IPT methodology. NO<sub>x</sub> emissions are a precursor to the formation of secondary PM<sub>2.5</sub> including NH<sub>4</sub>NO<sub>3</sub>. For the IPT methodology, CARB staff uses year-by-year NO<sub>x</sub> emission to estimate health impacts related to the formation of secondary PM for regulatory scenarios, when year-by-year modeled concentrations are not estimated.

For comments on pre-buy/no-buy and ACT rulemaking analysis, see the Agency Response to Comment A.(i)iii.5 and Comment A.(i)ii.9.

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<sup>193</sup> Appendix J: Methodology for Estimating Ambient Concentrations of Particulate Matter from Diesel-Fueled Engine Emissions And Health Benefits Associated with Reductions in Diesel PM Emissions from In-Use On-Road Heavy-Duty Diesel-Fueled Vehicles for the Rulemaking: “Proposed Amendments to the Truck and Bus Regulation, the Drayage Truck Regulation and the Tractor-Trailer Greenhouse Gas Regulation” California Air Resources Board, November 9, 2010.

<https://ww3.arb.ca.gov/regact/2010/truckbus10/correctedappj.pdf>; Note that this reference was included as reference (CARB,2010b) to APPENDIX C-1: STANDARDIZED REGULATORY IMPACT ASSESSMENT REFERENCES within the Omnibus ISOR.

<sup>194</sup> Estimating the Health Benefits of Reductions in Emissions of PM<sub>2.5</sub> or its Precursors: Short Description, California Air Resources Board, accessed March 9, 2020.

<https://ww2.arb.ca.gov/resources/documents/estimating-health-benefits-reductions-emissions-pm25-or-its-precursors-short>; Note that this reference was included as reference (CARB, 2020b) to APPENDIX E: HEALTH BENEFITS ANALYSIS REFERENCES to the Omnibus ISOR.

<sup>195</sup> “The influence of location, source, and emission type in estimates of the human health benefits of reducing a ton of air pollution,” Neal Fann, Charles M. Fulcher, and Bryan J. Hubbell, *Air Quality, Atmosphere & Health*, Volume 2, June 9, 2009, Pages 169–176. <https://doi.org/10.1007/s11869-009-0044-0>; Note that this reference was included as reference (Fann et al., 2009) to APPENDIX E: HEALTH BENEFITS ANALYSIS REFERENCES to the Omnibus ISOR.

<sup>196</sup> “Characterizing the PM<sub>2.5</sub>-related health benefits of emission reductions for 17 industrial, area and mobile emission sectors across the U.S.,” Neal Fann, Kirk R. Baker & Charles M. Fulcher, *Environment International*, Volume 49, November 15, 2012, pages 141-151, ISSN 0160-4120. <http://dx.doi.org/10.1016/j.envint.2012.08.017>; Note that this reference was included as reference (Fann et al., 2012) to APPENDIX E: HEALTH BENEFITS ANALYSIS REFERENCES to the Omnibus ISOR.

<sup>197</sup> “Assessing Human Health PM<sub>2.5</sub> and Ozone Impacts from U.S. Oil and Natural Gas Sector Emissions in 2025,” Neal Fann, Kirk R. Baker, Elizabeth A. W. Chan, Alison Eyth, Alexander Macpherson, Elizabeth Miller, Jennifer Snyder, *Environ. Sci. Technol.*, July 13, 2018, 52 (15), Pages 8095–8103. <https://doi.org/10.1021/acs.est.8b02050>; Note that this reference was included as reference (Fann et al., 2018) to APPENDIX E: HEALTH BENEFITS ANALYSIS REFERENCES to the Omnibus ISOR.

In response to the comment about what are “the specific epidemiological studies on which CARB is relying to calculate a C-R function or R-R function for secondary PM<sub>2.5</sub>, and why those specific studies were selected,” the epidemiological studies that CARB staff uses are listed in CARB document, “Estimating Health Benefits Associated with Reductions in PM and NO<sub>x</sub> Emissions: Detailed Description.”<sup>198</sup> This document is accessible from the webpage listed as reference #3 in the Omnibus ISOR’s section “XIII. References: E. Appendix E: Health Benefits Analysis References.” As discussed in the Omnibus Regulation ISOR, the epidemiological studies that CARB used were used by U.S. EPA for their 2010 “Quantitative Health Risk Assessment for Particulate Matter” (EPA-452/R-10-005).<sup>199</sup> In CARB’s document, it says, “For premature mortality, CARB uses the cardiopulmonary mortality risk coefficient for the 1999-2000 time period from Krewski et al., 2009, among the largest studies of its kind, with 360,000 participants. For cardiovascular and respiratory hospitalizations, CARB used Bell et al., 2008, and for emergency room visits for asthma CARB used Ito et al., 2007.”<sup>200,201,202</sup>

In response to the comment about what are the “QRF derived from the C-R or R-R functions,” CARB staff used C-R function coefficients derived from the three aforementioned studies, which are described by the U.S. EPA in their 2010 “Quantitative Health Risk Assessment for Particulate Matter” (EPA-452/R-10-005).<sup>198</sup> Specifically, the coefficients used were as follows: 0.01293 for cardiopulmonary mortality from Krewski et al., 2009, 0.00053 for cardiovascular hospitalizations from Bell et al., 2008, 0.00094 for respiratory hospitalizations from Bell et al., 2008, and 0.00453 for asthma emergency room visits from Ito et al., 2007.

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<sup>198</sup> “Estimating Health Benefits Associated with Reductions in PM and NO<sub>x</sub> Emissions: Detailed Description,” California Air Resources Board. <https://ww2.arb.ca.gov/sites/default/files/2019-08/Estimating%20the%20Health%20Benefits%20Associated%20with%20Reductions%20in%20PM%20and%20NOX%20Emissions%20-%20Detailed%20Description.pdf>

<sup>199</sup> Quantitative Health Risk Assessment for Particulate Matter (EPA-452/R-10-005). Research Triangle Park, North Carolina. (website: [https://www3.epa.gov/ttn/naaqs/standards/pm/data/PM\\_RA\\_FINAL\\_June\\_2010.pdf](https://www3.epa.gov/ttn/naaqs/standards/pm/data/PM_RA_FINAL_June_2010.pdf)); Note that this reference was included as reference (U.S. EPA, 2010) to the Omnibus ISOR.

<sup>200</sup> Krewski, D., M. Jerrett, R. T. Burnett, R. Ma, E. Hughes, Y. Shi, M. C. Turner, C. A. Pope, 3rd, G. Thurston, E. E. Calle, M. J. Thun, B. Beckerman, P. DeLuca, N. Finkelstein, K. Ito, D. K. Moore, K. B. Newbold, T. Ramsay, Z. Ross, H. Shin and B. Tempalski (2009). “Extended follow-up and spatial analysis of the American Cancer Society study linking particulate air pollution and mortality.” *Res Rep Health Eff Inst*(140): 5-114; discussion 115-136.

<sup>201</sup> Bell ML, Ebisu K, Peng RD, Walker J, Samet JM, Zeger SL, Dominici F. Seasonal and regional short-term effects of fine particles on hospital admissions in 202 US counties, 1999-2005. *Am J Epidemiol*. 2008 Dec 1;168(11):1301-10. doi: 10.1093/aje/kwn252. Epub 2008 Oct 14. PMID: 18854492; PMCID: PMC2732959.

<sup>202</sup> Ito K, Thurston GD, Silverman RA. Characterization of PM<sub>2.5</sub>, gaseous pollutants, and meteorological interactions in the context of time-series health effects models. *J Expo Sci Environ Epidemiol*. 2007 Dec;17 Suppl 2:S45-60. doi: 10.1038/sj.jes.7500627. PMID: 18079764.

In response to the comment about “whether any adjustments were made to the QRF- or R-R-derived incidences of cardiopulmonary mortality to account for any differences in the PM<sub>2.5</sub> exposure levels experienced by the epi-study populations, on the one hand, and the prevailing and projected levels of ambient secondary PM<sub>2.5</sub> in California from and after 2024, on the other,” CARB staff utilized California-specific baseline incidence rates for mortality as well as California-specific pollutant concentrations in the C-R functions that were used to estimate the baseline scenario for the IPT method. As described earlier, for future years beyond the baseline scenario, CARB staff did not estimate the ambient concentrations of secondary PM<sub>2.5</sub> but used the well-established IPT method to relate changes in emissions to changes in health outcomes.

In response to the comment that CARB staff uses “95th-percentile confidence intervals,” this statement is incorrect. Rather, CARB staff uses 95 *percent* confidence intervals as the lower and upper bound estimates for our analysis. It is common practice to report this statistic in health benefits analyses, which provides a range of possible health benefit estimates. In fact, as mentioned by Fann et al. (2009), which was footnoted earlier, “A comprehensive benefits analysis frequently reports confidence intervals around the mean incidence and valuation estimates.”<sup>195</sup> For instance, U.S. EPA reported 95 percent confidence intervals for their mortality and morbidity estimates in their 2010 “Quantitative Health Risk Assessment for Particulate Matter” (EPA-452/R-10-005) and in their 2020 “Policy Assessment for the Review of the National Ambient Air Quality Standards for Particulate Matter” (EPA-452/R-20-002).<sup>198, 203</sup> CARB staff’s use of 95 percent confidence intervals also relates to the comment about what are “the range of uncertainties that relate to any derived QRFs or R-Rs, and to any derived mortality estimates, and how those uncertainties were accounted for” since the 95 percent confidence intervals provide the lower and upper bound estimates for our analysis.

In response to the comment that “CARB does concede that it did not take into account most of the key uncertainties that impact the scaling and quantification of health benefits (including the interpolation and estimation of exposures to secondary PM<sub>2.5</sub>, socioeconomic status, and smoking rates), such that “the reported uncertainty ranges in [the reported] health impacts understate the true uncertainty,” CARB staff has utilized up-to-date information available at the time of the analysis but has acknowledged that there are uncertainties in the health impact estimates. Uncertainties are inherent in these types of analyses, as described by US EPA in their 2010 “Quantitative Health Risk Assessment for Particulate Matter” (EPA-452/R-10-005).<sup>198</sup> CARB staff has acknowledged the presence of uncertainties in our analysis by (1) providing our estimates with 95 percent confidence intervals, which takes into account the uncertainty of the

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<sup>203</sup> Policy Assessment for the Review of the National Ambient Air Quality Standards for Particulate Matter (EPA-452/R-20-002). Research Triangle Park, North Carolina. (website: [https://www.epa.gov/sites/production/files/2020-01/documents/final\\_policy\\_assessment\\_for\\_the\\_review\\_of\\_the\\_pm\\_naaqs\\_01-2020.pdf](https://www.epa.gov/sites/production/files/2020-01/documents/final_policy_assessment_for_the_review_of_the_pm_naaqs_01-2020.pdf))

R-R, and (2) qualitatively describing some of the other uncertainties in Appendix E and in the aforementioned CARB document, “Estimating Health Benefits Associated with Reductions in PM and NO<sub>x</sub> Emissions: Detailed Description.”<sup>198</sup> NERA’s own analysis also acknowledges the presence of uncertainties in their own estimates, “The findings contained in this report may contain predictions based on current data and historical trends. Any such predictions are subject to inherent risks and uncertainties.”

- (j)ii.2. Comment: We also encourage CARB to require upstream emissions accounting for the GHG and criteria pollutant emissions associated with upstream electricity generation for HD ZEVs. We support at a minimum, a well-to-wheel fuel lifecycle analysis to evaluate the benefits of vehicle technologies. There should be a comprehensive assessment on the fuel and energy impacts – particularly NO<sub>x</sub> emissions from electricity generation. (MEMA, JVS)

Agency Response: No change was made in response to the comment. Historically, the HD regulation structure has allowed the generation of credits from cleaner than required combustion engines to help offset the certification of engines with higher emission levels above the required emission standards. This has been allowed to provide engine manufacturers more flexibility as they transition to new more stringent standards. This is allowed through the ABT provisions in the Regulation. Currently, there is no requirement in the HD engine regulations to account for well-to-wheel emission impacts. In the Omnibus Regulation, HD ZEVs are now allowed to participate in the ABT program as a way to incentivize and support California’s transition from HD combustion to zero emission technologies. It would be inappropriate to require well-to-wheel requirements on HD ZEVs without first applying the same requirements on combustion engines. Such a change as requested by the commenter is outside the scope of this rulemaking. However, the ACT Regulation does evaluate well-to-wheel lifecycle analysis for HD ZEVs in Chapter VI of the ACT ISOR.<sup>204</sup> Please see the ACT ISOR for this analysis.

- (j)ii.3. Comment: The Regulation will have a California standard at 0.05 g/bhp-hr for the 2024 through 2026 MYs and for the 2027 MY the standard will drop to 0.02 g/bhp-hr. This reinforces that the replacement of MY 2007-2009 trucks will be with newer used diesel trucks. We request that CARB ensure that such impacts be modeled, especially for the many disadvantaged communities that will be impacted by the state’s goods movement industry over the next decade. (LNC, AFS)

Agency Response: No change was made in response to the comment. The commenter correctly summarized the emission standard levels proposed for 2024 through 2026 and for 2027 and subsequent MY HDEs. At these emission

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<sup>204</sup> The ACT ISOR can be found here:  
<https://ww2.arb.ca.gov/sites/default/files/classic/regact/2019/act2019/isor.pdf>

levels, Chapter VI and Appendix D of the ISOR contain the emission modeling details for the projected emission benefits of the Proposed Amendments. Emission benefits are modeled and projected to the 2024, 2031, 2040, and 2050 calendar years, as new low-NOx HD vehicles replace the legacy fleet, which include the mentioned 2007 to 2009 MY trucks. 2024 statewide emission benefits due to the Proposed Amendments are projected to be about 23 tpd, which increases to about 76 tpd in 2050 when the majority of fleet turnover to the low NOx standards is expected to occur.

Regarding California's disadvantaged communities, Chapter VIII of the ISOR discuss environmental justice, and states that the Proposed Amendments are consistent with CARB's environmental justice policy reducing exposure to harmful pollutants. While modeling of impacts in specific disadvantaged communities was not conducted for the ISOR, the Proposed Amendments would provide significant air quality benefits to communities where a high density of trucks operate, those located in proximity to major freight corridors such as ports and railyards, distribution centers, truck stops, and other places. The adoption of these Amendments is expected to benefit residents of such communities, affirming the Board's commitment to the fair treatment of all people throughout California.

- (j)ii.4. Comment: CARB has failed to model or quantify how much near-term NOx emission reductions the Regulation will deliver, even though CARB has stated it will incentivize early production of low-NOx engines prior to 2024 or 2027. (WPGA)

Agency Response: No change was made in response to the comment. CARB staff disagrees that CARB has failed to model near-term NOx reductions. Since the Board Hearing, CARB staff has conducted additional benefits analyses to include the recently adopted ACT Regulation and the 30-Day and 15-Day Notice Amendments. Emission benefits of the Proposed Amendments are projected to be 0.3 and 17.4 tpd in 2024 and 2031, respectively, in California. Please see Agency Response to Comment A.(k)i.12 for information on these analyses.

In addition, early compliance multipliers for the ABT program were proposed and adopted by the Board for engines and hybrid powertrains that fully comply with the Proposed Amendments earlier than the 2024 and 2027 implementation dates, as discussed in Chapter III.A.7.6 of the ISOR. Since it is difficult to project how many engines and hybrid powertrains would be certified for this optional early compliance provision, the emission benefits associated with this early compliance provision was not included in the emission benefit calculations of the Proposed Amendments.

- (j)ii.5. Comment: The proposed heavy-duty engine and vehicle Omnibus Regulation will set standards that will help with reducing these unhealthy air quality dates for the sake of our communities' health. For that reason, we need the

standards to begin sooner rather than later. This great rule should not be at the cost of environmental justice communities. (CAEJ)

Agency Response: No change was made in response to the comment. During the regulatory development process, CARB staff assessed the technological feasibility and timing of the proposed emission standards and determined that the earliest implementation date possible was the 2024 MY. This date allows adequate time needed for engine manufacturers to develop, test, and certify new products that would fully comply with the Proposed Amendments. As noted in Chapter VIII of the ISOR, the Proposed Amendments are consistent with CARB's environmental justice policy reducing exposure to harmful pollutants. In particular, the Proposed Amendments would provide significant air quality benefits to communities where a high density of trucks operates, those located in proximity to major freight corridors such as ports and railyards, distribution centers, truck stops, and other places. The adoption of these Amendments is expected to benefit residents of such communities, affirming the Board's commitment to the fair treatment of all people throughout California.

- (j)ii.6. Comment: In the competitive landscape of the California freight sector, a majority of miles (60%) are travelled by HD trucks originating from fleets based out-of-state, most of which will never have to purchase California-only engines. If the majority of fleet miles travelled in the state will not have to meet the proposed Rule, how will any air quality improvements be realized? Moreover, this 60% number is likely to increase under CARB's proposal. (TDAC)

Agency Response: No change was made in response to this comment. As explained in the ISOR, Chapter XI, CARB staff's Proposed Amendments were promulgated ahead of U.S. EPA because of the necessity to achieve emission reductions as quickly as possible in California and therefore to quickly adopt stricter HD standards and other amendments at the earliest possible implementation date in California.

To complement California's effort, timely action by U.S. EPA to establish more stringent national engine performance standards is essential. In January 2020, U.S. EPA published its Advanced Notice of Public Rulemaking for CTI,<sup>205</sup> noting its intention to adopt lower NOx emission standards and other requirements. Over the last few years, CARB staff has had regular meetings with U.S. EPA staff and will continue to work with them as the CTI is proposed and finalized, to encourage the adoption of national low-NOx standards that are identical to California standards and requirements and to achieve the goal of one national standard for 2027 and subsequent MY HDEs.

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<sup>205</sup> U.S. EPA. Advanced Notice of Proposed Rulemaking, Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine Standards, Federal Register Vol. 85, No. 13, January 21, 2020, pp. 3306-3330. <https://www.govinfo.gov/content/pkg/FR-2020-01-21/pdf/2020-00542.pdf>

## **(k) Comments Related to the EA**

### **(k)i. General Comments Related to Medium-Duty Engine Clarifications and Amendments**

- (k)i.1. Comment: CARB's EA (ISOR, section VII) is fundamentally deficient as well, and fails to satisfy CARB's obligations under the CEQA. In submitting the proposed Omnibus Regulations for adoption, CARB is attempting to rely on the EA that was prepared several years ago in connection with CARB's 2016 State SIP Strategy document, which included a preliminary analysis of just two of CARB's proposed Omnibus Regulations. (ISOR, p. VII-1.) That is wholly inadequate in this case, and will result in an invalid rulemaking. In support of not preparing an actual EA for this rulemaking, CARB states that, "Staff has determined that no additional environmental review is required for the current Proposed Amendments because there are no changes proposed to the originally approved project that involve significant environmental effects or a substantial increase in severity of previously identified significant effects." (Notice p. 25.) CARB staff's determination in that regard is plainly wrong. The full suite of proposed "Omnibus" Regulations has changed and expanded significantly since 2016. The 3B-MAW proposal and multiple in-use standards is new. The phased NOx standards are new, as is the lower PM standard. The extended warranty and FUL periods are new. The LLC standard is new. The durability requirements are new. And the EWIR changes and associated strict liability provisions are new. (EMA, Daimler, Navistar, Volvo)
- (k)i.2. Comment: First, the levels of the low-NOx standards currently at issue are different from, and are phased-in differently than, the low-NOx standards originally assumed and assessed in the 2016 SIP Strategy. Second, the currently proposed 3B-MAW-based in-use protocols and standards are entirely different as well, since, the 3B-MAW method, with its three separately binned in-use standards, was not even contemplated let alone evaluated when the EA for the 2016 SIP strategy was prepared. (EMA, Daimler, Navistar, Volvo)
- (k)i.3. Comment: CARB's EA for this Regulation does not adequately examine the significant environmental effects of this rulemaking. Instead, Staff Report asserts that CARB is not required to prepare the functional equivalent of an environmental impact report because it can rely completely on the program-level EA prepared for the 2016 State SIP Strategy. Consequently, CARB's 11-page EA here does not adequately evaluate the significant environmental effects of the rulemaking, nor does it account for changed circumstances and new information which suggest the likelihood of new significant environmental effects and/or a substantial increase in the severity of previously identified significant effects. In particular, the draft EA fails to sufficiently address the following environmental matters:

It does not address the full range of activities that are proposed pursuant to the current rulemaking. As noted in the comments made by the EMA, the full suite of proposed Omnibus Regulation has changed and expanded significantly since 2016. We incorporate those comments by reference. (CNGVC)

Agency Response to Comments (k)i.1 through (k)i.3: Because the comments addressed by this response are general in nature, a general response is appropriate.

CARB staff did not change the Proposed Amendments in response to these comments. In the above comments, the commenters list several elements of the Omnibus Regulation and claim that these elements have been modified and do not represent the elements in the 2016 State SIP Strategy<sup>206</sup> and therefore, the Omnibus Regulation's EA cannot rely on the EA done for the 2016 State SIP Strategy. CARB disagrees with these comments. As explained in greater detail below (and as already explained in the ISOR), each element of the Omnibus Regulation action specified by the commenter is encompassed within the suite of measures associated with the 2016 State SIP Strategy, and is thus within the scope of the 2016 State SIP Strategy.

By way of legal background, under traditional CEQA principles, "[w]hether a later activity is within the scope of a program [Environmental Impact Report] EIR is a factual question that the lead agency determines based on substantial evidence in the record." (14 C.C.R. § 15168(c)(2).) Similarly, CARB's certified regulatory program provides that CARB may "[r]ely upon or tier...from a prior Environmental Impact Analysis, if CARB determines a previous analysis remains applicable to and adequate for the project." (17 C.C.R. § 60004(b)(1)(B).)

The Omnibus Regulation implements two broad measures in the 2016 State SIP Strategy: (1) Lower In-Use Emission Performance Level, and (2) Low-NOx Engine Standard. The goal of the Lower In-Use Emissions Performance Level measure is to ensure that in-use HD vehicles continue to operate at their cleanest possible level over the lifetime of the vehicle. To achieve this goal, the SIP Strategy directs CARB staff to take the following actions<sup>207</sup>: [emphasis added]

- (1) *Amend the warranty and useful life provisions;*
- (2) *Amend the durability demonstration provisions within the certification requirements for heavy-duty engines;*
- (3) *Amend the NTE supplemental test procedures for heavy-duty diesel engines;*

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<sup>206</sup> CARB. [2016 State Strategy for the State Implementation Plan for Federal Ozone and PM2.5 Standards](#) (State SIP Strategy), page 62, March 7, 2017.

<sup>207</sup> CARB. [2016 State Strategy for the State Implementation Plan for Federal Ozone and PM2.5 Standards](#) (State SIP Strategy), page 62, March 7, 2017.

- (4) Adoption of comprehensive heavy-duty vehicle inspection and maintenance program; and
- (5) Amend CARB's existing Periodic Smoke Inspection and Heavy-Duty Vehicle Inspection Programs to revise the current opacity limit and make other program improvements.

Elements (1) through (3) are currently being addressed in the Omnibus Regulation. Elements (1) and (2) above expressly contradict the commenter's claims that "extended warranty and FUL periods," and "durability requirements" are new and not covered in the SIP Strategy. Similarly, the proposed 3B-MAW procedure would replace the NTE procedure and hence falls within the scope of element (3)'s anticipated amendments to the "NTE supplemental test procedures." Furthermore, to achieve the goals of the measure, the 2016 State SIP Strategy directs CARB staff to take actions or develop the details of the regulations either in the form of regulatory amendments or by developing new regulations. Accordingly, CARB staff is revising the existing HD regulatory programs via the Omnibus Regulation to implement the two measures discussed above in the 2016 State SIP Strategy EA.

The goal of the "Low-NOx Engine Standard" measure is to introduce near-zero emission engine technologies that will substantially lower NOx emissions from on-road HD vehicles. To achieve this goal, the 2016 State SIP Strategy directs CARB staff to establish more stringent engine performance standards for cleaner combustion technologies. Accordingly, CARB staff proposed more stringent NOx standards on existing certification cycles that are 75 percent and 90 percent below the current standard respectively in 2024 and 2027, as well as revising the test procedures to introduce a new LLC cycle and an associated low load NOx standard. The proposed phase-in of NOx standards in 2024 and 2027, and the LLC standard are all elements of the "Low-NOx Engine Standard" measure, and hence any environmental impacts from those elements are already accounted for in the EA for the 2016 State SIP Strategy.

The Low-NOx Engine Standard measure in the 2016 State SIP Strategy initially assumed the more stringent emission standards would be implemented in the 2023 MY, and did not expressly mention either a 0.05 g/bhp-hr NOx standard or a phase-in schedule for the NOx standards. However, those differences do not mean the Proposed Amendments exceed the scope of the 2016 State SIP Strategy EA, as claimed by the commenters. The commenters focus on, technical sub-components of the final Low-NOx Engine Standard measure in an attempt to frame them as departures from that measure, which is inaccurate. None of these sub-components alters either the accuracy of the description of this measure in the 2016 State SIP Strategy EA, or the 2016 State SIP Strategy EA's environmental conclusions. As noted above, CEQA provides that "[w]hether a later activity is within the scope of a program EIR is a factual question that the lead agency determines based on substantial evidence in the record." (14 C.C.R. § 15168(c)(2).) The CEQA Guidelines provide some general considerations in

making this determination, including but not limited to “consistency of the later activity with the type of allowable land use, overall planned density and building intensity, geographic area analyzed for environmental impacts, and covered infrastructure as described in the program EIR.” (Id.) While these criteria are keyed more to typical land use-type approvals under CEQA rather than statewide plans or regulatory programs, they nevertheless provide some insight here. The geographic area involved for the Omnibus Regulation remains the entire state, as was the case with the 2016 SIP Strategy EA. The Omnibus Regulation does not affect consistency with allowable land uses, density or building intensity or covered infrastructure, and thus the rest of the criteria in the applicable CEQA Guidelines do not suggest a departure from the scope of the 2016 SIP Strategy EA.

From a broader perspective, phasing in the more stringent emission standards a year later than assumed in the State SIP Strategy EA simply continues the existing conditions for an additional year, meaning the potential adverse impacts from this proposal (insubstantial as they may be in comparison with the proposal’s overall air quality and climate benefits) would simply not occur until one year later.

Regarding the NO<sub>x</sub> g/bhp-hr standard, simply because the SIP Strategy EA did not reference the specific numeric value of the standard that would ultimately be developed does not render that standard beyond the scope of the SIP Strategy EA. CARB staff developed its standard, after further research and analysis, to accomplish the very same purpose and objectives stated in the 2016 SIP Strategy EA. Adding more specificity does not render it beyond the scope of that EA, where its purpose and function is plainly to accomplish the goals set forth in the measure described in the EA.

Additionally, the Omnibus Regulation elements of the EWIR program and associated so-called “strict liability provisions” are covered within the scope of the Lower In-Use Emission Performance Level measure because they effectuate the intent of that measure to “ensure that in-use heavy-duty vehicles continue to operate at their cleanest possible level. [C]ARB staff would develop and propose new, supplemental actions to address in-use emissions and compliance, and to decrease engine deterioration.” (Revised 2016 State SIP Strategy at p. 61; 2016 State SIP Strategy Final EA at p.16.) The proposed PM requirements do not force any changes in the currently used aftertreatment systems, nor in the test procedures followed to demonstrate compliance with the proposed PM standard. Manufacturers currently are already certifying to significantly lower PM emissions than the proposed requirements.

The commenters do not specify how they believe the referenced sub-components would result in un-analyzed environmental impacts. In sum, the 2016 SIP Strategy EA’s analysis of the Low NO<sub>x</sub> Engine Standard and the

Lower In-Use Emission Performance Level measures remains applicable to and adequate for the Omnibus Regulation.

Accordingly, all of the contested elements are within the scope of the Low NOx Engine Standard or the Lower In-Use Emission Performance Level measures in the Revised 2016 State SIP Strategy.

- (k)i.4. Comment: [T]he prior EA did not (and could not) adequately assess the environmental impacts that will result from the significant differences, starting in the 2024 MY, between CARB's HDOH emission standards and EPA's federal HDOH emission standards. (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB disagrees with this comment and did not change the Proposed Amendments in response to this comment. The 2016 State SIP Strategy did address the importance of a federal action to ensure that new trucks that are certified to U.S. EPA emissions standards achieve the emission reductions needed to achieve California's air quality goals.

The comment also does not explain what "impacts" it is referring to in connection with the difference between state and federal emission standards. Furthermore, federal emission standards would be developed by U.S. EPA. It remains unclear what the final federal standards would look like. CARB action on the Omnibus Regulation in no way commits U.S. EPA to develop and implement its standards, since CARB lacks the authority to do so.

Since interstate trucking contributes significantly to California's NOx emissions inventory, the 2016 State SIP Strategy called for the U.S. EPA to develop and implement lower NOx HD engine emissions standards similar to California's HD low NOx engine emissions standards. The 2016 State SIP Strategy assumed that those federal requirements would start to take effect in 2024, a year after the expected California effective date of 2023.

To provide some further detail regarding the timing of potential federal action, in response to petitions from local and state air agencies, on December 20, 2016, the U.S. EPA acknowledged the need for federal action to achieve further NOx reductions from on-road HD vehicles, and announced it would initiate the work necessary to begin rulemaking efforts, targeting standards going into effect in the 2024 timeframe. On November 13, 2018, U.S. EPA announced its Cleaner Trucks Initiative or CTI to develop regulations to reduce NOx emissions from on-road HD vehicles.<sup>208</sup> On January 21, 2020, the U.S. EPA published an advance notice of rulemaking where it solicited comments on revising the HD regulatory elements similar to those proposed in the Omnibus Regulation.<sup>209</sup> However,

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<sup>208</sup> [U.S. EPA Cleaner Trucks Initiative](#), November 13, 2018.

<sup>209</sup> [Advance Notice of Proposed Rule: Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine Standards](https://www.epa.gov/regulations-emissions-vehicles-and-engines/advance-notice-proposed-rule-control-air-pollution-new), January 21, 2020. (<https://www.epa.gov/regulations-emissions-vehicles-and-engines/advance-notice-proposed-rule-control-air-pollution-new>)

because of legal lead time requirements and the implementation schedule of the Phase GHG requirements, the U.S. EPA indicated that its requirements could not take effect prior to the 2027 MY engines. This implementation date would create a gap of three years between the Omnibus Regulation implementation date scheduled to take effect in 2024 and the federal implementation timeline. Although the delay in the effective date would result in delaying the emissions reductions expected from federal certified trucks for the three years between 2024 to 2026, it would not change the status quo. U.S EPA would continue to certify engines to the current standards and emissions from federal trucks would remain the same and would not cause any new significant adverse environmental impacts. Again, federal rulemaking actions are beyond CARB's authority, and need not be analyzed as part of the EA for the Omnibus Regulation.

- (k)i.5. Comment: Moreover, CARB admits that it has done nothing to assess the significant pre-buy/no-buy ramifications that will certainly result from its "Omnibus" requirements as of the 2024 MY. And CARB has not done anything to address the increasingly relevant NOx-disbenefit phenomenon (see infra). (EMA, Daimler, Navistar, Volvo)
- (k)i.6. Comment: [T]he SIP Strategy EA failed to assess in any way the likely significant pre-buy/no-buy response from HDOH vehicle purchasers that the adoption of the Omnibus Regulations will cause. Nor did that EA consider how that pre-buy/no-buy response will be augmented due to the ACT Rule's year-by-year elimination of the diesel truck market, and due to the coincident new-vehicle purchase deadline that the Truck and Bus Regulation has set for the beginning of 2023, the year before the Omnibus Regulation will take effect, which is the same year that the anticipated pre-buy/no-buy response will reach its initial peak. (EMA, Daimler, Navistar, Volvo)
- (k)i.7. Comment: [I]t failed to fully address the scope or severity of those impacts by, for example, failing to evaluate the likely response of fleet operators in California to the Omnibus Regulation and the ACT Rule, which will cause fleet operators in California to accelerate their purchases of new HD vehicles before the regulations take full effect. (CNGVC)

Agency Response to Comments (k)i.5 through (k)i.7: CARB staff did not change the Proposed Amendments in response to these comments. Further, these comments do not raise an adverse CEQA impact, because purchases of currently compliant trucks in lieu of trucks compliant with a future regulation would not raise emissions above the CEQA baseline which is existing environmental conditions at the time the project's notice of preparation was published.

Even though pre-purchases would not result in emissions above the CEQA baseline, CARB staff provide the following response for informational purposes.

CARB staff acknowledged in the ISOR that the Omnibus Regulation might result in California fleets holding onto their existing vehicles longer, or purchasing used vehicles in lieu of new vehicles in California, or purchasing more used, out-of-state vehicles. CARB staff also considered that the Omnibus Regulation could cause some fleets to purchase vehicles ahead of when the standards take effect (i.e., via the “pre-buy” phenomenon). In the ISOR, due to the uncertainty associated with these potential impacts, as well as the difficulty quantifying them, CARB staff did not quantify these impacts. As noted in Chapter IX of the ISOR, CARB staff searched the literature and concluded that “research focused on the impact of regulatory costs on HD vehicle and engine prices does not exist. A number of studies have explored the relationship between general cost increases and the likelihood of out-of-state or used truck and engine purchases and found that there is a very wide range of estimates for how increased costs may impact purchasing behavior,<sup>210 211</sup> the estimates are highly uncertain, and that these estimates may change markedly in the span of only several years due to the dynamics of industry, and modern global economics.”

Although the Omnibus Regulation does not explicitly model the occurrence of a “pre-buy” effect where fleets increase purchases just before the Regulation would take effect in 2024 and then decrease sales immediately after, the model used to analyze the impacts of the Omnibus Regulation, EMFAC2017, already accounts for a pre-buy in 2023 due to the California Truck and Bus Regulation.<sup>212</sup> As noted in Chapter IX of the ISOR, “The final compliance date for the Truck and Bus Regulation is January 1st, 2023. As of that date, HD vehicle owners are required to fully turn over their fleet to 2010 standard compliant engines.” In order to comply with the Truck and Bus Regulation, California fleets will have just recently purchased trucks to comply with the Truck and Bus Regulation in the run-up to the January 1, 2023 deadline. Consequently, fleets that otherwise might have waited to purchase trucks in 2024 or 2025, instead are modeled to purchase trucks just before 2023, resulting in the increased new (“age 0”) population of in-state trucks in California in 2023 and decreased population of age 0 trucks in 2024. In essence, EMFAC2017 already models a pre-buy just before the Omnibus Regulation would take effect in 2024, and hence all the emission benefit and cost analyses in the Staff Report already include this pre-buy effect.

CARB staff did not explicitly model an additional pre-buy effect due to the Omnibus Regulation either in the Staff Report for the Omnibus Regulation or in the SIP Strategy EA, because although CARB staff recognizes that nationally,

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<sup>210</sup> “The Heavy-Duty Vehicle Future in the United States: A Parametric Analysis of Technology and Policy Tradeoffs,” Amanda C. Askin et al., Energy Policy, Science Direct, 2015. <https://www.sciencedirect.com/science/article/pii/S0301421515000683>

<sup>211</sup> “TAFV Alternative Fuels and Vehicles Choice Model Documentation,” David L. Greene, Oak Ridge National Laboratory, July 2001.

<sup>212</sup> EMFAC2017 Technical Documentation (<https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-modeling-tools-emfac-software-and> - accessed July 7, 2021)

pre-buy has occurred in the past when emission standards changed significantly, CARB staff believes an additional pre-buy in California before the Omnibus Regulation would take effect in 2024 is unlikely due to the impacts of the Truck and Bus Regulation. Fleets that just performed accelerated turnover to meet the requirements of the Truck and Bus Regulation to meet the January 1, 2023 deadline would be unlikely to immediately purchase additional trucks in 2023, just before the Omnibus Regulation takes effect with MY 2024 and subsequent engines.

Although CARB staff did not explicitly model the impacts of a pre-buy due to the Omnibus Regulation, CARB staff believes if an additional pre-buy did occur, it would cause more 0.2 g/bhp-hr NO<sub>x</sub> engines to be sold, which would cause decreased costs and also decreased benefits. However, even if such an additional pre-buy occurred, the benefits of the Omnibus Regulation would be significant, cost-effective, and worth pursuing.

- (k)i.8. Comment: And fifth, the prior EA failed to undertake any meaningful analysis of the NO<sub>x</sub>-disbenefits that could result from the implementation of the Omnibus Low-NO<sub>x</sub> requirements, especially in the western portions of the SoCAB, where the prevailing “VOC-limited” conditions mean that incremental reductions in NO<sub>x</sub> will cause ozone levels to increase. That phenomenon is well understood, including by the leading air modelers at the South Coast Air Quality Management District (SCAQMD). (See, e.g., SCAQMD Response to Comments on 2016 SIP, pp. 383, 510.) Indeed, the recent absence of ozone reductions in the SoCAB notwithstanding the dramatic COVID-related reductions in precursor emissions is a real-world example of the disbenefit phenomenon. CARB’s failure to address that NO<sub>x</sub>-disbenefit issue in any manner in the prior EA, along with the other factors listed above, renders its use as the EA for this rulemaking wholly inadequate under CEQA.<sup>213</sup> (EMA, Daimler, Navistar, Volvo)

Agency Response: The “NO<sub>x</sub> disbenefit” mentioned in EMA’s comment above is well understood and is one of the reasons why California’s 2016 State SIP Strategy relied on measures to reduce emissions of both NO<sub>x</sub> and VOCs to avoid an inadvertent increase in ozone as CARB implements the 2016 SIP measures, as discussed in the Agency Response to Comment A.(j)i.2. As explained in the ISOR section VII,<sup>214</sup> and the Agency Response to Comment A.(j)i.2, the Omnibus Regulation is expressly part of the 2016 State SIP Strategy. Since the 2016 State SIP Strategy addresses this issue and would ensure substantial NO<sub>x</sub>, VOC, and ozone benefits across the state (including in VOC-limited regions), the EA is sufficient and supports the Omnibus Regulation.

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<sup>213</sup> Ramboll Group has prepared a supplemental report documenting the continuing NO<sub>x</sub>-disbenefit impacts in the Western, more heavily-populated areas of the SoCAB. A copy of Ramboll’s supplemental report is attached hereto as Exhibit “F.”

<sup>214</sup> CARB. Staff Report: Initial Statement of Reasons (ISOR) for the Proposed Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments. June 23, 2020.

This NO<sub>x</sub> disbenefit phenomenon is sometimes referred to as the ozone “weekend effect” because the disproportionate reduction of NO<sub>x</sub> emissions on weekends relative to VOC due to reduced heavy duty truck activities can result in increased ozone formation on weekends in VOC-limited regions. Although the weekend effects persist in some areas of the SoCAB, the strength and spatial extent of the weekend effect has substantially decreased over the last two decades in California,<sup>215 216 217 218 219</sup> supporting the effectiveness of the previous control strategies for NO<sub>x</sub> and VOC.

The commenter here appears to cite this phenomenon to suggest that California should not make further efforts to reduce NO<sub>x</sub> emissions. This short-term weekend effect should not detract from the long-term needs and benefits of reducing ozone formation achieved through the strategic reduction of both NO<sub>x</sub> and VOC. Decreases in ozone observed in the SoCAB over the past five decades have been demonstrated to be a result of the decreases in local emissions of NO<sub>x</sub> and VOCs.<sup>220</sup> Furthermore, as noted above, the short-term weekend effect is not an outcome of the 2016 State SIP Strategy regardless (given its focus on simultaneous reductions of NO<sub>x</sub> and VOC). Therefore, this potential impact has already been adequately analyzed and avoided through careful design of the 2016 State SIP Strategy. NO<sub>x</sub> reductions are also needed in ozone non-attainment regions that are not VOC limited, as well as in all areas to reduce formation of secondary particulate from NO<sub>x</sub>.

- (k)i.9. Comment: CARB’s attempted reliance on the potential exemptions set forth in the CEQA Guidelines at section 15162 (see ISOR, p. VII-6) is unavailing, since, among other things: (i) there have been substantial changes in CARB’s proposed Low-NO<sub>x</sub> program; (ii) PEMS are incapable of detecting or implementing the proposed 3B-MAW-based in-use low-NO<sub>x</sub> emission standards; (iii) OBD systems cannot measure and detect emission exceedances or emission-related component failures at the low-NO<sub>x</sub> levels proposed under the Omnibus Regulations; (iv) the anticipated pre-buy/no-buy

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<sup>215</sup> “The vanishing ozone weekday/weekend effect,” Wolff, G. T., Kahlbaum, D. F., Heuss, J. M., *Journal of the Air & Waste Management Association* 2013, 63, (3), 292-299

<sup>216</sup> “Weakening of the weekend ozone effect over California’s South Coast Air Basin,” Baidar, S., Hardesty, R. M., Kim, S. W., Langford, A. O., Oetjen, H., Senff, C. J., Trainer, M., Volkamer, R., *Geophysical Research Letters* 2015, 42, (21), 9457-9464

<sup>217</sup> “Inferring Changes in Summertime Surface Ozone–NO<sub>x</sub>–VOC Chemistry over U.S. Urban Areas from Two Decades of Satellite and Ground-Based,” Jin, X., Fiore, A., Boersma, K. F., Smedt, I. D., Valin, L., *Environmental Science & Technology* 2020, 54, (11), 6518-6529

<sup>218</sup> “The Role of Temperature and NO<sub>x</sub> in Ozone Trends in the Los Angeles Basin,” Nussbaumer, C. M., Cohen, R. C., *Environmental Science & Technology* 2020, 54, (24), 15652–15659

<sup>219</sup> “Impacts of Traffic Reductions Associated With COVID-19 on Southern California Air Quality,” Parker, H. A., Hasheminassab, S., Crouse, J. D., Roehl, C. M., Wennberg, P. O., *Geophysical Research Letters* 2020, 47, (23), e2020GL090164

<sup>220</sup> “Trends in ozone, its precursors, and related secondary oxidation products in Los Angeles, California: A synthesis of measurements from 1960 to 2010,” Pollack, I. B., Ryerson, T. B., Trainer, M., Neuman, J. A., Roberts, J. M., Parrish, D. D., *Journal of Geophysical Research: Atmospheres*, 2013, 118, (11), 5893-5911.

response (including as quantified by ACT) does raise significant new adverse environmental effects (as does the very real NOx-disbenefit issue); (v) HDOH engine and vehicle manufacturers are likely to exit the California market in response to the Omnibus Regulations; and (vi) new information relating to the cost-prohibitive and infeasible nature of CARB's proposals has become available – information that further establishes that CARB's projected mitigation measures and emissions benefits are highly unrealistic. Accordingly, CARB's claim that there are "no new environmental impacts" to consider is utterly without merit. (See ISOR, p. VII-11.) (EMA, Daimler, Navistar, Volvo)

Agency Response: CARB staff disagrees with the above comment and did not change the Proposed Amendments in response to the comment. CARB staff stands by its assessment that the Omnibus Regulation presents no new significant adverse environmental impacts beyond those already outlined in the EA for the 2016 State SIP Strategy, or any of the other circumstances requiring subsequent environmental review set forth in CEQA Guidelines section 15162. Furthermore, the commenter incorrectly characterizes CARB's CEQA process for this item as an "exemption." To the contrary, the Omnibus Regulation, along with other key NOx and VOC reduction measures, underwent a full Environmental Impact Analysis as part of the 2016 State SIP Strategy. CEQA's purpose is not to generate paperwork; it is to ensure that a proposed activity's environmental impacts are properly analyzed, disclosed, and considered by the decision makers. As noted previously, CARB staff fully analyzed, disclosed, and considered the impacts from the Omnibus Regulation as part of the 2016 State SIP Strategy EA.

The commenter's specific contentions are addressed in more detail as follows:

(i) [T]here have been substantial changes in CARB's proposed Low-NOx program;  
See Agency Response to Comment A.(k)i.1 above.

(ii) PEMS are incapable of detecting or implementing the proposed 3B-MAW-based in-use low-NOx emission standards;

It is unclear how this technical comment relates to potential environmental impacts from the Omnibus Regulation. Therefore, no agency response is required.

However, CARB staff provides the following technical response: CARB staff disagrees with this comment. Current PEMS are adequate for the proposed 2024 0.050 g NOx/bhp-hr standard and CARB staff expects that PEMS manufacturers will improve their systems by 2027 in order to supply engine manufacturers with PEMS that can detect NOx emissions at the levels corresponding to the 2027 0.020 g NOx/bhp-hr standard. CARB staff has

evaluated the performance of a next generation HD PEMS prototype provided by AVL at low concentration levels (less than 1 ppm NO<sub>x</sub>) in the laboratory and real-world driving tests. The preliminary results strongly indicate that the next generation of PEMS has significantly smaller baseline drifts and less than 1 ppm limit-of- detection both in the laboratory and in the real-world driving tests. CARB staff also assessed the accuracy of the current and low NO<sub>x</sub> prototype PEMS analyzer compared to a laboratory chemical luminescent detector and determined that the error in calculating emissions rates is within acceptable limits (within viable range for Low NO<sub>x</sub> emissions evaluation). In addition, CARB staff also determined that because the proposed 3B-MAW approach is not dependent upon estimated torque, that method avoids a significant amount of measurement uncertainty related to the denominator, particularly at medium and low loads.

Continued in-use emissions policy development spans several global markets and will likely support continued development activity in the PEMS space. PEMS suppliers have typically introduced new products at a pace averaging about every three years, and CARB staff thus concludes that next-generation low NO<sub>x</sub> PEMS can be introduced to the market by the time the tightest NO<sub>x</sub> standards phase in for MY 2027.

(iii) OBD systems cannot measure and detect emission exceedances or emission-related component failures at the low-NO<sub>x</sub> levels proposed under the Omnibus Regulation;

It is unclear how this technical comment relates to potential environmental impacts from the Omnibus Regulation. Therefore, no agency response is required.

However, CARB staff provides the following technical response: CARB staff disagrees with this comment. CARB staff is providing engine manufacturers an interim level of relief in this Regulation by effectively maintaining OBD malfunction thresholds for NO<sub>x</sub> and PM emissions at the same levels required by the current OBD thresholds, but this allowance does not result in any new significant adverse environmental impacts or in changes that substantially increase the severity of significant adverse impacts previously disclosed in the EA for the 2016 State SIP Strategy. This is particularly true because it certainly would not result in any emissions increases above the current environmental setting.

(iv) [T]he anticipated pre-buy/no-buy response (including as quantified by ACT) does raise significant new adverse environmental effects (as does the very real NO<sub>x</sub>-disbenefit issue);

See CARB Agency Response to EMA's comment regarding the pre-buy/no-buy scenario in the paragraphs above. Also, see CARB staff response to EMA comment discussing the NO<sub>x</sub>-disbenefit in the paragraphs above.

(v) HDOH engine and vehicle manufacturers are likely to exit the California market in response to the Omnibus Regulation;

CARB staff disagrees with this comment. CARB staff does not believe that all vehicle manufacturers will exit the California market in response to the Omnibus Regulation, and believes that the market for on-road HD diesel engines in California will remain well-served. In fact, CARB staff is aware that several manufacturers are currently working on developing 2024 MY compliant engines for the California market. See the response immediately below for information regarding likely net cost increases for all vehicle classes, which do not rise to levels expected to cause manufacturers to exit the California market. Thus, CARB staff does not foresee any new significant adverse environmental impacts beyond those already outlined in the EA for the 2016 State SIP Strategy, or any changes that substantially increase the severity of significant adverse impacts previously disclosed in the EA for the 2016 State SIP Strategy.

(vii) [N]ew information relating to the cost-prohibitive and infeasible nature of CARB's proposals has become available – information that further establishes that CARB's projected mitigation measures and emissions benefits are highly unrealistic.

This comment does not raise any environmental impact concerns since it does not indicate how emissions or other environmental impacts would increase above the existing environmental setting (baseline). CARB staff also disagrees with this comment. CARB staff has analyzed the costs of the technologies needed to comply with the requirements of the Omnibus Regulation and determined those costs are only expected to increase the overall net costs for all vehicle classes, as a percentage of baseline purchase price, from 0.4 to 9.5 percent, with an average in MY 2024 to 2026 of 2.6 percent, in MY 2027 to 2030 of 5.2 percent, and in MY 2031 and subsequent of 5.8 percent. (ISOR at p. ES-15). In addition, as previously noted, CARB staff is aware that some engine manufacturers have committed to developing compliant 2024 MY engines, and are also making plans in meeting the 2027 requirements as well.

To the extent this comment questions CARB staff's projected emissions benefits, the comment does not specify which "mitigation measures" or projected emission benefits are "highly unrealistic", and it is therefore not possible to respond with specificity. Because the comments addressed by this response are general in nature, a general response is appropriate. (See *Paulek v. Department of Water Resources* (2014) 231 CA4th 35, 48.) CARB staff therefore responds generally that the commenter has not specified any new information showing that any of the circumstances set forth in CEQA Guidelines section 15162<sup>221</sup> would be present.

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<sup>221</sup> [14 CCR § 15162](#)

- (k)i.10. Comment: While CARB claims that its proposed Low-NOx Regulations could result in total NOx reductions of 28,617 tons as of 2032, and that EMA's nationwide alternative would result in 21,056 tons (SRIA, p. 129) – which is a difference of 7,561 tons or 26% – that is not correct. Independent air-quality-modeling experts from Ramboll Group (“Ramboll”) have compared the state-wide benefits of EMA's alternative nationwide program with the potential benefits under CARB's California-only program, and determined that EMA's alternative would yield more than 90% of the estimated NOx reductions under CARB's proposed regulations through 2035. (A copy of Ramboll's Report is attached hereto as Exhibit “E.”) Moreover, even CARB agrees that EMA's nationwide alternative would be far more cost-effective than CARB's California-only proposal. (EMA, Daimler, Navistar, Volvo)
- (k)i.11. Comment: The Omnibus Regulation is NOT scheduled go through the usual two-step CEQA process for adoption. This implies that CARB believes it is already covered by its SIP CEQA analysis adequately. This conclusion does not seem well supported, and calls into question whether any meaningful changes will occur to the Regulation as a result of the August Board meeting. Given that CARB has stated the Regulation is “one of three big policy pillars,” there appears to be a major shortfall in the EA. Unfortunately, there was no outreach to the low NOx industries to solicit feedback on ways to improve the Regulation prior to the release of the proposed June language. Therefore, it will certainly take amendments by the Board at the August meeting to make this Regulation impactful in the near-term. (LNC, AFS)

Agency Response to Comments (k)i.10 and (k)i.11: As the commenter states, the Omnibus Regulation was scheduled to be considered at one Board Hearing. As explained in the ISOR for this rulemaking action, the environmental impacts of the Omnibus Regulation were adequately analyzed by – and are within the scope of – the prior EA for the 2016 State SIP Strategy.

CARB staff disagrees with the comment that it improperly concluded that a supplemental or subsequent EA is not required for the Omnibus Regulation. In addition, CARB staff did not change the Amendments in response to this comment. As explained in the EA chapter of the ISOR (see discussion starting at page VII-7), the proposed Omnibus Regulation measures would not result in any new significant adverse environmental impacts or substantially increase the severity of significant adverse impacts previously disclosed in the EA for the 2016 State SIP Strategy. As explained in the ISOR's EA chapter, none of the circumstances requiring subsequent environmental review in CEQA Guidelines 15162<sup>222</sup> would be present. The Omnibus Regulation is therefore within the scope of the EA for the 2016 State SIP Strategy and does not require either a supplemental or subsequent EA or the two-Board-meeting process to approve for adoption the EA for the Omnibus Regulation. The Executive Officer retains

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<sup>222</sup> 14 CCR § 15162

the discretion, however, to bring the item back to the Board for further consideration at a future date.

For later activities under a previously CEQA-reviewed program, if an agency concludes that no subsequent Environmental Impact Report (EIR) is required, then the agency can approve the activity as being within the scope of the programmatic EIR (in this case, the SIP Strategy EA) (CEQA Guidelines 15168(c)(2)).<sup>223</sup> No subsequent EIR (or in this case, Environmental Impact Analysis) is required where the activity would not have any new or more severe significant impacts beyond those previously analyzed in the prior Impact EA (here, the SIP Strategy EA).

CARB staff also disagrees with the claim that “there was no outreach to the low NOx industries to solicit feedback on ways to improve the Regulation prior to the release of the proposed June language.” Indeed, as described in further detail in Chapter XII of the ISOR for this rulemaking action, in November 2016, CARB staff created technical workgroups to exchange ideas and provide updates on regulatory concepts. The HD Omnibus Low NOx workgroup had more than 150 members and included representatives from HD engine manufacturers (including Thomas Lawson, president of the California Natural Gas Vehicle Coalition, a group that represents many of the signees of the comment letter<sup>224</sup>), component suppliers, academia, non-governmental organizations, trade associations, and other interested persons with some of the technical professionals based outside the United States. Since March 2017, CARB staff held eight workgroup meetings, all of which were conducted using online webinars. In addition to workgroup meetings, CARB staff also held three public workshops regarding the Omnibus Regulation, on November 3, 2016, January 23, 2019, and September 26, 2019. Signees of this comment letter,<sup>225</sup> including Sean Edgar, Director, CleanFleets.Net, Tim Carmichael, State Agency Relations Manager, Southern California Gas Company, and Erik Neandross, CEO, Gladstein Neandross & Associates, in fact, were explicitly invited to each of the workshops via email ahead of each workshop. At these workshops, CARB staff discussed concepts to the Omnibus Regulation. Attendees included engine manufacturers, trade associations, component suppliers, members of academia, non-governmental organizations, and members of the general public, including representatives of the NG industry. To reach a wider audience, the workshops were also webcasted.

- (k)i.12. Comment: CARB has failed to model or quantify how much near-term NOx emission reductions the Regulation will deliver, even though CARB has

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<sup>223</sup> 14 CCR § 15162

<sup>224</sup> Low NOx Coalition Comment Letter: “Re: Omnibus Regulation: Changes Needed to Accelerate Use of Available Renewable Natural Gas and Propane Low NOx Trucks and Deliver Much Needed Near-Term Emissions Reductions.” submitted by Ryan Kenny, August 19, 2020 (<https://www.arb.ca.gov/lists/com-attach/14-hdomnibus2020-BmldNgFuUmhWMgB1.pdf> - last accessed 7/8/2021)

<sup>225</sup> Ibid.

stated it will incentivize early production of low NOx engines prior to 2024 or 2027. This is a serious concern that should be addressed and vetted through the CEQA process. CARB has additionally stated in the Staff Report, “The California Legislature has placed the responsibility of controlling vehicular air pollution on CARB...[and] broadly authorize and require CARB to achieve the maximum feasible and cost-effective emission reductions from motor vehicles, including the adoption and implementation of vehicle emission standards and in-use performance standards.”<sup>226</sup>

This can be shown in the Mobile Emissions Toolkit for Analysis model produced to support the 2020 Mobile Source Strategy. The chart below shows CARB’s view that low NOx trucks are not going to be part of the solution in a business-as-usual scenario.

Calendar Year	Pre-2010	2010-certified	Accelerated Turnover to ZEVs	MY 2024+ HD ZEVs	CA Cert.: Low NOx	Federal Cert.: Low NOx	Total ZEVs	Total Pop	Calc
2017	369,252	233,090	0	0	0	0	0	602,342	
2018	340,022	275,579	0	0	0	0	0	615,601	
2019	312,736	320,397	0	0	0	0	0	633,133	
2020	263,802	385,777	5,776	0	0	0	5,776	655,355	
2021	224,107	434,673	11,553	0	0	0	11,553	670,333	
2022	161,967	503,648	17,329	0	0	0	17,329	682,944	
2023	61,654	608,335	23,106	1,077	0	0	24,122	694,111	
2024	54,820	624,500	28,882	5,139	3,388	2,918	34,021	719,647	
2025	47,204	618,611	34,659	12,030	19,795	7,445	46,689	739,744	
2026	43,066	601,472	40,435	21,327	41,236	15,268	61,762	762,805	
2027	39,766	579,025	46,212	32,247	62,958	23,232	78,458	783,438	
2028	34,939	554,120	51,988	45,651	84,793	31,458	97,638	802,948	
2029	29,921	526,389	57,764	63,677	104,881	39,906	121,441	822,539	
2030	26,578	493,344	63,541	85,605	123,884	48,469	149,146	841,421	
2031	23,394	456,596	69,317	110,265	142,028	56,867	179,583	858,467	

<sup>226</sup> CARB, Staff Report: ISOR, p. II-4.

Such modeling should be standard procedure for all of CARB’s air quality regulations so that the Board can make an informed decision on the Regulation. If CARB hasn’t modeled for air quality impacts, how can it be argued the Regulation is the remedy for the near-term ozone SIPs? How can CARB claim this is the remedy for the low NOx marketplace if it doesn’t estimate the number of trucks that would be incentivized? (LNC, AFS)

Agency Response: CARB staff did not change the Proposed Amendments in response to the comment above. This comment does not raise a significant environmental impact from the Omnibus Regulation. However, CARB staff provides the following response for informational purposes.

CARB staff disagrees with the claim that it has failed to model or quantify the near-term NOx emission reductions attributable to the Omnibus Regulation. CARB staff has quantified these emission reductions, as can be seen in the ISOR at <https://ww3.arb.ca.gov/regact/2020/hdomnibuslownox/isor.pdf>. In particular, ISOR Tables V-1 and V-2 present expected emission reductions, including in the near-term. Since the Board Hearing, CARB staff has updated the cost analysis in the ISOR to match the proposed Omnibus Regulation to account for the ACT Regulation and the 30-Day and 15-Day Notice Amendments that are incorporated in this FSOR (see Agency Response to Comment A.(i).1). Updated Tables V-1 and V-2 are presented here.

**Table V-1. Projected NOx Emission Benefits from the Proposed Amendments Statewide and for the South Coast and San Joaquin Valley Air Basins (tpd)**

<b>Calendar Year</b>	<b>Statewide</b>	<b>South Coast</b>	<b>San Joaquin Valley</b>
2024	0.3	0.1	0.1
2031	17.4	5.2	4.3
2040	34.6	10.4	8.6
2050	45.2	13.7	11.3

**Table V-2. Projected Statewide NOx Emission Benefits from the Proposed Amendments for 2022 to 2050**

<b>Calendar Year</b>	<b>NOx Tons Per Year Benefits</b>
2022	0
2023	0
2024	92
2025	584
2026	1,305
2027	2,072
2028	2,926
2029	3,827
2030	4,654
2031	5,430
2032	6,144
2033	6,818
2034	7,473
2035	8,099
2036	8,710
2037	9,291
2038	9,839
2039	10,345
2040	10,799
2041	11,214
2042	11,598
2043	11,964
2044	12,320
2045	12,657
2046	12,968
2047	13,254
2048	13,521
2049	13,769
2050	14,092
<b>2022-2050 (tons)</b>	<b>225,763</b>

The baseline ISOR analysis does not assume any use of the early compliance credit multipliers prior to the 2027 MY, i.e., no manufacturers are assumed to produce any engines meeting the proposed Omnibus Regulation 2024, 2027, or 2031 standards early in order to earn Omnibus Regulation compliance credits. CARB staff made that assumption because, although some NG vehicles currently are certified to a 0.02 g/bhp-hr NOx standard, no NG vehicles currently meet the full Omnibus Regulation standards (including associated durability, in-

use testing, warranty and useful life requirements), and because recent CARB incentive funding solicitations have revealed limited demand for NG vehicles. Potential demand for NG is already fully served. For example, a recent CARB \$30 million statewide solicitation in 2020 from the Volkswagen mitigation fund was significantly undersubscribed (with applications for only about \$6 million received, leaving \$24 million on the table). This was despite generous incentives of up to \$85,000 per vehicle. This suggests that manufacturers are unlikely to manufacture more NG vehicles to obtain credits under the Omnibus Regulation. Although such credit would be valuable to manufacturers, it would not be valuable enough to make it worthwhile producing vehicles if fleets are showing little interest in purchasing them.

- (k).i.13. Comment: Neither its analysis nor the current EA adequately analyzes the scope or severity of the short-term air quality impacts that are likely to result from the Regulation. The 2016 programmatic EA concluded that the proposed SIP strategy would result in potentially significant and unavoidable short-term air quality impacts due to the foreseeable compliance response, including construction of infrastructure for natural gas and hydrogen refueling stations and construction and operation of new manufacturing facilities.

Furthermore, the 2016 programmatic EA concluded that mitigation measures were outside CARB's authority. Similarly, here, the current EA states that there are "[n]o newly feasible or different mitigation measure . . . which could substantially reduce one or more of the previously-identified significant effects of the project." This is simply inaccurate. As we have previously requested in this and other proceedings, CARB should incentivize the use of low NOx vehicles, which are an immediately-available remedy to the problems of NOx and GHG emissions, and are currently certified by CARB as 90 percent cleaner than today's certified diesel. Indeed, in the recent ACT Regulation proceedings, CARB suggested that a credit for low NOx vehicles would be considered during the Omnibus Regulation proceedings. Such a measure is now available, and could substantially reduce the previously identified significant effects of the rulemaking.

We believe that these items should be addressed in a full EA, rather than a truncated statement about why such additional environmental review is not necessary. (CNGVC)

Agency Response: CARB staff disagrees with all of this comment's assertions that CARB's EA is not adequate. CARB staff did not change the Proposed Amendments in response to these comments. CARB staff has determined that the Omnibus Regulation does not present any of the circumstances set forth in CEQA Guidelines section 15162<sup>227</sup> that would require a new EA to be developed. Therefore, no additional EA is required. The basis for CARB staff's determination that none of the conditions requiring further environmental review are triggered is

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<sup>227</sup> 14 CCR § 15162

discussed thoroughly in the ISOR, Chapter VII, section D.2. and in Agency Response to Comment A.(k)i.1 above.

The commenter states that even if the 2016 programmatic EA covered the proposed activities, the current EA does not adequately analyze the scope or severity of the short-term air quality impacts that are likely to result from the Regulation because it fails to address the likely response of fleet operators in California would have to the Omnibus Regulation and the ACT Regulation, which will cause fleet operators in California to accelerate their purchases of new HD vehicles before the regulations take full effect. As stated in Agency Response to Comment A.(k)i.1, CARB staff has sufficiently addressed this comment.

The commenter also states that the 2016 programmatic EA concluded that mitigation measures were outside CARB's authority, but CARB should have evaluated mitigation measures such as incentivizing the use of existing low NOx vehicles. CARB staff clearly explained in detail in Chapter VII of the ISOR that reasonably foreseeable compliance responses to the Low NOx Engine Standard measure would include incremental changes to existing HD vehicle engine manufacturing and near zero emission technology that will not require the construction of new manufacturing facilities, and that reasonably foreseeable compliance responses to the Lower In-Use Emission Performance Level involve amendments to existing HDIUT procedures and protocols that would not result in additional physical changes to the environment beyond what the changes identified in the EA for the 2016 State SIP Strategy. The environmental impacts of those reasonably foreseeable compliance responses and the mitigation measures identified for those impacts were also fully set forth in that EA. Furthermore, it is worth noting again that the purpose of both the State SIP Strategy and the Omnibus Regulation is to substantially reduce emissions across the state in both the near- and long-term.

The commenter asserts that incentivizing low NOx vehicles (presumably HD vehicles fueled by NG-powered engines) constitutes a new or different mitigation measure than the mitigation measures described in the EA for the 2016 State SIP Strategy. However, the commenter does not describe or explain how increasing the production and use of those vehicles would mitigate the environmental impacts of the reasonably foreseeable compliance responses of this rulemaking action. The rulemaking action of course is designed to foster the introduction of lower emitting HD vehicles beginning in the 2024 MY, and to ensure those vehicles maintain their emissions over their useful lives. In fact, the commenter's proposal would involve making NG engines to qualify for early compliance credit multipliers as high as 2.5 that would in turn enable manufacturers to make other engines higher emitting than the standards. Hence, ironically over the life of the regulation, the commenter's proposal would actually increase, rather than mitigate any claimed environmental impacts of this rulemaking action.

The final paragraph of the comment states that these items should be addressed in a full EA, rather than a truncated statement about why such additional environmental review is not necessary. As noted in the ISOR and throughout the responses to comments in this section of the FSOR, these items were addressed in a full EA – the EA for the 2016 State SIP Strategy – as well as in Chapter VII of the ISOR.<sup>228</sup>

## (I) Miscellaneous Comments

### (I)i. Harmonized National Low NOx Program

- (I)i.1. Comment: MEMA encourages CARB and U.S. EPA to continue to coordinate on their HD low NOx programs and to work to harmonize the programs as closely as possible. A true national program with stringent, long-term targets will provide regulatory certainty for the domestic supplier industry. These elements will provide a stable framework the industry needs for long-term planning and investment decisions critical to continue strengthening supplier manufacturing sector jobs and driving global technology leadership. (MEMA)
- (I)i.2. Comment: As discussed in more detail below, both our associations support the development of a harmonized, national approach to further reduce NOx emissions from HD vehicles. We implore the Board to work with U.S. EPA on the development of a national program to achieve the most effective means of reducing truck emissions without harming California trucking businesses and services.

California’s “go it alone” approach will create an uneven playing field for the state’s trucking fleets while not delivering on the promised benefits. Mandating the sale of trucks with more expensive, unproven emissions control technologies only in California will simply force companies to avoid or delay purchasing these vehicles. Competing companies based outside the state will still be able to operate in California with upgraded fleets meeting federal engine emissions standards with the latest safety and convenience features.

Rather than proceeding with a rulemaking that will fail to achieve the promised emission reductions and penalize the state's businesses, the Board should refocus its efforts on a collaborative national approach targeting 2027. This approach is considered the most promising and effective means of reducing truck emissions across the nation and in California. Together, with all industry stakeholders, we can develop the next pathway to cleaner trucks.

The trucking industry wants to ensure that the development of a low-NOx rule is not unduly influenced by politics but rather by sound scientific and economic analysis and reasoning. We continue to support the alignment of Phase 2

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<sup>228</sup> CARB. [Staff Report: Initial Statement of Reasons \(ISOR\) for the Proposed Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments](#). June 23, 2020.

implementation milestones with those of a low-NOx rule given the need for manufacturers to design and engineer technological pathways that satisfy both standards. With the deadline to finalize a low-NOx rule to align with the Phase 2 implementation milestone in 2024 having already passed due to the Clean Air Act four-year lead time requirement, CARB and EPA should not rush to finalize the rule until they have conducted a thorough cost/benefit analysis and undertaken comprehensive in-fleet testing of identified technologies under all seasonal and geographic parameters.<sup>229</sup> We stand ready to work closely and openly with CARB and EPA to ensure a national rule will satisfy the aims of both the environment and our industry. (CTA/ATA)

- (l)i.3. Comment: Finally, in addition to adopting the HD Omnibus Regulation, we request that CARB continue to work in close collaboration with EPA to achieve a single national program that preserves all the features and benefits of CARB program. A single national program is essential to ensuring that the critical national need for reductions in highway HD NOx emissions of at least 90 percent from current in-use levels is met by no later than MY 2027 to help states and localities across the country achieve and sustain their clean air goals. (NACAA)
- (l)i.4. Comment: We urge CARB to work with U.S. EPA to adopt a national set of standards that harmonize a single set of requirements. (MECA)
- (l)i.5. Comment: Jacobs encourages CARB and U.S. EPA to continue to coordinate their HD low NOx programs as closely as possible. A closely coordinated low HD NOx rule will provide the stability and predictability that motor vehicle suppliers need for controlling capital costs and drive significant domestic technological investments...We encourage CARB and EPA to harmonize their HDIUT and minimize variation between CARB and EPA cycles for vehicle and engine manufacturers. (JVS). (TDAC)
- (l)i.6. Comment: Ensuring dependability should be a priority -- should be a major focus of this rulemaking.

Testing two engines in a laboratory does not ensure dependability. The combination of a shortened lead time and the closing of a labs in testing facilities due to COVID will result in a very complex product being rushed to market without time for adequate testing and troubleshooting. As a result, product quality to the end user will suffer, apprehension will prevail, and the desired results will not be achieved. Instead, like many other, including the Truck Dealers Alliance, we are asking you to refocus this effort on a collaborative national approach targeting 2027.

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<sup>229</sup> 42 U.S.C. §752l(a)(3)(C).

[W]e ask you to work with EPA and industry stakeholders on the development of a national program to achieve the most effective means of reducing truck emissions without harming California trucking businesses and services. (ATA)

Agency Response to Comments (I)i.1 through (I)i.6: No change was made in response to these comments. CARB staff agrees with the commenters regarding the benefits of nationally harmonized HD emission standards. From the start of the Omnibus regulatory process, CARB staff has had regular meetings with U.S. EPA staff to discuss and develop the elements of Proposed Amendments. When U.S. EPA published its Advanced Notice of Public Rulemaking for CTI in January 2020, CARB staff provided comments to encourage U.S. EPA to harmonize with California's Omnibus Regulation.<sup>230</sup>

As explained in the ISOR, CARB staff's Proposed Amendments were promulgated ahead of U.S. EPA because of the necessity to achieve emission reductions as quickly as possible in California and therefore to quickly adopt stricter HD standards, improved test procedures, and related amendments at the earliest possible implementation date of 2024 MY in California. Due to constraints at the federal level, implementation of these lower HD emissions standards nationally was not possible for the 2024 MY. This necessitated the action of California to move ahead of U.S. EPA due to its need to mitigate its severe air quality problems. Currently, the U.S. EPA is targeting a start date for its CTI of the 2027 MY. CARB staff will continue to work with U.S. EPA as the CTI is proposed and finalized, to attempt to achieve the goal of one national standard and harmonized in-use testing procedures for 2027 and subsequent MY HDEs.

Regarding the comment on a needed cost/benefit analysis and identified technologies, the technological feasibility and cost/benefit analysis of the proposed emission standards are carefully outlined in Chapters III, V, and IX of the ISOR.<sup>231</sup> Regarding coordinating with the Phase 2 GHG emission standards, the implementation of the proposed interim standards in the 2024 MY and the low NOx standards in the 2027 MY match those for the Phase 2 GHG Regulation implementation timeframe. For the comment regarding the four-year lead time requirement of the federal CAA, please see the Agency Response to Comments A.(I)ii.1 through A.(I)ii.3. For the comment regarding lead time and dependability of engines, please see the Agency Responses to Comments A.(a)iv.1, A.(a)iv.2, and A.(f)i.2 through A.(f)i.4.

- (I)i.7. Comment: On behalf of California's commercial truck dealerships, TDAC respectfully requests that your office direct CARB to align with the U.S. EPA on

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<sup>230</sup> Letter from Richard Corey to Administrator Wheeler (U.S. EPA), submitted to Docket ID No. EPA-HQ-OAR-2019-0055, Richard Corey, California Air Resources Board, February 20, 2020.

<https://www.regulations.gov/comment/EPA-HQ-OAR-2019-0055-0471>

<sup>231</sup> CARB. Staff Report: Initial Statement of Reasons (ISOR) for the Proposed Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments. June 23, 2020.

a single nationwide Low-NOx truck engine standard for 2027. Based on all the reasons discussed above, we respectfully urge your office to direct CARB to hold the 2024-2026 standards in the Omnibus Low-NOx rule in abeyance and instead focus its resources on aligning with the EPA on a single nationwide truck engine Low-NOx standard for 2027. (TDAC)

- (l)i.8. Comment: National emissions standards are critical for product and market stability, and will aid in accelerating emission reductions in California, since approximately 60% of HD vehicle miles traveled come from out-of-state trucks that are exempt from California standards. Accordingly, the Volvo Group recommends CARB defer action on a lower California-only NOx emissions standard and instead focus on policies that promote ZEV vehicle adoption in the immediate term while working toward an achievable national NOx standard. (Volvo)

Agency Response to Comments (l)i.7 and (l)i.8: No change was made in response to these comments. In the ISOR, CARB staff showed the air quality need for early emission reductions as well as the technological feasibility to begin implementation of the interim emission standards in the 2024 MY. This early implementation date of the reduced emission standards is necessary to achieve near-term air quality benefits in California. For details on the technological feasibility of the proposed 2024 MY emission standards, please see Agency Responses to Comments A.(a)i.1 and A.(a)ii.1.

Regarding federal standards, CARB staff will continue to work with U.S. EPA as the CTI is proposed and finalized, to encourage one national standard for 2027 and subsequent MY HDEs. For ZEV implementation, CARB has already approved the ACT Regulation, which requires California fleets to purchase ZEVs. The ACT Regulation and the Omnibus Regulation work together synergistically to achieve much needed emission reductions in California.

- (l)i.9. Comment: [C]ontrary to one of CARB's core rationales, the scope and timing of the Omnibus Regulations will not serve as "a model of success" for U.S. EPA to follow, as CARB asserts in its ISOR. (See ISOR, p. ES-19.) First, EPA could never justify the costs of CARB's unique Omnibus program on a nationwide basis. (See NERA Report, discussed infra, which shows that any EPA rulemaking would face a per-truck cost cap less than \$3,000.) Second, CARB's program is not calibrated for "success." (EMA, Daimler, Navistar, Volvo)

Agency Response: No change was made in response to this comment. The Proposed Amendments have been developed to address California's unique air quality needs, utilizing the most advanced emission control technologies in the on-road HD sector. CARB staff is hopeful that U.S. EPA will align with the majority of the proposed amendment elements to create a nationally harmonized HD program. In calculating the per-truck cost in the ISOR, the basis was on the population of vehicles in California. With economies of scale on a national

vehicle level, the estimated per-truck cost should decrease as compared to the estimated ISOR California per-truck cost. In addition, as emission control technologies continue to mature, emission control costs will typically decrease.

Throughout the rulemaking process, CARB staff has worked with engine manufacturers, emission control manufacturers, research organizations, and other affected parties to address challenges and issues associated with the elements of the Proposed Amendments. Since 2014 when CARB staff initiated work on this rulemaking, numerous issues relating to technological feasibility, test procedures, certification, in-use testing, etc. have been evaluated and addressed. Similar to CARB's rulemaking process, U.S. EPA will use its rigorous rulemaking process to develop the CTI Regulation and engage affected parties as well as provide the necessary analysis to determine costs and feasibility on a national basis.

- (l)i.10. Comment: With respect to those new certification standards, one important consideration that CARB has not addressed during the course of this rulemaking is the RMC test-point weighting factors. The [Supplemental Emission Test] SET (the precursor to the RMC) was first introduced into the regulatory certification and compliance program for HDOH engines in the early 2000's. Weighting factors were established for each of the 13 steady-state test points on the basis of typical engine duty cycles of that time. Since then, engine designs and calibrations, along with complete powertrain configurations, have led to significant engine down-speeding trends. Recognizing that trend, during the course of the GHG Phase 2 rulemakings, CARB (and EPA) used data from modern down-spiced engine designs to reweight the RMC test-point weighting factors. The adjustments made were not insignificant. A full 22% of the engine's weighted emissions output was transferred from the highest speed ("C" speed) to the lowest engine speed ("A" speed). That was determined to be necessary to ensure that the resultant CO<sub>2</sub> emissions from the RMC test would be representative of real-world emissions. There was not adequate time available during the course of the Phase 2 GHG rulemaking, however, to assess the consequences of reweighting the RMC test points with respect to criteria emissions (e.g. NO<sub>x</sub> and PM) certification-testing.

Currently, EPA is planning to set new HDOH criteria emissions standards through its CTI. As part of that rulemaking, EMA anticipates that EPA will take steps to align the criteria-emissions RMC test weighting factors with the new CO<sub>2</sub> RMC test weighting factors. Indeed, failing to do so would result in implementing new regulatory requirements utilizing test cycles no longer considered representative of today's lower speed engines. Not only will the reweighted RMC cycle promote the optimal technologies to achieve real-world emissions reductions, the harmonized test procedures also will provide greater efficiencies for manufacturers in their development and certification processes. EMA supports the alignment of the CO<sub>2</sub> and criteria-emission RMC weighting factors. CARB also should align those test cycles to achieve enhanced

environmental benefits and regulatory efficiencies. (EMA, Daimler, Navistar, Volvo)

Agency Response: No change was made in response to this comment. The technology demonstration work done at SwRI used the current RMC test cycle. They also ran the reweighted RMC test cycle required by Phase 2 GHG Regulation and found very little differences in the emissions control performance between the two RMC test weighting requirements. Currently, U.S. EPA requires the current RMC for criteria emissions and the Phase 2 revised RMC for GHG emissions.

As U.S. EPA prepares the CTI Notice of Public Rulemaking and Final Rulemaking in the coming months, CARB staff will be closely participating in the federal rulemaking progress, including federal revisions to the RMC test weighing factors. Once U.S. EPA finalizes its CTI rule, CARB staff would likely align the California test procedures to incorporate these revised federal RMC weighing factors to ensure harmonized federal and California engine test procedures.

- (l)i.11. Comment: Lastly, CARB and EPA need to eliminate administrative redundancies between the two certification programs. (CTA/ATA)
- (l)i.12. Comment: We encourage CARB and EPA to harmonize their HDIUT and minimize variation between CARB and EPA cycles for vehicle and engine manufacturers. (MEMA)

Agency Response to Comments (l)i.11 and (l)i.12: No change was made in response to these comments. Currently, engine manufacturers must certify their engines with both U.S. EPA and CARB. While many elements of the HD engine programs are identical between the California and federal programs, certain requirements have been adopted that are specific to California to address its unique air quality needs. Thus, separate certification programs between CARB and U.S. EPA are needed. In addition, a separate certification through CARB enables California to independently enforce its emission standards and test procedures on vehicles that drive in California. To the extent possible, superfluous and unnecessary redundancies between the two certification programs have already been eliminated, and CARB staff will continue to evaluate and eliminate any unnecessary redundancies. Regarding federal adoption of California HDIUT provisions and certification test cycles, CARB staff will continue to work with U.S. EPA as the CTI is proposed and finalized to encourage harmonized provisions for HDEs.

#### **(l)ii. CAA and Federal Waiver of Preemption**

- (l)ii.1. Comment: The Omnibus Regulations also are illegal, not only because they violate the requirements for adopting valid administrative regulations

(including under the California Administrative Procedures Act), but also because they directly violate the controlling “leadtime” provisions of the federal CAA. CAA section 202(a)(3)(c) mandates that new HDOH standards relating to the control of emissions cannot take effect unless the regulations afford four full-years of leadtime. CARB needs to demonstrate its compliance with CAA section 202(a), including the four-year leadtime requirement, in order to obtain a waiver of federal preemption under CAA section 209(b). (See 42 U.S.C. § 7543(b)(1)(c).) Since the Omnibus Regulations are providing only two years of leadtime for all of the 2024 MY requirements, CARB’s Regulations are violative of the controlling provisions of the CAA, are disqualified from receiving a waiver of federal preemption, and, as a result, are illegal. (EMA, Daimler, Navistar, Volvo)

(l)ii.2. Comment: CARB cannot demonstrate that manufacturers will have sufficient leadtime to incorporate into their product development and manufacturing plans all of the new elements and technological advances that CARB envisions will be required to meet the 2024 MY standards, which would include: heated urea dosing, improved engine and aftertreatment system calibration, increased EGR rates and higher idle speeds, engine hardware modifications, larger SCR catalysts and improved catalyst substrates, and repackaging and reorientation of aftertreatments systems in vehicles. Indeed, by the time the Omnibus Regulations actually become final in late-2021 after OAL approval, manufacturers would have only 2 full years of leadtime to try to meet all of the 2024 MY requirements. That amount of leadtime is clearly inadequate, and, as noted, is directly contrary to the controlling provisions of the federal Clean Air Act, which would preclude a preemption waiver for the Omnibus requirements, and which would render the 2024 standards and requirements invalid and unenforceable as a matter of law. (EMA, Daimler, Navistar, Volvo)

(l)ii.3. Comment: CARB must obtain a preemption waiver from EPA for its unique motor vehicle air quality rules. Given the proposal’s short lead time, it is not expected to qualify for an EPA preemption waiver. And, without an EPA preemption waiver, the rule will be rendered invalid and unenforceable. (TDAC)

Agency Response to Comments (l)ii.1 through (l)ii.3: No change was made in response to this comment. The lead time and stability provisions of section 202(a)(3)(C) of the CAA do not apply to emission standards and other emission requirements applicable to new engines that are established in this rulemaking action. Section 202(a)(3)(C) only applies to standards “promulgated or revised under this paragraph [section 202(a) of the CAA],” that is, to standards promulgated by the Administrator of the U.S. EPA. CARB adopted the emission standards and other emission requirements applicable to new engines and new motor vehicles pursuant to authority of California state law, and the waiver provisions of section 209(b) of the CAA, and therefore the lead time and stability

requirements of section 202(a)(3)(C) are inapplicable. Moreover, the Board directed CARB staff that to the extent it is necessary, to either request a waiver or a confirmation that the regulations are within the scope of an existing waiver of federal preemption pursuant to section 209(b) of the CAA.

Also, since 1970, U.S. EPA has typically applied a “two-pronged” test of whether California standards are consistent with CAA section 202(a) as required by section 209(b)(1)(C). The standards first must be technologically feasible in the lead time provided considering the cost of compliance, and second must be compatible with the federal test procedures so that a single vehicle could be subjected to both tests. No more should be required. This is in accord with the legislative history of section 209. When the California waiver provisions and the “consistent with section 202(a)” language were first placed in the CAA in 1965, section 202(a) consisted of just one sentence requiring adequate lead time in consideration of technological feasibility and economic costs. In the 1977 CAA amendments, Congress amended section 209 “to afford California the broadest possible discretion in selecting the best means to protect the health of its citizens and the public welfare.” (H. R. Rep. No. 294, 95th Cong., 1st Sess. 301 (1977), reprinted in 4 Leg. Hist., at 2768.) At the same time, Congress expanded section 202(a) to add several directives to U.S. EPA regarding its adoption of emission standards, including the four-year lead time requirement for HD vehicles. Given Congress’s expressed intent to strengthen the waiver provisions, it is clear that Congress did not intend to apply the specific four-year requirement to California, which would effectively narrow the deference provided to the state.

For a response related to the lead time necessary to implement the proposed 2024 MY emission standards, please refer to the Agency Responses to Comments A.(a)i.1 and A.(a)i.2.

- (l)ii.4. Comment: Additionally, ambiguity exists - particularly in the ACT rulemaking process – concerning the status of California’s waiver emissions program. Given that the status of California’s waiver program is being litigated and is not settled, there is concern as to whether CARB’s rulemaking authority regarding these rules is preempted in light of the federal administration’s action to roll back the state’s ability to enforce more stringent limits on vehicle emissions than prescribed by the federal government. We recommend that careful consideration is taken by CARB to avoid subjecting the rulemaking process to potential legal challenge. (WSPA)

Agency Response: No change was made in response to this comment. As discussed above in the Agency Response to Comments A.(l)ii.1 through A.(l)ii.3, California is the only state that is authorized to, in the first instance, adopt separate new motor vehicle and new motor vehicle emission standards, provided that it obtains a waiver from the U.S. EPA.

In September 2019, U.S. EPA and the U.S. Department of Transportation, through the National Highway Traffic Safety Administration (NHTSA), finalized an action in which U.S. EPA withdrew a previously granted waiver for California's GHG standards and ZEV standards for 2021 and later MY vehicles, and in which NHTSA adopted a regulation declaring that state GHG and ZEV standards are preempted by the Energy Policy and Conservation Act of 1975, "[t]he Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule Part One: One National Program." CARB, along with a number of other states and interested parties, are challenging that action. However, it is important to note that NHTSA's and U.S. EPA's actions only affect CARB's authority to promulgate GHG and ZEV standards for light-duty vehicles, and consequently, do not raise issues regarding California's authority to adopt the emission standards and other emission-related issues for medium and HD vehicles and medium- and HD vehicle engines at issue in this rulemaking action. It should further be noted that on January 20, 2021, President Biden issued an Executive Order that directed U.S. EPA and NHTSA to, in pertinent part, to consider publishing for public notice and comment a proposed rule to suspend, revise, or rescinding the SAFE Vehicles Rule Part One: One National Program by April 2021. NHTSA's proposed action to withdraw the SAFE Vehicles Rule Part One (SAFE-1) was published May 12, 2021. 86 Fed. Reg. 25980 (May 12, 2021), and EPA's proposed action to reconsider its actions taken in SAFE-1 was published on April 28, 2021. 86 Fed. Reg. 22421 (April 28, 2021).

### **(I)iii. Implementation of Early Low NOx Technology**

- (I)iii.1. Comment: The ultimate emission target in the Regulation (0.02 g/bhp-hr NOx) is already achieved in practice by renewable natural gas and propane operated low NOx fueled engines (current low NOx). Getting as many low NOx engines on the road should be of paramount importance to the Board, particularly given that production volumes under the ACT Regulation will take several years. The currently Regulation does not incentivize early adoption of the cleanest technology due to the additional regulatory burdens placed on the technology, coupled with the removal of incentive eligibility for those manufacturers that do take advantage of the Regulation's early crediting provisions.

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Given that the Regulation fails to provide meaningful rewards for manufacturers who already are producing low NOx technologies, it appears that the main goal of the Regulation appears to enable diesel technology to catch up with today's renewably fueled<sup>232</sup> low NOx trucks that already are certified at 0.02 g/bhp-hr NOx.

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<sup>232</sup> When running on low carbon renewable fuels, lifecycle greenhouse gas emissions are reduced substantially when compared to diesel, including "carbon negative" for some feedstocks.

Moreover, there is little incentive for manufacturers to bring more 0.02 certified vehicles to market prior to 2027. This is confirmed by staff in this regulatory package: ", because diesels have the existing market share, diesel engine manufacturers have not been motivated to differentiate themselves on the basis of improved NOx emissions performance, like their CNG- and liquefied petroleum gas-fueled competitors."<sup>233</sup> We strongly believe that more cleaner low NOx trucks would be introduced into the market if incentives were more generous and easy to obtain. More clean trucks also would be purchased if regulatory authorities required fleets to purchase low NOx trucks. (LNC, AFS)

- (l)iii.2. Comment: While the propane industry appreciates the intent of the proposed regulation, there are ways it could be improved. The emission target in the regulation of 0.02 g/bhp-hr NOx is already achieved by using renewable natural gas and propane operated low NOx fueled engines. However, the current proposed regulation does not incentivize early adoption of the cleanest technology due to the additional regulatory burdens placed on the technology as well as taking away any possibility for incentives for those manufacturers that do take advantage of the regulations' early crediting provisions. (NPGA)
- (l)iii.3. Comment: Despite advancements with renewable propane and increased offerings of propane low NOx engines, CARB is sending a signal to the market not to innovate but to instead continue with the status quo. (NPGA)
- (l)iii.4. Comment: NACAA strongly supports prompt establishment of a...program that...should incentivize early introduction of the cleanest engines and technologies for MYs 2024 through 2026. (NACAA)
- (l)iii.5. Comment: Despite our advancements with renewable propane and increased offerings of low-NOx engines, CARB is sending a signal to the market not to innovate, but instead to continue with the status quo. (WPGA)

Agency Response to Comments (l)iii.1 and (l)iii.5: No change was made in response to these comments. The Proposed Amendments represent a comprehensive strategy of regulating NOx emissions in clean HDEs, including low emission standards, representative test cycles, improved in-use compliance test procedures, and improved durability of emission controls both at certification and during in-use operation of the engines. While the proposed 0.02 g/bhp-hr NOx emission standard is a critically important component to achieving the overall goal of clean HDEs, the other proposed elements mentioned above are all essential to ensuring real emission reductions from HDEs over their lifetime of use. Thus, these additional proposed requirements in addition to a low NOx emission standard would be necessary for future MY clean HDEs.

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<sup>233</sup> CARB. Staff Report: Initial Statement of Reasons (ISOR) for the Proposed Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments. June 23, 2020. Page I-7

The advances already achieved for NG and propane engines that currently certify to CARB's optional 0.02 g/bhp-hr NOx standard provide a significant head-start toward complying with all the proposed Amendment requirements as compared to other engines that are certified closer to the current 0.20 g/bhp-hr NOx standard. Additionally, with further development, complying low-emitting engines qualify to participate in a proposed provision to generate significant emission credits by certifying earlier to the required emission standards. This provision provides credit multipliers, ranging from a 1.5 to 2.5 times the normal credit for 2022 through 2030 MY engines. Furthermore, in the 30-Day Notice Amendments, CARB staff included a new optional low NOx standard of 0.01 g/bhp-hr as measured on the FTP and RMC for 2022 and 2023 MY HDEs, to continue to innovatively encourage even lower-emitting engines. Another beneficial provision in the Proposed Amendments encourages the certification of HD ZEVs by allowing these vehicles to generate emission credits for the 2022 through 2026 MYs. These provisions will innovatively encourage the use of cleaner technologies as early as possible rather than the current status quo of legacy engines.

Regarding comments related to restrictions on financial incentive funding for optionally certified low NOx engines, please refer to Agency Response to Comments A.(I)iii.6 through A.(I)iii.9 below.

- (I)iii.6. Comment: Low NOx trucks, like ZEVs, should not lose eligibility for state vehicle incentives or other incentive programs if they receive early sales credits... There is a lack of near-term inclusion of low NOx trucks in the ACT Regulation and other recent regulatory decisions by CARB. We are not aware of any regulatory or incentive mechanism that will effectively achieve near-term NOx reductions in the HD space and we ask staff to outline what, if any, policies in the current portfolio would convince or require a fleet to adopt a 0.02 g/bhp-hr low NOx strategy over purchasing a new or ten-year-old used diesel engine.<sup>234</sup>

However, we do not believe the Regulation is in fact an early driver for low NOx truck adoption. Nor will it grow the low NOx truck market to meet the immediate air quality needs of the state for at least another decade. We believe the Regulation is a limited platform for promoting low NOx technology and highlights why incentive funding programs and fleet mandates are so critical. Even so, changes can be made to the Regulation that would incentivize additional sales of vehicles that are currently 90% cleaner than diesel. (LNC, AFS)

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<sup>234</sup> The Truck and Bus Regulation only requires the affected fleet owner to purchase a 2010 or newer diesel engine so 10-year-old used diesel trucks can be purchased to replace some or all of the more than 300,000 diesel trucks affected by the 1/1/2023 deadline.

- (l)iii.7. Comment: Low NOx trucks should be able to continue to participate in incentive programs including, but not limited to, Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project and/or a modernized and improved Carl Moyer Program, like all technologies that are not widely commercially available and which cannot yet compete with much cheaper diesel trucks. (LNC, AFS, NPGA)
- (l)iii.8. Comment: Low NOx trucks should not lose eligibility for state vehicle incentive programs if they receive early sales credits. (NPGA)
- (l)iii.9. Comment: [T]he way that this Regulation is designed, it makes fleets pick between Carl Moyer and this program. You cannot use both programs. We think that's an issue. We still believe that Carl Moyer is a good program. We still believe that there are definitely improvements necessary to make that work better for fleets to use with the air districts.

And so we're still looking forward to modernizing that program at some point and allowing it to reach its full potential. But having a regulation that makes you choose between one or the other, we don't think is an actual -- you know, strengthens the Carl Moyer program. And that's something that we should take a look at. (CNGVC)

Agency Response to Comments (l)iii.6 through (l)iii.9: No change was made in response to these comments. The Omnibus Regulation is primarily focused on setting technically feasible and stringent NOx emission standards for the HD sector in California for 2024 and subsequent MYs. As part of the Omnibus Regulation, CARB staff developed non-monetary incentive mechanisms for advanced emission control technologies including zero-emission technologies through the CA-ABT program. These include significant credits to incentivize manufacturers to make cleaner engine technologies, including the low NOx NG engines. Specifically, credits from one NG engine meeting a 0.020 g/bhp-hr NOx standard, and meeting all the other 2031 regulatory elements, could allow a manufacturer to avoid cleanup of as much as 14 dirtier diesel engines with the credits multipliers proposed in this Regulation. CARB staff believes this is a strong incentive for current NG engines certified to the 0.02 g/bhp-hr standards.

The Omnibus Regulation did not amend any of the monetary incentive programs, and the policies of such monetary incentive programs (such as the Carl Moyer Program) are beyond the scope of this rulemaking. CARB staff understands that some incentive funding programs, such as Carl Moyer, do not allow funding for engines that are also generating emission credits. However, as mentioned by the commenter, there are some incentive programs that do not have this restriction.

- (l)iii.10. Comment: CARB management has stated on numerous occasions that the early action credits are the incentives for early adoption within the Regulation, but in order to receive early credits with the "big multiplier" a manufacturer must sign up for additional and significant regulatory obligations and sacrifice

its low NOx engine's access to the only existing market incentives available to help penetrate the market. Specifically, the manufacturer must agree to additional (non-emissions) requirements for the 2024 MY and thereafter. Without taking on the additional liability risks, the sale does not qualify for the "incentive" credits. Therefore, if you do not sign up for the more robust in-use and durability testing prior to the 2024 MY you would get the minimal credit multiplier of 1.5 (per the table). These added requirements are not free. While the credits have "value" they must be seen in comparison to the other options for compliance. It very well may not be worth it for manufacturers to pursue the credits, thus rendering them valueless and providing no additional incentives to sell. (LNC, AFS)

Agency Response: No change was made in response to this comment. The current federal-ABT program already has a structure for cleaner-than-required engines to be able to generate emission credits. When it comes to the issue of multipliers associated with emission credits, CARB staff believes that manufacturers should only be able to get multipliers if they design, develop and distribute products that meet all future requirements in terms of emission standards, in-use requirements, durability requirements, etc. A multiplier would only be applicable if the manufacturer makes the necessary investments to produce products using advanced emission control technologies.

CARB staff does not believe that multipliers should be applied to current production engines and hence did not make a change to the Proposed Amendments in response to this comment. Under existing regulations, current cleaner-than-required production engines have a pathway for generating straight emission credits without any multipliers. Regarding availability of incentive funding, please refer to the Agency Response to Comments A.(I)iii.6 through A.(I)iii.9.

- (I)iii.11. Comment: Based on our experience and citations herein, the proposed Omnibus Regulation will NOT drive early low NOx truck adoption. Worse, the Regulation will ironically delay the deployment of lifesaving low NOx strategies into California's disadvantaged communities that are available today because the rule is silent on any fleet requirements and lacks any workable incentive to encourage immediate adoption of available technology. Effective regulatory programs and additional incentive dollars in the near term for low NOx trucks will increase the rate of deployment, bring it closer to true commercialization, and deliver an immediate improvement to local air quality and climate change. We do not believe the Omnibus Regulation, as currently proposed, will achieve any of these goals. (LNC, AFS)
- (I)iii.12. Comment: Coupling this Regulation with continued incentives via HVIP and a modernized Carl Moyer Program can improve the lives of California's most disadvantaged communities in the shortest timeframe. (LNC, AFS)

- (l)iii.13. Comment: Without a suite of incentives and regulations that promote the near-term implementation of low NOx technology, CARB will have failed its mission. (LNC, AFS)
- (l)iii.14. Comment: Unfortunately, as proposed, the Omnibus Regulation will not drive early adoption of low-NOx trucks and will not result in near-term emission reductions. Instead, the Regulation will ultimately place more conventional diesel trucks on our roads. (WPGA)
- (l)iii.15. Comment: We are one of 20 who signed on to a coalition letter from the industry -- the low-NOx industry that does not support the Regulation as it has been proposed. The proposed regulation will not drive early adoption of low-NOx trucks. And we feel that the focus not on the near term will actually drive more conventional diesel to be adopted by fleets.

What is concerning to the industry is that the language in the regulation, and the PowerPoint presentation today, and also even the fact sheet that was produced for this regulation does not provide any mention of near-term emission reductions, even though the first federal attainment deadline is in 2023. It's really focused on 2031.

Federal attainment, of course, is vital for near-term emission reductions. We even noticed on slide three [Board Hearing presentation slide] today that it mentions 12 million Californians breathe unhealthy air. And, of course, that's -- the only solution provided with this regulation is years from now. So we're not trying to say us over ZEVs -- low NOx over ZEVs. We're saying include us too. Let's have near-term emission reductions included in this proposal.

[W]e don't believe this regulation will achieve near-term air quality improvements and immediate health -- public health benefits. The industry is not in sport. And we request amendments to the regulation, so near-term emissions reductions are achieved now and well before the year 2027. (Clean Energy)

- (l)iii.16. Comment: [T]he Omnibus Regulation will do nothing to achieve near-term air quality improvements and immediate public health benefits.

Notably, no fleets or manufacturers are in support of the proposed regulation. Agility requests that CARB amend the regulation so that near-term emissions reductions are achieved now and well before 2027. (AFS)

Agency Response to Comments (l)iii.11 through (l)iii.16: No change was made in response to these comments. The Proposed Amendments aim to reduced emissions from new HDEs and do not apply to engines that are already currently in-use, which would result in immediate emission reductions. For the Proposed Amendments, any near-term emission reductions would be achieved when the

implementation occurs beginning in the 2024 MY, which is the earliest implementation date possible given adequate time needed for engine manufacturers to develop, test, certify, and produce new products. In addition, CARB staff has included the ability to qualify for credit multipliers opportunities for combustion technologies, such as today's NG engines certified to the optional low NOx standards. Also, please refer to the Agency Response to Comments A.(I)iii.6 through A.(I)iii.9.

To address immediate and near-term emission reductions, CARB staff has been implementing various other HD programs. One such program, the Truck and Bus Regulation, requires replacing older engines in HD vehicles with the new lower-emitting engines and has resulted in significant emission reductions from HD vehicles. Another program, the Air Quality Improvement Program, reduces emissions through voluntary, incentive measures such as the Clean Vehicle Rebate Project, truck and bus vouchers, and the Truck Loan Assistance Program. To address air quality in disadvantaged communities, CARB has established the Community Air Pollution Program, as directed by Assembly Bill 617 in July 2017, to develop and implement the best new strategies to measure air pollution and reduce health impacts in the near-term specifically at the community level.

In addition, CARB staff is currently developing another HD near-term reduction program, a comprehensive HD I/M Regulation, which would ensure that emission control systems on HD vehicles are properly functioning and remain low-emitting throughout their entire operating life. CARB staff's proposal to the Board is tentatively scheduled for the end of 2021 with proposed implementation in 2023.

- (I)iii.17. Comment: ZEVs are able to double or even triple count on credits while low NOx trucks cannot, which is picking winners and losers and delaying air quality improvements: if credits are received for low NOx engines, that vehicle will lose eligibility for ANY incentive funding in other programs. However, staff confirmed that ZEVs would obtain credit: 1. under the Omnibus Regulation through 2030; 2. via the ACT Regulation, which is "double counting," and 3. they would still remain eligible for incentive funding which is "triple counting."

This is unequal treatment with the picking of winners and losers by CARB between technologies and preventing free market decisions by truck owners. In addition, because ZEV HD trucks are not expected to be commercially ready for at least a decade, it disincentivizes the adoption of low NOx trucks which are readily available now. This unequal treatment will not address near-term NOx reductions, and won't allow the state to achieve attainment without significant truck turnover for the next decade. (LNC, AFS)

Agency Response: CARB staff did not make a change to the Proposed Amendments in response to this comment. The ACT Regulation creates a percentage-of-sales mandate for HD ZEVs in 2024 and subsequent MY timeframe. On the other hand, the Omnibus Regulation amends the current HD combustion engine emission standards.

Within the current HD emission standards regulations, zero-emission technologies are not eligible to generate any NOx emission credits, and HD combustion engines are only eligible to generate straight credits with no multipliers. CARB staff used these conditions as the baseline for developing additional incentive mechanisms for both combustion engines and zero-emission technologies.

As such, the Omnibus Regulation's CA-ABT program creates a pathway for HD-ZEPs to generate NOx credits but do not qualify for credit multipliers, and HD combustion engines that meet future emission standards and requirements would be eligible for early compliance credit with multipliers. Both mechanisms are non-monetary incentives that were added to the current regulatory structure via the CA-ABT program. Therefore, CARB staff believes that both zero-emission and low-emission combustion technologies will be incentivized under the Omnibus Regulation.

With regards to the policies of monetary incentive programs (such as the Carl Moyer Program and Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project), and in what cases HD ZEVs qualify for funding, are beyond the scope of this rulemaking.

- (l)iii.18. Comment: Low NOx trucks should not be subject to the Regulation's additional warranty, testing, and other requirements until 2027 as a requirement to obtain credits. Credits should be generated with current technology as-is, especially since this technology was made available more than 10 years ahead of the Regulation's proposed required standard. These additional warranty, durability, and in-use testing requirements are not cost-free and can substantially erode the value of the credits earned. Deploying these technologies early onto California's roads and disadvantaged communities should be the focus for incentivizing 0.02 g/bhp-hr trucks today. So-called incentives that place a heavy burden on the lowest emission technology and strips it of state and local vehicle incentives is a misstep and backward. The additional costs associated with the new regulatory burden can remove the value of participation for manufacturers and fleets. As-is, the value of the potential credit does not warrant the increased liability associated with having to adopt the more onerous future requirements. If the objective is to incentivize early actions, then all new regulatory burdens must be applied starting in 2027. (LNC, AFS)

- (l)iii.19. Comment: The additional requirements on items including warranties, useful life, and testing should not apply until the 0.02 g/bhp-hr NOx standard applies across the entire sector in 2027. (NPGA)

Agency Response to Comments (l)iii.18 and (l)iii.19: CARB staff did not make a change to the Proposed Amendments in response to these comments. The purpose of advanced technology multipliers generally is to encourage manufacturers to take actions they would not otherwise take to reduce emissions, earlier or more than otherwise would occur. Granting advanced technology multipliers to engines already being produced that do not meet all the elements of the Omnibus package (such as low-load cycle, HDIUT, etc.) would not be consistent with that purpose and would only serve to reduce the emission benefits of this Regulation by allowing an increased number of higher polluting engines.

Under the current regulatory structure, cleaner-than-required engines with emissions below the applicable standards are eligible for generating NOx emission credits. Under the Omnibus Regulation, additional emission credits through the credit multiplier pathway would only be available if the manufacturers make the necessary investments to design, develop and distribute products that meet all future MY requirements, not just the emission standard. These future MY requirements would ensure that future HD engine emission performance on-the-road is similar to what is observed in the laboratory at the time of certification. Without meeting these stringent requirements, credit multipliers would not be appropriate and hence would not be granted under the Omnibus Regulation.

- (l)iii.20. Comment: Staff should be directed to incorporate low NOx trucks as a compliance option in the upcoming ZEV fleet rule(s) in order to provide sufficient motivation for fleets to take substantial early action with currently available technologies. (LNC, AFS, NPGA)
- (l)iii.21. Comment: We encourage in the future ACT Regulation for some direction to be given to provide for a credit formula for fleets that deploy low-NOx vehicles now. (Clean Fleets)

Agency Response to Comments (l)iii.20 and (l)iii.21: The commenters' requests for modifying the Advanced Clean Fleet rulemaking are outside the scope of this rulemaking, and hence CARB staff did not make a change to the Proposed Amendments in response to these comments. However, the upcoming Advanced Clean Fleet rulemaking will also have an open comment period during its regulatory process. Stakeholders are encouraged to provide feedback to CARB staff at that time.

#### **(I)iv. Fuel Issues**

- (I)iv.1. Comment: WSPA believes regulations should be technology/fuel neutral and that the state should create an even playing field so that all technologies are allowed to compete to meet the needs of the state. Lower emission diesel, renewable diesel and bio-diesel, natural gas, hybrid powertrains and renewable natural gas vehicles should be able to compete on an equal footing, with the goal of achieving the targeted NOx and GHG emission reductions. We are concerned that the current rulemaking approach, which bifurcates consideration of ACT and Low NOx rules, limits consideration of the role for all technologies and fuels. That is because the analysis of all technologies and fuels should have been conducted comprehensively to understand what the potential opportunities are from both an emissions and cost perspective. Not having this comprehensive analysis likely impedes opportunities for quicker emission reductions in non-attainment areas and throughout the state. We highly recommend that CARB step back and take more of a comprehensive, technology/fuel neutral approach with greater stakeholder engagement on key technical issues before rule proposals are formulated. These steps should be the foundation of rulemaking, not done after rule adoption as has happened with the ACT rule and appears to be happening now. As we noted in our May 28, 2020 letter to CARB on the ACT rule, “it is unclear from CARB’s analysis whether the shorter-term air quality goals could be met utilizing currently existing low and ultra-low NOx technologies in a much more cost-effective manner than the approach currently proposed by CARB.” These important technical outreach and regulatory process steps are necessary to ensure that an expeditious and cost-effective emission reduction strategy is clear to all stakeholders and the Board. They should come before Board decisions on the Omnibus Low NOx and future Zero Emission Truck rules. (WSPA)
- (I)iv.2. Comment: The Omnibus Regulation should be amended to be fuel neutral, so that low-NOx trucks are treated the same as ZEVs. Without this change and given that full adoption of ZEVs will take a decade or more, what is CARB doing about clean air in the next seven years. (AFS)

Agency Response to Comments (I)iv.1 and (I)iv.2: CARB is committed to progress on near-term air quality targets while on a path to meet long-term air quality and GHG obligations. CARB staff has been closely following the costs of alternative fueled, advanced technology and zero emission technologies as part of the incentives program development and public process of the Annual Funding Plan. This has been augmented with specific work projecting costs for the type of diesel and gasoline engines expected for meeting Omnibus Regulation requirements. CARB staff has conducted an extensive public process for both the ACT and Omnibus Regulations detailing cost calculations and emissions reductions as well as the overlap between these concurrent rulemakings. CARB staff disagrees that delaying both ACT and Omnibus

Regulations would accelerate near-term air quality improvement or that such delay can be justified. Continued support for the lowest emitting engines in the near-term is part of CARB's commitment to near-term air quality target progress during a transformation to clean, sustainable transportation.

- (l)iv.3. Comment: Any inclusion of incentives for NG-burning engines considerably compromises the health of communities where NG is produced, and thwarts the leaps CARB is seeking to make towards a clean energy, clean air future. Any flexibility in the rule that incentivizes the continued development of NG engines and technology undermines the goals of such a bold rule and must be resolved. (LCJA)

Agency Response: Although CARB staff shares interest in potential upstream impacts of vehicle regulations and how those manifest at the community level, CARB staff did not change the Proposed Amendments or analysis in response to this comment. CARB staff is actively working to minimize impacts from oil and gas extraction, transmission and distribution including through the Greenhouse Gas Emissions Standards for Crude Oil and Natural Gas Facilities<sup>235</sup>, and the Natural Gas Leak Abatement Program<sup>236</sup> (per SB 1371, Leno 2014). Further, CARB staff is studying the impacts of oil and gas extraction on nearby communities through the Study of Neighborhood Air near Petroleum Sources<sup>237</sup> which may help inform additional measures to reduce exposure, while also working in parallel to address community scale direct impacts from heavy duty vehicles. Projects to capture fugitive methane and produce biomethane from organic waste sources for use in transportation are able to generate LCFS credits and have gained a significant and growing market share of transportation fuel used in California NG vehicles. These projects are displacing transportation demand for fossil NG, an effect which reduces the potential for increased NG extraction to meet transportation needs.

In the Omnibus Regulation, the NOx credit generation potential of engines cleaner than mandatory emissions standards declines with the phase-in of increasing Omnibus Regulation standards stringency (smaller available difference between the standard and the actual certified emissions rates). These declining credit opportunities are open to any fuel type cleaner engine. CARB staff believes the current Proposed Amendments balance the calls for immediate near-term air-quality progress with the need for rapid transformation to meet the longer-term air-quality and GHG obligations. CARB staff notes that even today's Optional Low NOx engines will have to meet additional requirements to qualify

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<sup>235</sup> More information on the Greenhouse Gas Emissions Standards for Crude Oil and Natural Gas Facilities can be found here: <https://ww2.arb.ca.gov/our-work/programs/oil-and-natural-gas-production-processing-and-storage>.

<sup>236</sup> More information on the Natural Gas Leak Abatement Program can be found here: <https://ww2.arb.ca.gov/resources/documents/senate-bill-1371-natural-gas-leakage-abatement>.

<sup>237</sup> More information on the Study of Neighborhood Air near Petroleum Sources can be found here: <https://ww2.arb.ca.gov/our-work/programs/study-neighborhood-air-near-petroleum-sources>.

under the Omnibus Regulation that they are not held to today, including the new LLC, the new in-use emissions assessment and as they phase-in the durability, useful life and warranty improvements. These changes are important to encourage continued development of the technology and improvements in actual long-term emissions performance.

- (l)iv.4. Comment: One general comment is to request that CARB encourage its staff to review the interaction between the Proposed Omnibus Rule and other CARB rulemakings that impact diesel fuel and biodiesel/renewable hydrocarbon diesel. Such rulemakings include those associated with the Low Carbon Fuel Standard (LCFS), the Alternative Diesel Fuel (ADF) rule, and the upcoming Low Emissions Diesel (LED) rule. As the Omnibus HD Regulation is implemented, CARB should direct its staff to identify and reconcile any potential differences or conflicts in purpose or direction that may exist between these programs so they can all be implemented in a more productive and effective manner. (NBB)

Agency Response: CARB staff did not change the Proposed Amendments or analysis in response to this comment. CARB staff working primarily on fuels issues was included in the Omnibus Regulation development effort. This collaborative cooperation between CARB staff with fuels and engine/vehicle technology expertise and program knowledge is anticipated to continue as CARB staff moves ahead with proposing or updating the aforementioned programs.

- (l)iv.5. Comment: The Proposed Amendment's technical foundation contains several data gaps and incorrect assumptions about biofuel quality, which are readily addressed with recent and ongoing work by NBB and others. In regard to sharing of information, the ISOR did specifically state: "Although the aforementioned data and studies are reassuring, because advanced aftertreatment has not been tested on biodiesel out to the longer useful lives recommended, and because current biodiesel blend stock recommendations are less protective than current DEF standards, CARB staff plans to continue to seek information on lifetime exposure/emissions impact relationships, prevailing fuel metals levels and to evaluate the potential need for future changes to biodiesel standards."...To further quantify this, NREL has recently partnered with the NBB and biodiesel suppliers who participate in the industry's BQ-9000 fuel quality program to collect, statistically analyze, and publish on-going values for various critical ASTM B100 properties that are requirements of the BQ-9000 program. BQ-9000 companies represent over 90% of the biodiesel produced in the U.S. each year, so the data set is quite robust with over 400 individual results for each of calendar year 2017 - 2019. (NBB)

Agency Response: CARB staff would welcome receiving a specific list of issues the commenters feel is being overlooked or incorrect and receiving further

research data and analysis should it become available in the future. CARB staff notes the recent appearance of the third annual BQ-9000 report <sup>238</sup> on biodiesel production quality that was not available in time for inclusion with the two previous BQ-9000 reports cited in the Omnibus Regulation ISOR. These most recent results were in line with expected ranges based on ASTM 6751 recommendations for biodiesel B100 blendstocks as applicable. This additional data did not highlight particular new concerns with variability or deviation from ASTM 6751 recommendations. Hence, CARB staff did not make any changes to the analysis or Proposed Amendments in response to this comment beyond this response and including the third annual BQ-9000 report in the Omnibus Regulation record.

- (l)iv.6. Comment: There is always the temptation to take half measures even when the best solution is up for consideration if the best solution is even a little bit out of the box. Hydrogen fuel cells are the best option for heavy duty vehicles given the range advantages existing fueling site locations, sustainability and synergies between applications - creation of smart grids, potential for grid stability uses and resilience in the form of backup during natural disasters. As a leader in environmental consciousness, California has the opportunity to create a clean industry and the workforce of the future, make significant improvements in air quality and noise reduction by incentivizing hydrogen technology. Existing vehicles can be retro-fitted with fuel cell prime movers extending or meeting the life cycle needs of capital investments already made and deploying new capital investment that meets or exceeds current life cycle needs. (IHC)

Agency Response: CARB staff did not change the Proposed Amendments or analysis in response to this comment. However, CARB staff share the commenter's interest in timely development and fielding of the cleanest and most flexible zero emission technologies as part of a comprehensive strategy for meeting near and long-term climate, criteria and community toxics goals. CARB staff is taking regulatory action in the ACT's ZEV sales requirement and in the Omnibus Regulation's early HD-ZEP NOx credit generation opportunities. CARB is also funding a number of demonstration and incentive programs to assist the development and early market for the fuel cell electric vehicles specifically mentioned by the commenter.

Even with the aggressive zero emission truck sales required under the ACT, there is projected to be a large number of combustion engines sold each year during the transition to ZEVs and subsequently operated for years thereafter. Hence, it is important to ensure these combustion engines are as low-emitting as possible, and that is the focus of the Omnibus Regulation. While CARB staff supports fuel cell and battery electric zero emission technologies including through regulations and incentives, this Omnibus Regulation seeks to require

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<sup>238</sup> More information regarding the third annual Assessment of BQ-9000 Biodiesel Properties for 2019 can be found here: <https://www.nrel.gov/docs/fy20osti/76840.pdf>

substantially improved performance from all HD engines that are sold during the transition to ZEVs.

- (I)iv.7. Comment: We believe that an opportunity exists to significantly reduce VOC emissions from gasoline HD engines by expanding Onboard Refueling Vapor Recovery (ORVR) to incomplete HD gasoline vehicles rated over 14,000 lbs. GVWR. The U.S. EPA and CARB regulatory framework offers the most comprehensive evaporative control program in the world for chassis certified vehicles. ORVR has been successfully implemented in the US and Canada for over 25 years. Engine-certified gasoline engines have missed a significant opportunity to reduce their VOC emissions, and MECA supports U.S. EPA's consideration of extending advanced canisters and ORVR systems to this category of engines and significantly reduce VOC emissions from these engines. (AESI)
- (I)iv.8. Comment: Today, both complete and incomplete heavy HD gasoline vehicles are implementing Tier 3 evaporative requirements, and all complete heavy HD gasoline vehicles will have ORVR by MY 2022. Incomplete heavy HD gasoline vehicles are the only class of gasoline motor vehicles without refueling control. There should no longer be implementation concerns, and with the availability of cost-effective control technology, we believe that ORVR requirements and testing should be applied to this final category of on-road gasoline engines to control these VOC and air toxic emissions from heavy HD gasoline vehicles. U.S. EPA has signaled their intent in proposing to tighten the refueling requirements for this category of HD gasoline engines under the CTI. We urge CARB to review the U.S. EPA final CTI rule and consider harmonizing evaporative refueling control requirements for this sector as part of future HD Omnibus Amendments. (MECA)

Agency Response to Comments (I)iv.7 and (I)iv.8: No change was made in response to these comments. As discussed in the comments, CARB staff agrees that reducing evaporative and refueling emissions from on-road vehicles may provide much needed HC emission reductions in California. In U.S. EPA's CTI Advanced Notice of Public Rulemaking, an evaluation of evaporative and refueling controls on incomplete HD gasoline vehicles was discussed, and U.S. EPA specifically requested comments on how to implement refueling requirements on this sector of vehicles, given the multiple manufacturers and testing issues. CARB staff provided comments to the Advanced Notice of Public Rulemaking and expressed support for this requirement. CARB staff will continue to work with U.S. EPA staff as they develop the CTI rule. Once the CTI Final Rule is promulgated, CARB staff will consider including harmonized ORVR requirements in a future CARB rulemaking.

#### **(I)v. Impact on Dealerships and Trucking Fleets**

- (I)v.1. Comment: The impacts of the proposed rule on the state's truck dealerships

and trucking fleets have not been adequately addressed. Missing from this rulemaking process has been a focus on the needs of the sellers and purchasers of these engines – the companies that will ultimately decide success or failure.

The differences between meeting certification requirements over standardized test cycles on an engine dynamometer and engine performance when operated in a vehicle on the road is highlighted in CARB's enforcement report,<sup>239</sup>

...staff has continued to receive complaints from fleet owners that they were experiencing more vehicle downtime with the newer engine technology. Anecdotally, some trucking fleets have had to purchase 10% more trucks to cover increased costs of downtime related to decreased durability of newer trucks. Downtime is important because while engine repairs are costly, the truck is also not working when it is being repaired, and this can cost a fleet \$500 per day or more...

Given the extent of problems that have been experienced with newer engines and SCR systems, it is imperative that both CARB and EPA work in unison to undertake comprehensive in-use testing of technologies that represent all seasonal and geographic parameters. Both agencies need to work together, either through memorandum of understanding or other mechanisms, to ensure continuity and consistency in testing protocols, procedures, and input parameters. (CTA/ATA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments in response to this comment. CARB staff analyzed the economic impacts of the Proposed Amendments to businesses and individuals. The Omnibus Regulation's original cost analysis is contained in Appendix C-3 of the Staff Report, and additional cost and benefits analyses to include the recently adopted ACT Regulation were performed in conjunction with the 30-Day and 15-Day Notice Amendments. The cost analyses primarily focus on the impacts to California fleets because the cost impacts to engine manufacturers for complying with the Omnibus Regulation are assumed to be passed on to the engine/vehicle operators in the form of increased upfront production and operational costs compared to current engines and vehicles. The cost impact to California's HD vehicle fleets is extensively discussed in both Appendix C-3 and the updated economic analyses for the Notice Amendments, which include examples of cost impacts to a typical fleet (California fleets with four or more medium- and HD vehicles) and a small fleet (California fleets with three or less medium- and HD vehicle).

Truck dealerships are mentioned in Appendix C-3 and the updated economic analyses for the Notice Amendments as one of the secondary industries that

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<sup>239</sup> California Air Resources Board, 2018 Annual Enforcement Report (June 2019).

would also be impacted due the Omnibus Regulation. HD vehicles complying with the Proposed Amendments are expected to cost more than existing HD vehicles and would be priced according to the manufacturer. The estimated cost increases of 0.5 to 10.4 percent in the purchase prices of new HD vehicles could affect the purchasing behavior of truck owners, and therefore affect truck dealerships. However, truck dealerships would also benefit from increased repair business generated from lengthening the warranties for HD vehicles. Furthermore, the retail and wholesale impacts to trucking dealership are addressed in aggregate in the on-road HD REMI.

In response to comments received from stakeholders, the Board recommended and directed CARB staff to consider modifications to the Proposed Amendments. Included in these modifications are some flexibilities for manufacturers and transit agencies in order to improve product availability in California for some engine/vehicle types. One such flexibility would be a limited exemption for 2024 through 2026 MY HD engines rated at or above 525 horsepower which have relatively few sales in California. The proposed change would provide manufacturers the flexibility to continue to certify and make products available for California businesses and consumers while allocating resources for other more popular engine families and zero emission engines. An additional proposed change includes the development of a process to allow qualifying transit agencies to request compliance flexibility or assistance in complying with the Proposed Amendments. Under this process, qualifying transit agencies may request exemptions to purchase, rent, or lease exempt buses, contract for service with bus service providers to operate exempt buses, or re-power buses with engines certified to federal emission standards under certain conditions for 2022 and subsequent model diesel-fueled HD engines used in urban buses.

In adopting low NO<sub>x</sub> standards for on-road HD engines and vehicles, CARB staff knew that it would also be important that these vehicles be durable throughout their longer service lives so that the emission benefits can be maintained. That is why CARB staff chose to include in the Proposed Amendments to simultaneously strengthen the durability requirements, and lengthen the useful life periods and warranty periods to ensure that HDEs and vehicles remain low-emitting throughout the majority of their operational lives. Low NO<sub>x</sub> HDEs will be required to undergo a more rigorous certification process to ensure that these engines will be more durable throughout their useful lives. The adopted durability requirements and longer useful life periods will reduce the possibility of new technology failing early which should help to reduce repair downtime. Lengthened warranty provisions will help encourage manufacturers to develop more durable engines and emissions control systems and minimize the out-of-pocket costs if and when emission control parts need to be replaced or repaired.

CARB staff held discussions with U.S. EPA staff numerous times during the rulemaking process to ensure harmonization of requirements to the extent feasible with respect to adopting new standards and test procedures, including

requirements for in-use testing. Indeed, CARB's rulemaking team met with their U.S. EPA counterparts every other week for several years to stay closely coordinated and to jointly discuss the technical underpinnings of the Omnibus Regulation. California's air quality concerns are greater than the rest of the nation; therefore, CARB had to act more quickly than U.S. EPA in order to address California's air quality nonattainment issues. The cooperation between U.S. EPA and CARB during the rulemaking process will ultimately result in better aligned standards and test procedures in the future.

- (l)v.2. Comment: Together, dealer companies in California collectively employ and support more than 10,000 Californians and their families. The new and used vehicles we sell, lease, and service to large and small businesses throughout the state are the lifeblood of California's economy and are especially vital in today's times. The proposed regulation contains an unprecedented, unworkable, and arguably illegal criteria pollutant standard for HD engines sold in California starting in 2024. We are very concerned that the adoption and implementation in 2024-2026 of this proposed Omnibus Low-NOx Rule will harm our industry, leading to job losses, lower tax revenue for state and local governments, and increased emissions. (TDAC)

Agency Response: Although CARB staff respects the dealer industry and appreciates its contribution to California's economy and economic well-being, CARB staff did not change the Proposed Amendments or analysis in response to this comment. The SwRI demonstration program and MECA modeling results support the feasibility of a 0.05 g/bhp-hr NOx standard. The SwRI program showed significant NOx reductions can be achieved just by changing engine calibration to reduce cold-start emissions and improved aftertreatment systems can further reduce NOx levels to meet the 2024-2026 NOx standard. Modeling by MECA demonstrated that improving engine calibration together with average-sized SCR catalysts, available in the market today, could reduce composite FTP NOx emission levels to 0.03 g/bhp-hr levels. In addition, a few manufacturers have certification data that show test results well below today's standards and nearly meeting the 0.05 g/bhp-hr NOx standard. This demonstrates that the 2024-2026 NOx standard is feasible and achievable. The total emissions benefit from the Omnibus Regulation for the time period from 2022 through 2050 is expected to be 352,797 tons of NOx.

CARB staff's analysis on the employment impact of the Omnibus Regulation predicts that as the requirements of the Proposed Amendments would go into effect, affected sectors would experience increases in production costs and hence slightly lower employment than they otherwise would have. The largest decrease in employment would manifest in the manufacturing, construction, transportation, and retail and wholesale trade sectors, which are estimated to realize an increase in production costs driven by the increased HD truck prices due to the Proposed Amendments. However, the change in employment due to the Proposed Amendments would represent no more than 0.01 percent of

baseline California employment in any year. Similarly, the business impacts measured as gross output are also likely to be affected by production costs and demand changes. The sector more significantly impacted would be the transportation sector and the years of maximum impact would be 2030 and 2034 at a decrease of 0.11 percent in output. However, annual impacts on total California output are predicted to never exceed 0.01 percent.

CARB staff disagrees with the commenter's assertion that the Omnibus Regulation mandates an illegal criteria pollutant standard for HD engines sold in California starting in 2024. As discussed in Chapter II, section B of the Staff Report, CARB is authorized to adopt standards, rules and regulations needed to properly execute the powers and duties granted to and imposed on CARB by law (H&SC 39600 and 39601). H&SC 43013 and 43018 broadly authorize and require CARB to achieve the maximum feasible and cost-effective emission reductions from motor vehicles, including the adoption and implementation of vehicle emission standards and in-use performance standards (H&SC 43013(a)) and by improving emission system durability and performance (H&SC 43018(c)(2)), resulting in an expeditious reduction of NOx emissions from diesel vehicles, "which significantly contribute to air pollution problems" (H&SC 43013(h)).

CARB staff disagrees with the commenter's assertion that that the Omnibus Regulation contains an unprecedented criteria pollutant standard for HD engines. The federal CAA grants California the ability to set its own emission standards to address the serious needs for improving air quality in the state. CARB has a long history of setting emission standards for HD engines that have become progressively more stringent with the development of emission control technologies. In 1970, the first HD engine emission standards that set limits on tailpipe CO and HC+NOx emissions were adopted by CARB and became effective in California in 1973. The first regulations to control HD engine PM emissions were adopted in 1986 and became effective in 1988. Since then, regulations to control HD engine pollutant emissions have become more rigorous, continuing in the 1990s through 2010, with increasingly stringent standards and test procedures for CO, HC, NOx, and PM emissions. The 2004 and 2007-2010 emission standards were made possible with significant advancements in emission control technologies with the use of cooled EGR, DPFs, DOCs, and SCR systems, as well as variable geometry turbochargers, high pressure fuel injection, and electronic controls. The Omnibus Regulation demonstrates the continuing push since the 1970s to strive towards cleaner-emitting HD engines and vehicles and agrees with the precedents set from past adoptions of emission standards.

Based on CARB staff's analysis, tax revenue for state and local governments would increase based on the higher purchase price of low NOx engines and vehicles being sold in California. Sales tax revenue for state governments is

projected to be \$177 million over the period from 2022 through 2050 and for local government is projected to be \$249 million for the same time period.

#### **(I)vi. Other Miscellaneous Comments**

- (I)vi.1. Comment: CARB's proposed Low-NOx Regulations are cost-prohibitive, infeasible, unenforceable and illegal. The cost implications, and the related pre-buy/no-buy response to the proposed requirements, will be highly disruptive to the California trucking industry, and potentially the economy as a whole, with marginal air quality benefits, especially as those benefits might relate to ozone attainment in the South Coast. The contemporaneous ACT Rule will further strain and dilute manufacturers' research and product-development resources, and thereby OEMs' ability to comply with those overlapping and overly burdensome provisions. The net result could be an absence of CARB-compliant HDOH products in California starting in 2024. Consequently, CARB should pause and fundamentally rethink the proposed Omnibus Regulations. (EMA, Daimler, Navistar, Volvo)

Agency Response: No change was made in response to this comment. CARB staff carefully evaluated cost, technological feasibility, enforceability, and other considerations of the Proposed Amendments during the rulemaking process as outlined in the ISOR. In the ISOR, CARB staff also discussed the need for significant HD vehicle emission reductions required for the attainment of air quality standards in California. While there may be undeniable impacts on the California trucking industry, the Proposed Amendments were developed during the public process with industry and other stakeholders to minimize negative impacts while still meeting the significant emission reduction needs. Furthermore, the ISOR evaluated interactions of the Proposed Amendments with the ACT Regulation in the Executive Summary as well as other sections, including the background, need for the Proposed Amendments, emission benefits, and costs. For a more detailed discussion of the specific areas of concern, please refer to the Agency Responses to Comments A.(i)j.1 and A.(i)k.1 for cost implications and the pre-buy/no-buy scenario, Comments A.(a)j.1 and A.(a)j.2 for lead time and 2024 MY product availability, Comment A.(a)k.1 for technological feasibility, and Comment A.(b)l.4 for enforcement procedures.

- (I)vi.2. Comment: Similarly unreasonable and unjustified is CARB's proposal to eliminate subsection (e) of 40 CFR 1068.5. That regulatory provision expressly allows manufacturers to request an administrative hearing if the manufacturer disagrees with the agency's determination to reject a manufacturer's application of good engineering judgement. CARB proposes to strip away that basic element of due process and to create a new power for itself to act as the sole arbiter of what is and what is not good engineering judgement. CARB should refrain from assuming that role as it would be manifestly unfair, violative of basic due process rights, and fundamentally

inconsistent with the manner in which EPA administers the parallel provisions of the corresponding federal regulations. There is no justification for CARB's proposal to eliminate administrative due process. (EMA, Daimler, Navistar, Volvo)

Agency Response: No change was made in response to this comment. CARB staff disagrees with the suggestion that the regulation should be modified to provide every affected manufacturer an opportunity to challenge CARB's determination that the manufacturer has not exercised good engineering judgment in making decisions under title 13, CCR section 2141(f) before an administrative law judge. The Fourteenth and the Fifth Amendments to the United States Constitution prohibit states and the federal government, respectively, from depriving persons of "life, liberty, or property, without due process of law." These provisions have both procedural and substantive aspects. The substantive aspects of these due process protections ensure that the substance of challenged governmental actions are consistent with the provisions of the Constitution. The procedural aspects of these provisions ensure that the government follows proper procedures before it acts to directly impair a person's constitutionally cognizable life, liberty, or property interests.

[In analyzing substantive due process challenges to a governmental action, courts first determine whether the action affects a fundamental right (or creates a suspect class of affected persons). Fundamental rights include the protections of most of the Bill of Rights. If a fundamental right is affected, a court will determine whether the challenged law was enacted to further a compelling governmental interest, and whether the law was narrowly tailored to achieve that interest.]

In *Mathews v. Eldridge*, 424 U.S. 319 (1976), the U.S. Supreme Court identified three factors that must be considered in determining whether a particular administrative procedure satisfies the requirements of procedural due process: (1) the private interest that will be affected by the official action; (2) the risk that the procedure could result in an erroneous deprivation of such interest, and the likely benefit provided by additional or substitute procedural safeguards; and, (3) the Government's interest, including the fiscal and administrative burdens that additional or substitute procedural requirements would require. In *Mathews*, the Court held that the administrative procedures at issue in that case, which expressly did not provide for an evidentiary hearing before the Social Security Administration terminated disability payment benefits of recipients, did not deprive said recipients of their procedural due process rights. The *Mathews* court affirmed that the fundamental requirement of due process is "the opportunity to be heard "at a meaningful time and in a meaningful manner." 424 U.S. 319, 333 (internal citations omitted).

The regulatory provision at issue, title 13, CCR section 2141(f)(4) requires manufacturers to exercise good engineering judgment in making decisions required under section 2141(f). For example, section 2141(f)(1) requires

manufacturers to, in pertinent part, analyze failures of and determine the probable cause of failures of emission-related components, and section 2141(f)(4)(B) requires manufacturers to submit written descriptions of engineering judgments when requested by CARB. Section 2141(f)(4)(D) provides that if CARB's Executive Officer rejects a manufacturer's decision on the basis the decision is not based on good engineering judgment, the manufacturer may be subject to penalties and/or have the opportunity to submit additional information to CARB's Executive Officer in order to further explain the basis for the manufacturer's engineering judgment.

The provisions of title 13, CCR section 2141(f)(4), when considered in light of the three factors identified by the Matthews court, satisfy due process requirements. First, the private interest at issue is a manufacturer's interest in exercising engineering judgment as needed to fulfill its obligations to comply with a regulation. That interest is not as significant as the interests of private citizens to continued disability or welfare benefits, especially in light of the fact a manufacturer is not automatically subject to liability if CARB disagrees with its exercise of engineering judgment. As discussed above, section 2141(f)(4)(D) provides that if CARB's Executive Officer disagrees with a manufacturer's exercise of good engineering judgment, the manufacturer still has the opportunity to submit additional information in order to validate the basis of its engineering judgment.

Second, the procedures provide manufacturers of the opportunity to be heard if the Executive Officer disagrees with their determinations that good engineering judgment has been exercised, § 2141(f)(4)(B), inform manufacturers of the specific engineering judgments at issue, *ibid*, provide manufacturers the opportunity to submit information relevant to the specific engineering judgments, § 2141(f)(4)(D), and ensure that the Executive Officer will meaningfully consider information submitted by manufacturers by requiring the Executive Officer to notify manufacturers of his or her decision, and to state the basis of that decision in writing, § 2141(f)(4)(E). The fact that the procedures are reliant on the written submission of information does not undermine the fairness nor the reliability of the procedures. In *Matthews*, the Court determined that evidentiary hearings or oral presentations to the decisionmaker would not substantially reduce the risk of an erroneous decision in the context of hearings that involved information derived from medical sources, such as treating physicians, and in light of the fact that "[s]uch sources are likely to be able to communicate more effectively through written documents than are welfare recipients or the lay witnesses supporting their cause. The conclusions of physicians often are supported by X-rays and the results of clinical or laboratory tests, information typically more amenable to written than to oral presentation." *Matthews* at 345. These considerations likewise apply to CARB's procedures, in that the decisions are entirely reliant on information derived from technical sources, such as opinions of engineers, who are likely to more effectively communicate information through written presentations.

Third, the procedures do reflect the government's interest in "conserving scarce fiscal and administrative resources", Matthews at 348. Notably, the Mathews court stated that "[t]he judicial model of an evidentiary hearing is neither a required, nor even the most effective, method of decision making in all circumstances. The essence of due process is the requirement that 'a person in jeopardy of serious loss (be given) notice of the case against him and opportunity to meet it.' (internal citations omitted), *ibid*.

Finally, CARB notes that a manufacturer that is directly affected by an Executive Officer decision in implementing § 2141(f)(4) may request an administrative hearing to review that decision pursuant to the provisions of title 17, CCR sections 6055.1 et seq.

- (l)vi.3. Comment: We cannot wait another 11 years to achieve meaningful reductions from the largest emission source under your authority. We certainly cannot afford a pre-buy/no-buy scenario as outlined by the EMA. We can and should do better. Our disadvantaged communities stand in the balance. That is why I'm asking the Board to direct staff to include low-NOx trucks that meet a 0.02 gram NOx standard as a key component of the Advanced Clean Fleets Regulation. (Clean Energy)

Agency Response: CARB staff did not change the Proposed Amendments or analysis in response to this comment. CARB staff's research on supply and demand and price elasticity suggests that for every one percent increase in cost there could be a decrease in demand of two percent to six percent. To avoid paying for higher priced low NOx trucks, consumers may decide to keep their existing vehicles longer, or purchase used vehicles or "new" federally certified vehicles out-of-state. In fact, some fleets are already doing this now to avoid paying higher sales tax and registration fees. CARB staff conducted a sensitivity analysis on the effects of a pre-buy/no-buy cost scenario. In the mechanics of a pre-buy/no-buy scenario, it is assumed that there will be a decrease in the purchase of low NOx vehicles and therefore a decrease in both cost and emission benefits of the regulation. Using a scenario where 20 percent of the projected sales volumes decrease as a result of a no-buy, shown in the table below as Scenario B, the total NOx benefits would be 206,312 tons for the period from 2022 through 2050 with a cost of \$3.6 billion, savings of \$528 million, and a cost-effectiveness of \$7.50 per pound of NOx. The pre-buy/no-buy argument was comprehensively addressed by CARB staff in response to EMA's pre-hearing comments in section 7-6 of Attachment B to Resolution 20-23. As such, it was concluded that even if a pre-buy scenario occurred, the benefits of the Omnibus Regulation would still be significant, cost-effective, and worth pursuing.

**Table IV.A.(I)vi.3.1 Pre-Buy/No-Buy Scenario Comparison with Proposed Amendments**

<b>Scenario</b>	<b>Total Cost of Regulation [Millions]</b>	<b>Total Savings of Regulation [Millions]</b>	<b>Total NOx Benefits [Tons]</b>	<b>Cost-Effectiveness [\$/Ton]</b>	<b>Cost-Effectiveness [\$/lb]</b>
<b>Primary</b>	\$4,495	\$650	352,797	\$10,896	\$5.45
<b>A, OOS</b>	\$3,622	\$528	282,212	\$10,965	\$5.48
<b>B, No Buy</b>	\$3,622	\$528	206,312	\$14,999	\$7.50
<b>C, Natural Gas</b>	\$3,682	\$547	298,944	\$10,485	\$5.24

The Omnibus Regulation complements the existing ACT and proposed Advanced Clean Fleets Regulations in that the ACT and Advanced Clean Fleets Regulations focus on promoting the development and use of zero-emission HD vehicles while the Omnibus Regulation focuses on the development and use of low-emission combustion HD vehicles. Currently, both low-emission combustion and zero-emission HD vehicles serve their purpose in the transportation sector. These regulations will ensure that future HDEs and vehicles will be the cleanest possible where feasible. Regarding the Advanced Clean Fleets Regulation, addressing recommendations to this regulation is beyond the scope of these Proposed Amendments and should be directed to the CARB staff of the Advanced Clean Fleets Regulation. The homepage for the Advanced Clean Fleets program is <https://ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets> where interested parties can follow regulatory developments and the public process of that rulemaking.

(I)vi.4. Comment: The global COVID-19 pandemic also is forcing EMA-member companies to consider the practical realities of how the pandemic will impact their operations and business outlook over the next several years. While it is difficult to predict the scale and duration of the impacts on member-company operations and finances (including access to capital) — let alone the scope and duration of the likely damage to the U.S. and global economies — we all must acknowledge the gravity of the situation, and consider and plan for practical measures to deal with the crisis, and ultimately its aftermath. To that end, EMA strongly urges CARB to reconsider the program elements and effective dates of the Omnibus Regulations, which, even before the current crisis upended the world, would present unworkable and cost-prohibitive challenges to manufacturers, and may, as we have noted, preclude future HDOH product availability in California. (EMA, Daimler, Navistar, Volvo)

Agency Response: No change was made in response to this comment. As a result of the current COVID-19 pandemic, CARB staff has accordingly provided flexibilities as needed for current programs. For warranty reporting requirements

and corrective action, engine manufacturers have generally continued to comply with these requirements during the pandemic. In instances where manufacturers have not been able to meet the requirements, CARB staff has allowed for some flexibility to accommodate manufacturers. An example would be allowing manufacturers requesting extensions to have additional time for warranty reporting.

For HDIUC testing, CARB staff has provided COVID-19 relief for engine manufacturers implementing a vehicle recall, where engine manufacturers may delay recalls until California's stay-at-home orders are lifted. This also provides extra time for engine manufacturers to produce and build capacity on the recalled part. For the manufacturer-run HDIUT, CARB staff provided relief of mandatory testing and reporting by not issuing any 2020 test orders to require engine manufacturers to test vehicles. In addition, upon requests from engine manufacturers, CARB staff has approved extensions of testing and reporting requirements for 2019 test orders as allowed by the applicable regulations. Furthermore, CARB staff has suspended utilization of the Department of Motor Vehicle tie-in program for new vehicle recalls such that vehicle registration is not blocked if recall repair work is not performed. This is helpful as it potentially reduces the number of vehicle owners that visit a service center at a given time, thus aiding service centers with implementing social distancing. As illustrated in these examples, CARB staff has worked with engine manufacturers to accommodate them if issues related to COVID-19 arise.

As such, CARB staff will continue to work with engine manufacturers and provide flexibilities as warranted during the implementation of the Proposed Amendments as a result of the COVID-19 pandemic. Thus, no change was made to the Proposed Amendments in response to this comment.

- (l)vi.5. Comment: CARB needs to consider the relationship between engines and engine oils.... CARB's Omnibus Regulations are infeasible and unworkable not only because they provide insufficient lead time for engine technology development, but also because they fail to consider related effects – such as those pertaining to engine lubricants. The proposed low-NOx standards and extended useful life and warranty periods could have significant impacts necessitating new engine oil formulations. CARB's proposed implementation schedule, however, does not allow for such necessary considerations. (EMA, Daimler, Navistar, Volvo)

Agency Response: No changes to the Proposed Amendments were made in response to this comment. CARB staff recognizes that engine lubricants are a critical component of efficient long-lasting engine and aftertreatment systems. As underscored by the series of specifications leading to today's CK-4 and FA-4 engine lubricants, CARB staff expects continued progress optimizing lubricants including better tribological protection, enhanced oxidative stability, enhanced soot tolerance, reduced residual ash and related components, and lower overall

friction. However, projecting continued lubricant development was not used as basis for the proposed standards, warranty and useful life periods. For further detail on the development of the warranty and useful life periods please see the Agency Responses to Comments A.(c)i.1, and A.(c)ii.1 and A.(c)ii.2. The proposed emissions standards, warranty and useful life periods were developed based on data using commercially available engine lubricants. The chemical aging of aftertreatment systems on the Low NOx demonstration engines at SwRI utilized the manufacturer recommended lubricant for the baseline engines. Historical engine and vehicle survivability trend assessments came from broad field datasets that were not restricted on the basis of type of lubricant and would be expected to represent the prevailing market mix of lubricants in use by the sequence of fleets registering vehicles and eventually selling them to engine rebuilders.

In addition, the advanced engine architecture durability testing reported by Achates Power was performed using commonly available commercial engine lubricant.<sup>240</sup> <sup>241</sup> This advanced engine architecture has been recently demonstrated to meet Low NOx emissions without adding aftertreatment components to the basic DPF/SCR type systems used today.<sup>242</sup>

- (l)vi.6. Comment: We recognize CARB may receive requests for exemptions for certain engines that are manufactured in small volumes. We request that, should CARB establish compliance flexibilities for certain categories of engines, these flexibilities be tailored to have limited applicability and duration. (NESCAUM)

Agency Response: No change was made in response to this comment. CARB staff did not intend to generate a general small volume engine family exemption through this heavy-haul exemption provision. Instead, CARB staff focused on a segment of the HD diesel sector (in this case heavy-haul applications that use engines at or above 525 hp) where the total production volume for the whole sector is small, and the engine production costs are relatively high comparing to the other sectors.

For this particular sector, CARB staff provided a limited term (2024 through 2026 MY) window where manufacturers could continue to distribute federally certified engines in California. In order to prevent any significant increase in production of

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<sup>240</sup> Chown, D., Koszewnik, J., MacKenzie, R., Pfeifer, D. et al. "Achieving Ultra-Low Oil Consumption in Opposed Piston Two-Stroke Engines, SAE Technical Paper 2019-01-0068, 2019, doi:10.4271/2019-01-0068. <https://achatespower.com/wp-content/uploads/2019/12/2019-01-0068.pdf>

<sup>241</sup> "Achates Power Opposed-Piston Engine Oil Consumption & Durability Results." <https://achatespower.com/wp-content/uploads/2021/02/Durability-Assessment-of-OP-Engines-Feb.2021.pdf>

<sup>242</sup> "Achates Power Opposed-Piston Heavy-Duty Diesel Engine Demonstration Performance Results – Ultralow NOx without additional hardware." <https://achatespower.com/wp-content/uploads/2020/12/Achates-Power-Opposed-Piston-Heavy-Duty-Diesel-Engine-Demonstration-Performance-Results-Ultralow-NOx-without-additional-hardware.pdf>

these engines, CARB staff imposed a sales cap based on the highest sales volume of 2018 or 2019 MY engines. The sales cap would ensure that these engines would continue to constitute a small fraction of the California HD diesel engine market in the specified time period of 2024 through 2026 MY engines.

- (l)vi.7. Comment: We suggest that CARB consider funding an on-road demonstration of the low-NOx engine from SwRI after installation in a vehicle. (MECA)

Agency Response: No change was made in response to this comment. To support and develop the proposed NOx emission standards, in 2014 CARB sponsored the Low NOx Demonstration Program with SwRI. Funded in partnership with MECA, U.S. EPA, SCAQMD, and engine manufacturers, the program grew to \$5 million and has demonstrated the feasibility of achieving significantly lower exhaust emissions from HD engines; it has achieved its primary purpose of supporting the proposed low NOx emission standards.

Current efforts continue to demonstrate advanced technology on HD vehicles. CARB has funded a project that includes on-road demonstration of the opposed piston technology capable of complying with the 0.02 g/bhp-hr NOx engine (note that this is not the SwRI low NOx engine.) Two advanced technology engines will be installed in heavy HD vehicles with a minimum 3-month demonstration and data collected using PEMS; this will likely occur later in 2021.

- (l)vi.8. Comment: In proposing the regulatory package, staff identify two alternative scenarios for establishing new heavy duty truck NOx standards that may be considered instead of the current CARB proposal in Appendix D to the CARB Low-NOx Omnibus Staff Report, Emissions Inventory Methods and Results for the Proposed Amendments. Alternative Scenario 1 advances engine NOx requirements to start in MY 2022 and is estimated to result in 5 tpd in 2024 and 8.2 tpd in 2025 of NOx statewide reductions. Without implementing Alternative Scenario 1, the Amendment will result in a significant shortfall from the NOx reduction commitments in the 2018 PM2.5 Plan. The Valley Air District recommends that CARB carefully consider Alternative Scenario 1, which would allow for additional early emission reductions to be achieved statewide and in the Valley. (SJVAPCD)

Agency Response: No change was made in response to this comment. Alternative 1 was proposed by the SCAQMD in its letter to CARB staff on May 24, 2019, where the same elements for the Proposed Amendments would be implemented on an earlier timeline, two years earlier for interim engines and three years earlier for low NOx engines. While Alternative 1 would achieve greater NOx reductions in California sooner, the accelerated schedule would not provide enough lead time for the development of interim engines in 2022 and the low NOx engines in 2024. Without sufficient time for engine manufacturers to conduct research, development, and durability testing, products will not be able

to meet the stringent criteria of the Proposed Amendments. Manufacturers need sufficient lead time for full product development from proof of concept to full production. After much consideration, Alternative 1 was not recommended, because it did not provide the necessary lead time for engineering and full product development.

- (l)vi.9. Comment: [W]e believe the current Regulation, as proposed, will not achieve the desired NOx emission reductions to reach attainment. Instead, it risks undermining the air quality improvements expected from this Regulation and the recently passed ACT Regulation while imposing economic hardship on the state's fleets, truck dealers and goods movement industry.

CARB staff's proposed Omnibus Regulation requires significant NOx and PM reductions, new testing protocols, additional reporting measures, increased warranty and useful life provisions, as well as expanded durability and OBD requirements, all on top of national major GHG requirements which will add significant risks and cost penalties for the Volvo Group, our suppliers, and customers. (Volvo)

Agency Response: No change was made in response to this comment. The Proposed Amendments would implement two on-road HD measures in the 2016 State SIP Strategy.<sup>243</sup> In the ISOR, CARB staff carefully identified the need for the proposed elements of the Amendments in section II.C and described these elements in detail in section III.A. Projected costs for the Proposed Amendments were calculated in section IX. of the ISOR for costs to engine manufacturers, to businesses and individuals, and to government agencies. Since the Board Hearing, CARB staff has conducted additional cost and benefits analyses to include the recently adopted ACT Regulation and the 30-Day and 15-Day Notice Amendments. Please see Agency Responses to Comment A.(i)i.1 and A.(k)i.12.

In 2031, projected NOx emission benefits of the Proposed Amendments are estimated to be approximately 17.4 tpd statewide and 5.2 tpd<sup>244</sup> in SCAB. These emission benefits were calculated using CARB's latest mobile source emissions inventory model EMFAC2017, which incorporates the latest available information on vehicle emission rates, population, and VMT. CARB staff estimated the overall cost-effectiveness of the Proposed Amendments to be \$4.51 per pound of NOx reduced, which is within the range of the cost-effectiveness of CARB's previously adopted measures.

In the executive summary (page 16) of the ISOR, the interaction of the Proposed Amendments and the ACT Regulation are discussed. Although the ACT Regulation and the Proposed Amendments would broadly apply to the same category of on-road vehicles, the primary goal of the ACT Regulation is to

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<sup>243</sup> CARB. [2016 State Strategy for the State Implementation Plan for Federal Ozone and PM2.5 Standards](#) (State SIP Strategy). March 7, 2017

accelerate the introduction of zero-emission trucks in applications that are best suited for electrification, while the Proposed Amendments would reduce NOx emissions from all new on-road HD engines and ensure those emission reductions are maintained when the engines are operated on the road. Rather than undermine the ACT Regulation, the Proposed Amendments complement it by ensuring that the portions of manufacturers' engine family lines that are powered by internal combustion engines will be emitting at the lowest NOx emission standards possible.

Please also see the Agency Responses to Comments A.(a)iv.1, A.(a)iv.2, and A.(f)i.2 through A.(f)i.4 for information on lead time issues and technological feasibility.

- (l)vi.10. Comment: The Low NOx Omnibus Rule, the ACT rule, the Heavy-Duty Inspection and Maintenance Program, accelerating fleet turnover through incentive funding and other strategies must form a clear and comprehensive plan to eliminate trucking pollution in California. (ALA)

Agency Response: No change was made in response to this comment. California's comprehensive strategy to achieve attainment with the NAAQS is clearly described in detail in the 2016 State SIP Strategy<sup>245</sup>, its official and legally binding plan to meet these standards over the next fifteen years. The Proposed Amendments would implement two on-road HD measures in the 2016 State SIP Strategy. Please refer to this document for further details of the comprehensive plan to eliminate trucking pollution in California.

- (l)vi.11. Comment: Electric trucks will be on the market and are critical to meeting our long-term climate and air quality goals, and CARB's proposed stringency targets should reflect the availability of this NOx-reduction strategy. (UCS)

Agency Response: No change was made in response to this comment. The stringency of the proposed emission standards was established through rigorous test programs on NG and diesel engines and on technological improvements that may be made to achieve low NOx emissions. Since the certification standards are for internal combustion engines, electric powertrains and vehicles were not taken into consideration when establishing the stringency targets of the proposed emission standards. However, other California regulatory programs, such as the adopted ACT Regulation and the currently proposed Advanced Clean Fleet Regulation being developed, will advance usage of electric vehicles in the HD marketplace.

- (l)vi.12. Comment: We're still not convinced, based on conversations that we've had, that the rule does the thing that I think is something that all of us want which

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<sup>245</sup> CARB. [2016 State Strategy for the State Implementation Plan for Federal Ozone and PM2.5 Standards](#) (State SIP Strategy). March 7, 2017

are reductions in air quality. The ones you can get right now, we're still not seeing that happening. (CNGVC)

Agency Response: No change was made in response to this comment. As described in section V.B of the ISOR, CARB staff's analysis of the air quality benefits associated with the Proposed Amendments used CARB's latest mobile source emissions inventory model EMFAC2017, which incorporates the latest available information on vehicle emission rates, population, and VMT. Since the Board Hearing, CARB staff has conducted additional cost and benefits analyses to include the recently adopted ACT Regulation and the 30-Day and 15-Day Notice Amendments. Please see Agency Responses to Comment A.(i).1 and A.(k).i.12.

In 2031, projected NOx emission benefits of the Proposed Amendments are estimated to be approximately 17.4 tpd statewide and 5.2 tpd in SCAB. CARB staff estimated the overall cost-effectiveness of the Proposed Amendments to be \$4.51 per pound of NOx reduced, which is within the range of the cost-effectiveness of CARB's previously adopted measures. For information on near-term emission reductions, please refer to Agency Response to Comments A.(l).iii.11 through A.(l).iii.16.

- (l).vi.13. Comment: Also linked to those new preconditioning requirements is a provision that "emissions performance should not deteriorate, degrade, or decrease upon successive repeats of the certification cycle." That vague requirement provides no meaningful guidance to manufacturers regarding how they should account for test-to-test variability, or small changes in calibrated settings due to changes in the initial certification-cycle test (such as stored SCR NH3 levels or SCR temperature). Moreover, such a requirement is not appropriate for inclusion in the CFR Part 1065 testing procedures; any requirement such as that should be included in the standard-setting provisions. (EMA, Daimler, Navistar, Volvo)

Agency Response: No change to the Proposed Amendments was made in response to this comment. CARB staff added additional language in the 30-Day Notice Amendments to clarify the requirements with regards to preconditioning prior to certification testing. Specifically, the new language highlights that emissions control targets should not be changed during back-to-back tests where the conditions are similar. CARB staff understands variability in emissions during back-to-back testing and has included language as such. For example, CARB's proposed language states the emissions should be consistent during back-to-back testing where test conditions are similar; the language does not state that emissions must be exactly the same during back-to-back testing. CARB staff does not agree adding the preconditioning requirements to the standard setting provisions in 13 CCR 1956.8, since the Diesel Test Procedures are already incorporated by reference in 13 CCR 1956.8(b), which makes them

part of the standard setting provisions. Please see also Agency Response to Comment B.(a)vii.2

## B. Comments Received During the 30-Day Comment Period

Table IV.B.1 lists the commenters who submitted comments in response to the first 30-Day Notice Amendments, arranged in the time order in which the comments were received. The table identifies the date in which the comments were submitted, commenter name, and affiliation. Following the list is each objection or recommendation from these commenters, together with an agency response providing an explanation of how the proposed action has been changed to accommodate the objection or recommendation, or the reasons for making no change. To easily find comments by topic, the 30-Day comments have been arranged by topic with the same headings and subheadings as the comments received before or at the hearing, in section A.

One commenter, SwRI, provided a final report to support the technological feasibility of the proposed action. In addition, many of the commenters provided comments in support of certain elements of the 30-Day Notice Amendments. These comments of support are appreciated by CARB staff but are not summarized below in this section.

**Table IV.B.1. Written Comments Received During the 30-Day Comment Period**

<b>Commenter</b>	<b>Affiliation</b>
Sharp, Christopher (May 10, 2021)	SwRI
Gookin, Nate (May 17, 2021)	Private citizen
Button, Doug (June 3, 2021)	South San Francisco Scavenger Co., Inc. (Scavenger)
DeVaney, Randy (June 3, 2021)	Mid Valley Disposal (MVD)
Segal, Errol H. (June 3, 2021)	Active Recycling Co., Inc (Active)
Wilcock, Justin (June 4, 2021)	Marin Sanitary Service (MSS)
Erman, Ceyhun (June 4, 2021)	TEMSA
Karr, Luke (June 4, 2021)	Southern California Disposal Co., Inc. (SCD)
Holmes, Laurie (June 4, 2021)	MEMA
Fenton, Dawn (June 4, 2021)	Volvo
Bretecher, Brad and Burcar, Kirk (June 4, 2021)	New Flyer of America Inc. (New Flyer) and Motor Coach Industries, Inc. (MCI)
Biggio, David (June 4, 2021)	Mill Valley Refuse Service (MVRs)
Panero, Jacob (June 4, 2021)	Varnier Bros., Inc. (Varnier)
Chance, Barbara (June 4, 2021)	Allison
Waters, Sean (June 4, 2021)	DTNA
Berry, Steve and French, Timothy (June 4, 2021)	EMA
Yeager, Jackie (June 4, 2021)	Cummins
Alexander, Meredith (June 4, 2021)	CALSTART
Brezny, Rasto and Geller, Michael (June 4, 2021)	MECA

**(a) Comments Related to NOx and PM Standards for 2024 and Subsequent MY HD Engines**

**(a)i. New 2024 Through 2026 MY NOx and PM Emission Standards for HD Engines**

(a)i.1. Comment: We request that owners of solid waste collection vehicle be granted a similar flexibility in the proposed regulation. The Notice of Public Availability (at p. 6-7) provides CARB's rationale for the exemption. Please note the following similarities and parallels between transit's situation and waste collection's situation, which support our request for the ability to apply for an exemption from the Executive Officer between 2021 and 2027 to purchase diesel engines that may not be certified to otherwise-applicable Low-NOx standards:

1. The 8.9-liter diesel engines for urban bus and the 8.9-liter diesel engines for waste collection vehicles are made by the same manufacturer and are nearly identical.
2. The same engine manufacturer expressed its intent to no longer produce the 8.9-liter for waste collection vehicles in California starting in 2024, as well as the 11.9-liter diesel engine that powers many waste collection vehicles. To our knowledge, diesel engines of this size will not be available from any other manufacturer in California, because of various challenges to meeting the low NOx standards for these engines.
3. If waste collection companies are not able to purchase diesel trucks beginning in 2024, the only alternatives are CNG or ZEV. CNG fueling infrastructure may not be available at the vehicle's home base. ZEV infrastructure development is the current focus, but ZEV vehicles and charging equipment may not be widely available or affordable by 2024. Without the required equipment and infrastructure, waste haulers cannot operate CNG and ZEV vehicles.
4. Older refuse trucks will need to be replaced in compliance with the Truck & Bus Regulation. If new clean diesel trucks are not available, the unintended consequence may be waste collection companies having to continue operating older, less environmentally-friendly trucks, which may lack state-of-the-art safety features.
5. The waste industry continues to be impacted by the financial toll of COVID-19, as well as the continuing recycled commodities market plunge. Neither our company nor the waste industry has unlimited access to capital, and CARB has restricted our ability to rely on grant funds to help offset the higher costs of CNG and ZEV trucks.

The Modified Text of the proposed regulation is published at a time when the future of heavy-duty truck regulation is uncertain. Despite the industry's billion-dollar investment in CNG, the end of state CNG incentives and support is either looming or past. A ZEV manufacturer deadline is approaching, with no clear path forward on a fleet rule or infrastructure.

We are deeply concerned with the removal of clean diesel engines from our range of options during these critical transition years, and we encourage you to modify the present proposal to add the exemption request process for waste collection vehicles. We are committed to working with staff to craft an appropriate and fair flexibility. (Active, MSS, MVD, MVRs, Scavenger, SCD, Varner)

- (a)i.2. Comment: Manufacturers' product offerings will be limited for California and other states adopting CARB's Omnibus Regulations, compared to the rest of the country. In response, CARB has appropriately Proposed Amendments with limited exemptions for engines at or above 525 horsepower and for diesel transit bus engines. Cummins supports those transitional flexibilities. However, other customers and markets beyond high-horsepower applications and transit agencies are expected to also go underserved due to limited product offerings. Cummins remains concerned about vocational vehicle applications. Because many of those vehicles are essential to support our daily lives, CARB should finalize additional transitional flexibilities to allow manufacturers to temporarily sell a limited number of EPA-certified engines in California. The higher emissions from those engines could be more than offset by CARB not finalizing its proposed restrictions on NOx credit opportunities, which then would ensure customer needs are met with a simultaneous benefit to the environment. (Cummins)
- (a)i.3. Comment: MCI is requesting that the 2024 diesel engine exemption outlined under 1956.8(a)(2)(F) of the amendments be extended to include motor coaches for both public and private operators. (New Flyer and MCI)
- (a)i.4. Comment: In our August comments in response to CARB's 60-day proposal, Cummins shared its intent to work towards meeting the proposed MY 2024 0.050 g/bhp-hr NOx standard with advanced technology internal combustion engines and powertrains, including alternative fuel options, even as concerns remained with the sweeping changes proposed in the Regulation. We highlighted some of the significant uncertainties and challenges which manufacturers are facing in implementing CARB's new MY 2024 requirements due to the shortened, two-year lead time and the unprecedented scope of change to certification and compliance protocols. Cummins appreciates the proposed 30-Day changes that are intended to provide additional clarity and improve manufacturers' ability to comply, such as:

- Removal of the 50-state option for MY 2024-2026
- Additional options for new durability / DF demonstration testing
- Prohibitions against interfering with certifying manufacturers' access to the in-use data needed to meet the new DF reporting requirements
- Additional compliance margin for the new moving average window (MAW) in-use compliance protocols
- The ability for zero-emissions powertrain manufacturers to generate NOx credits

While these and other proposed changes are steps in the right direction, they do not fully address all the concerns. Lead time remains short, with no margin for delays that might be encountered while attempting to understand and implement all-new regulatory requirements and at the same time develop and validate new products to meet them. CARB should allow discretion by certification staff in the final rule to address significant timing issues that may arise leading up to and during the certification application process.  
(Cummins)

- (a)i.5. Comment: The proposed time frame of regulation transition is not sufficient for the designing and manufacturing process. The designing and manufacturing process of just one vehicle takes approximately 2 years. So it seems impossible to design and produce the vehicles which meet the requirements regarding this proposed regulation for 2024MY. So the application of this proposed rule is more reasonable for 2027MY. As a vehicle manufacturer, we will need to improve our vehicle models from now but unfortunately the engine manufacturers are not ready yet to supply us with their solution for the California market. And supposing that we made our buses ready for the California market, we have to start for the next improvement for 2027 MY. We suggest making the necessary improvements in one time and sell these buses to either California or the other states with 2027MY with the best air quality solution. As a result of our consideration of the regulation in terms of the market, our determinations are given below:

1- According to the proposed rule, each engine manufacturer will have to choose whether to CARB certify to a new California low-NOx standard only those engines to be sold in California. This approach ensures neither uniformity of standards nor a level playing field among manufacturers. In fact, it holds the potential to create competitive imbalances not only in California, but in each of the other 49 states.

2- This proposed rule may create economic disparities outside of California. If only one manufacturer were to certify their national product line to the proposed 50-state standard, they would incur a cost disadvantage on sales occurring outside of California due to the added cost of meeting the California standards. As a result, the proposed approach has the potential to create

economic disparities among businesses located wholly outside the state of California.

Based on all the reasons discussed above, we respectfully urge your office to direct CARB to hold the 2024-2026 standards in the Omnibus Low-NOx rule in abeyance and instead focus its resources on aligning with the EPA on a single nationwide engine Low-NOx standard for 2027. (TEMSA)

Agency Response to Comments (a)i.1 to (a)i.5: Based on these comments, CARB staff has revised the Proposed Amendments by introducing a provision in title 13, CCR, section 1956.8(a)(2)(C)3 that allows for limited production of legacy engines rated below 525 bhp in 2024 through 2025 MYs. This new certification pathway would allow engine manufacturers to certify and distribute up to 45 percent of their HD diesel as legacy engines in the 2024 MY, and 25 percent in the 2025 MY. In order to produce and distribute legacy engines, engine manufacturers must offset all excess emissions generated by legacy engines using credits from the zero-emission averaging set or other sources approved by CARB.

CARB staff believes that the legacy engine provision would eliminate any product availability concerns and issues raised by the commenters for HD diesel engines rated below 525 bhp.

- (a)i.6. Comment: The proposed exemption for model year 2024 through 2026 engines rated at 525 HP and above would create a competitive disadvantage between OEMs, including a specific disadvantage to the Volvo Group. Based on Volvo's understanding from staff, the 525 HP and up exemption is proposed in order to provide a solution for heavy-haul applications that are of limited volumes and would not justify the investment in a compliant engine. But the Volvo Group offers proprietary powertrains for these heavy-haul applications with lower HP rated engines and 2L less displacement. For example, the Volvo Group offers a 500 HP – 1,850 lbf\*ft 13L engine in low volumes and in the same applications as other engine manufacturers offering 525 HP – 1,850 lbf\*ft and higher rated engines. These engines are typically offered in heavy-construction vehicles, heavy-haul tractors, and demanding long-haul tractors, the latter of which typically run higher horsepower to traverse steep grades and high mountain passes. Beyond this, the fact is that 525 HP engines are not limited to heavy-haul application vehicles at 120,000 lbs gross combined vehicle weight (GCVW), but are also frequently used in 80,000 lb GCVW trucks. That means this exemption, based solely on horsepower rating, would allow many more exempt engines to operate in the state than intended to meet specific heavy-haul demanding applications. Without a volume cap based on the average annual percentage of heavy-haul vehicle purchases in the state (vehicles at 120,000 GCVW) rather than historic volumes of higher horsepower engines, this exemption would enable the use of these exempt engines in other applications and undermine CARB's stated goal of limiting the volume of exempt engines into heavy-haul

applications. The Volvo Group strongly believes that the exemption must be further refined to avoid a competitive disadvantage among engine manufacturers. This can be done most efficiently and fairly by changing the exemption to one defined by application (heavy-haul) which can be easily tracked by the vehicle's GHG subfamily certification. If instead CARB chooses to define the exemption by horsepower rating, it should reduce the level to 500 HP – 1,850 lbf\*ft to maintain a level playing field and prevent discrimination against Volvo Group and other OEMs who can meet the needs of this application through cleaner, more efficient engine technology. (Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. In order to prevent excessive production of relatively dirty HD engines that are rated at or above 525 bhp (heavy-haul engines), the Proposed Amendments limit the future production volume of heavy-haul engines based on the 2018 or 2019 MY California productions for each certifying engine manufacturer. For example, if a manufacturer sold a total of 90 heavy-haul engines in 2018 MY, and 100 heavy-haul engines in 2019 MY in California, they would be limited to selling no more than 110 heavy-haul engines in each of the 2024-2026 MYs in California. Although some of these heavy-haul engines are currently used in applications other than heavy-haul, CARB staff believes that, historically, the vast majority of heavy-haul engines sold in California are indeed used in heavy-haul applications, and there is no information that would indicate a future shift in this practice.

In developing this exemption provision, CARB staff reached out to Volvo and other certifying engine manufacturers in California to collect information regarding historical sales of engines in California that are used in heavy-haul tractors and whether the current exemption provides a level playing-field. The result indicated that the vast majority of heavy-haul engine sales in California (during 2018-2019 MYs) were rated at or above the 525 bhp range. While one engine manufacturer distributed a small number of heavy-haul engines between 500-525 bhp, that manufacturer requested CARB to keep the status of the exemption as is since it would be difficult for them to track which engine ends up in which vehicle. Furthermore, most engine manufacturers indicated their preference for keeping the status of the exemption as is, and EMA which is the industry trade group representing engine manufacturers took a neutral stance on this issue.

Given that the majority of engine manufacturers favor the current version of the exemption, CARB staff believes the current proposal does create a level playing-field.

**(a)ii. Aftertreatment System Used to Demonstrate the New 2024 Through 2026 MY NOx Standards for HD Engines**

30-Day comments were not received for this subsection.

**(a)iii. Fuel Economy and GHG Emissions Related to the 2024 MY Standards**

- (a)iii.1. Comment: We appreciate and fully support CARB's efforts to maintain alignment with the EPA Technical Amendment package. Further to that effort we have identified several areas of nonalignment and request that CARB adopt all EPA technical amendments as described in the EPA Pre-publication version, March 10, 2021. We would like to highlight the following provisions that are not aligned with EPA:

§1036.150(q) and §1036.235(c): CARB should align with EPA's March 10, 2021 Technical Amendments for these provisions related to fuel map confirmatory test procedures.

§1036.701(j): CARB should allow for carry-over of Phase 1 vocational engine credits when recalculated against the revised Phase 2 baseline, in alignment with EPA's March 10, 2021 Technical Amendments.

§1037.501(i): CARB should align with EPA provisions related to declared GEM inputs and compliance margins.

§1037.660: CARB should align with EPA provisions related to partial credits for neutral-at-idle technology and should include the additional stop-start overrides, in alignment with EPA. (EMA)

- (a)iii.2. Comment: The modifications to the Test Procedures are closely aligned with the EPA's recently signed (awaiting publication in the Federal Register) Technical Amendment package (EPA Prepublication version from March 10, 2021, or "Pre-publication version"). Though closely aligned, there are several key provisions that CARB did not adopt, which appear arbitrary and capricious. The Volvo Group requests that CARB fully align the amendments to the Test Procedures with the EPA's March 10, 2021 pre-publication version to avoid creating reduced flexibilities, increased stringencies, and additional cost and complexity resulting in undue burden for manufacturers without added greenhouse gas reductions. (Volvo)

- (a)iii.3. Comment: 1036.150(p): CARB did not adopt the alternative 2024-2026 vocational engine standards for manufacturers who participated in the 2020 pull-ahead of the 2021 engine standards. In the Phase 2 final rule EPA provided an option for manufacturers to certify 100% of their 2020 model year engines to the 2021 Phase 2 requirements (see 1036.150(p)). The optional pull-ahead provided manufacturers with the flexibility of extended tractor

engine credit life and an alternate model year 2024-2026 standard. CARB accepted the provision without change in its Final Phase 2 Greenhouse Gas Amendments to “California Greenhouse Gas Exhaust Emission Standards and Test Procedures for 2014 and Subsequent Model Heavy-Duty Vehicles” effective April 1, 2019. In the prepublication version EPA has extended this same flexibility to vocational engines. However, CARB is not proposing to adopt the EPA provision, even though their comments to the NPRM were in support and reiterated the EPA’s justification:

“CARB staff agrees with U.S. EPA's proposed alternative standards for vocational engines. These alternative standards are only about 0.7 to 0.8 percent less stringent than the corresponding primary standards. In addition, as U.S. EPA stated, vehicles installed with engines certified to a less stringent standard would still be required to meet the applicable Phase 2 vehicle standards. Hence, this provision would provide vocational engine manufacturers more flexibility without reducing the overall GHG emission benefits.”

Furthermore, according to the EPA’s Pre-publication version preamble (II.B.2):

“Instead of certifying engines to the final year of the Phase 1 engine standards, manufacturers electing the alternative instead certified to the MY 2021 Phase 2 engine standards. Because these engine manufacturers reduced emissions of engines that would otherwise have been subject to the more lenient MY 2020 Phase 1 engine standards, there can be a net benefit to the environment [emphasis added].”

Accordingly, the Volvo Group supports the EPA’s pre-publication version allowance and its justification and urges CARB to re-evaluate their omission and adopt the prepublication version allowance. (Volvo)

- (a)iii.4. Comment: 1036.701(j)(2): CARB does not allow for carry-over of Phase I MHD and HHD vocational engine credits when recalculated against the Phase II vocational engine baselines. As noted, the EPA requested comment in their Phase 2 Technical Amendment NPRM on whether it should allow manufacturers to carry-over Phase I vocational engine credits if they were recalculated against the revised Phase 2 baseline. EPA finalized this provision in its Pre-publication version. Again, CARB did not adopt the provision, even though it commented in support and, once again, restated EPA’s main justification in their argument for the proposal:

“CARB staff agrees with U.S. EPA's proposal. It would be reasonable to allow manufacturers to generate Phase 1 credits with respect to the Phase 2 baseline and use those for the Phase 2 program as it would reflect their actual Phase 1 certified emission level and Phase 2 baseline. In addition,

regardless of whether the engines would need to use credits to meet the Phase 2 engine standards, vehicle manufacturers who use those engines will still be required to meet the applicable Phase 2 vehicle standards; hence the use of Phase 1 credits would not result in an emissions dis-benefit to the Phase 2 program overall.”

Again, the Volvo Group supports the EPA’s pre-publication version allowance and its justification and urges CARB to re-evaluate their omission and adopt the pre-publication version allowance. (Volvo)

- (a)iii.5. Comment: 1036.150(q): CARB did not adopt the engine fuel map confirmatory testing measurement variability allowance of 2% based on EPA and EMA sponsored testing at SwRI.

We urge CARB to reconsider its position with respect to the engine fuel map confirmatory testing measurement variability allowance. The Volvo Group believes that CARB’s insistence in its comments to EPA that the allowance reduces engine stringency by 40% is misguided and has absolutely no impact to engine stringency.

CARB asserts in their comments that the engine fuel map measurement allowance “would effectively give away 2 percent of a 5 percent CO2 benefit from the Phase 2 engine standards” and that “this clearly represents a significant erosion of stringency”; however, this allowance only applies to confirmatory testing of engine fuel maps (which do not impact the engine standards of 40 CFR 1036) and defines the procedure for determining when the agency would replace a manufacturer’s fuel maps.

In their comments to the EPA’s Phase 2 Technical Amendment NPRM CARB requested EPA provide an end-date for the provision. In lieu of a fixed end date the EPA’s pre-publication version response noted that the allowance is an interim provision that the agency will re-evaluate as they “learn more about the impact of measurement variability during fuel mapping, including the full impact of the proposed test procedure improvements that are intended to reduce measurement variability.”

In order to accomplish this EPA intends “to enter into a round robin study of criteria and GHG pollutant engine testing variability with interested engine manufacturers, with the involvement of the Truck and Engine Manufacturer’s Emission Measurement and Testing Committee. This data will add to the existing knowledge regarding the variability of the FTP, SET and fuel mapping test procedures and may help inform if future action is needed to further improve the test procedures.”

The Volvo Group strongly urges CARB to finalize the EPA provision and suggests that CARB join the multi-stakeholder cooperative effort to find a fair solution for all parties. (Volvo)

- (a)iii.6. Comment: The Volvo Group requests that CARB also adopt the following EPA pre-publication version provisions:

1037.501(i): CARB did not adopt language from the EPA meant to assuage suppliers' concerns over non-conformance penalties, thereby giving them confidence not to apply error margins to all component certification data they provide to OEMs. EPA envisions that the OEM would apply a single margin to the FEL on most supplier components that would account for the maximum possible error from any single component under audit or confirmatory test.

1037.660: CARB did not adopt any of the changes of this section which specify how to claim partial credit for neutral-at-idle technology that does not fully disengage the torque converter, as well as updated safety over-ride conditions for Automatic Engine Shutdown systems, Engine Stop-Start, and Neutral-at-idle. (Volvo)

- (a)iii.7. Comment: 1036.235: CARB's modification currently aligns with May 12, 2020 EPA update, but will need to align with the EPA March 10, 2021 prepublication version in order to provide for updated test procedure and 2% allowance determination of 1036.150(q). (Volvo)

Agency Responses to Comments (a)iii.1 through (a)iii.7: No change was made in response to this comment as part of the Omnibus Regulation. Because of the date U.S. EPA finalized their Phase 2 GHG technical amendments, there unfortunately was not time for CARB staff to align with all provisions of the Phase 2 GHG technical amendments as part of the Omnibus Regulation. However, CARB staff is planning to eventually propose amending CARB's Phase 2 GHG Regulation to align with U.S. EPA on the following sections 1036.150(p), 1036.230(f), 1036.701(j), 1037.501(i), and 1037.660 as part of a future HD rulemaking, tentatively within a rulemaking anticipated to align with U.S. EPA's CTI.

However, as discussed in the submitted comments on the Notice of Proposed Rulemaking for U.S. EPA's Improvements for Heavy-Duty Engine and Vehicle Test Procedures, and other Technical Amendments, CARB staff has serious concerns in section 1036.150(q), as well as some provisions in section 1036.235, regarding effectively giving away 2 percent of a 5 percent CO<sub>2</sub> benefit from the Phase 2. There is no need to replace a manufacturer's fuel maps during confirmatory testing if the measured fuel maps are within 2 percent of the manufacturer's maps. This means manufacturers could exceed the standards by 2 percent and still technically be in compliance.

**(a)iv. New 2027 and Subsequent MY NOx Emission Standards for HD Engines**

30-Day comments were not received for this subsection.

**(a)v. Aftertreatment System Used to Demonstrate the New 2027 and Subsequent MY NOx Emission Standards for HD Engines**

30-Day comments were not received for this subsection.

**(a)vi. Cylinder Deactivation Technology**

30-Day comments were not received for this subsection.

**(a)vii. LLC**

- (a)vii.1. Comment: §1065.518.B.1.: EMA supports CARB’s proposal to retain the current “default” number of allowed preconditioning cycles (specifically, two preconditioning cycles). It is appropriate and beneficial that CARB maintain the same requirements as under the federal regulation.

To be clear, and consistent with the provisions of §1065.680.B.1., EMA recommends that the provision include the addition of the underlined text:

For confirmatory testing, you may request Executive Officer approval for us to run more than two preconditioning cycles; the Executive Officer shall approve this upon determining that the extra preconditioning cycles are limited to the minimum technically necessary to meet the intent of this section, for example, to restore ammonia in the SCR catalyst due to the effect of DPF regeneration on NH<sub>3</sub> storage in the SCR catalyst; that emissions during the operation from the end of the regeneration through the end of the requested extra preconditioning cycles (preceding the standard preconditioning cycles not requiring Executive Officer approval) are fully accounted for in the measurement and calculation of emission factors  $EF_L$  and  $EF_H$  as specified in section 1065.680 of these test procedures; and that the request for extra preconditioning cycles was made prior to the engine family being certified.

The Regulation should also acknowledge that the LLC, which is proposed by CARB to use two *FTP* preconditioning cycles, is an exception to the requirement in this provision that “the specific cycles for preconditioning are the same ones that apply for emission testing.” (EMA).

Agency Response: No changes to the proposed Amendments were made in response to this comment. The intent of the language is to include all preconditioning cycles in the measurement and calculation of the emission factors  $EF_L$  and  $EF_H$  when the preconditioning limits in §1065.680.B.1 have

been exceeded. Therefore, CARB staff cannot include the suggested language. Further, the preconditioning for the LLC has been clearly stated in the regulation.

- (a)vii.2. Comment: §1065.518.B.2. includes new requirements regarding emissions stability during successively repeated emissions tests.

The requirement at issue establishes unreasonable expectations regarding measured tailpipe emissions stability when repeating a certification cycle multiple times. Measurement variability will play an obvious role in the differences in the measured results from one test to the next. The environmental conditions in the test cell can vary over time, influencing tailpipe emissions results. During recent “Round Robin” testing among industry, regulatory agencies, and other laboratories, the same test article was shown to have decreases in subsequent hot FTP tests in one lab, but increases in another:

### Individual FTP NO<sub>x</sub> Results –Volvo, Cummins, PACCAR

	Set	Cold 1	Hot 1	Hot 2	Hot 3	Composite	Hot-Avg
EPA4	1	0.437	0.081	0.072	0.063	0.132	0.072
Group 2	2	0.472	0.088	0.074	0.060	0.143	0.074
New SCR	3	0.456	0.085	0.081	0.070	0.138	0.079
	<b>Average</b>	<b>0.455</b>	<b>0.085</b>	<b>0.076</b>	<b>0.065</b>	<b>0.138</b>	<b>0.075</b>
	Stdev	0.0177	0.0035	0.0046	0.0050	0.0055	0.0033
	Cvar	3.9%	4.1%	6.1%	7.7%	4.0%	4.4%

- Volvo results showed a downward trend

	Set	Cold 1	Hot 1	Hot 2	Hot 3	Composite	Hot-Avg
Cummins-2	1	0.471	0.059	0.055	0.047	0.118	0.054
Group 2	2	0.496	0.052	0.055	0.042	0.115	0.050
	3	0.473	0.067	0.050	0.047	0.125	0.055
	<b>Average</b>	<b>0.480</b>	<b>0.059</b>	<b>0.053</b>	<b>0.045</b>	<b>0.119</b>	<b>0.053</b>
	Stdev	0.0136	0.0077	0.0032	0.0029	0.0052	0.0026
	Cvar	2.8%	13.1%	5.9%	6.4%	4.3%	5.0%

- Cummins-2018 results generally stable day-to-day

	Set	Cold 1	Hot 1	Hot 2	Hot 3	Composite	Hot-Avg
PACCAR	1	0.461	0.072	0.055	0.059	0.127	0.062
Group 2	2	0.472	0.081	0.078	0.063	0.137	0.074
	3	0.464	0.087	0.074	0.067	0.140	0.076
	<b>Average</b>	<b>0.466</b>	<b>0.080</b>	<b>0.069</b>	<b>0.063</b>	<b>0.135</b>	<b>0.071</b>
	Stdev	0.0059	0.0075	0.0125	0.0041	0.0068	0.0076
	Cvar	1.3%	9.5%	18.1%	6.5%	5.1%	10.8%
							<b>0.0105</b>

- PACCAR results showed small increasing trend



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These variations could be even more significant, on a relative basis, at the very low emissions levels that will need to be demonstrated when certifying products to CARB’s 2027 NO<sub>x</sub> standards. For example, a 2024 or 2027-compliant engine may have a hot-FTP measured test result of 0.001g/bhp-hr, with a subsequent hot-FTP measuring 0.002 g/bhp-hr. A mere 0.001 g/bhp-hr increase of that type, an entirely possible and, in fact, highly probable outcome with future engines, is actually a 100% increase in measured emissions. This example clearly illustrates the need for reasonable limits regarding emissions increases. Manufacturers require reasonable limits that

they can design to and staff require reasonable limits that they can enforce in a reasonable manner.

Additionally, there is no reason to expect that the entry conditions to a hot-FTP cycle with or without a soak period following the cold-FTP/20-minute-soak/hot-FTP certification cycle would be the same or similar to the entry conditions of the “official” hot-FTP that follows the 20-minute soak period. The NH<sub>3</sub> storage levels may not be the same. There can be aftertreatment temperature differences that could influence emissions levels. Indeed, any number of factors can influence tailpipe emissions in such a case. The SCR-related variables mentioned are an indisputable consequence of utilizing this important technology, the very technology that CARB has literally doubled-down on in the feasibility demonstration by Southwest Research Institute for the 2027 NO<sub>x</sub> standards.

CARB staff have explained that they expect manufacturers to design their emissions control systems and control strategies to be fully robust against small deviations in emissions when running consecutive repetitive tests, even when there are no limitations on varying soak times between tests. That is an unreasonable expectation, for which CARB has made no demonstration of technical feasibility. Without reasonable limits on the amount by which the highest of successive repeat tests might be permissibly greater than the official test of record, this provision is simply not workable.

One approach a manufacturer could consider to ensure compliance with the successive repeats emissions-increase prohibition is to develop controls that essentially guarantee, or at least improve the chances that, the first test is always the highest in the series. That approach, however, would violate the prohibition on differing control commands in successive repeats: “The emissions control system should not use different control targets upon successive repeats of the certification cycle given the same or similar test conditions.” EMA has concerns with that *control stability* requirement as well. One should expect natural variability in the table values used to command functions caused by the variability of sensed values, or even true values, during the test cell measurement procedures. Moreover, there is considerable uncertainty associated with the phrasing “same or similar input conditions.” There is also the possibility that periodic control strategies could be invoked that would “use different control targets,” such as an approved AECD [auxiliary emission control device] that assesses and adjusts stored ammonia levels in the SCR catalyst, or the initiation of an intrusive monitor. Future engines are likely to expand upon the implementation of controls that constantly monitor engine and ambient conditions and make small adjustments in the effort to balance NO<sub>x</sub> emissions compliance and CO<sub>2</sub> compliance. EMA therefore recommends the addition of the underlined text here:

The emissions control system should not use different control targets upon successive repeats of the certification cycle given the same or similar test conditions, except where AECDs are triggered according to conditions approved by the Executive Officer.

CARB should reconsider and adopt this qualifying element in these stability provisions. (EMA)

Agency Response: No changes to the Proposed Amendments were made in response to this comment. Given the same test conditions, CARB staff expects the same emissions performance; that would include AECD performance since AECDs are part of the emission control system. Emissions control targets should not be changed during back-to-back tests where the conditions are similar. Therefore, it follows that tailpipe emissions should be stable when repeating the certification cycle multiple times; such performance is required for a compliant AECD and staff currently expects such behavior when screening for non-compliant AECDs. It is noted that test conditions are similar during back-to-back repetitive tests. It is further noted that CARB is not requiring an exact match in back-to-back emissions performance and is not prescribing a percentage deviation for compliance, but has included language to account for variability in test conditions and emissions performance. In cases where the test conditions are different (e.g., temperature differences due to varying soak times) the proposition can be made that the test conditions are different and may result in different emissions performance. Specifically, staff does not intend to compare data from significantly varying soak times between hot emissions tests under this language. The proposal takes such variability into consideration by using language such as "...the same or similar test conditions." Therefore, the suggested language is not applicable.

- (a)vii.3. Comment: Returning to the prohibition against increased tailpipe emissions results during successive repeats of certifications tests, CARB also rejected EMA proposals to allow emissions to increase above the first tests results, but only if all the results from all of the repeated tests were compliant to the standard or FEL to which the engine was certified. For example, as long as all of the hot- FTP results in a series of repeated hot-FTPs, when combined with the cold-FTP measured prior to the first hot-FTP (test of record), produced compliant results (after applying IRAFs and DFs), the engine would not be determined to be non-compliant.

CARB's refusal to accept this practical and reasonable means to address concerns about successive certification test results creates the potential for unreasonable if not irrational consequences. Consider the case where Manufacturer A is deemed compliant if the cold-hot composite emissions were held constant over successive hot repeats (e.g. cold/hot#1 composite = cold/hot#n composite) at a level 20% below the standard, whereas Manufacturer B's family would be deemed non-compliant if cold/hot#1 were

50% below the standard, but the highest successive hot pushed the composite to 40% below the standard. This example clearly illustrates why the “as long as all repeats are compliant” approach is the most rational way for CARB to deal with any concerns about emissions controls in the case of repeated certifications tests.

Considering all of the foregoing factors, EMA recommends that CARB modify the requirements of §1065.518.B.2 regarding successive repeats to allow for increases in emissions as long as no individual test produces failing results. If CARB continues to reject this practical and reasonable solution, they should specify reasonable limits on the amount by which the highest of successive repeat tests might be permissibly greater than the official test of record, but only after presenting data that demonstrates the feasibility of those limits. Either of these recommendations would also require that CARB establish reasonable grounds for the *emissions control* stability as well, making the exception for approved AECD activity, for example.

If CARB rejects both the first and the second recommendations set forth in the previous paragraph, then EMA recommends that CARB modify the provision by adding the underlined text as follows:

Additionally, emissions performance should not deteriorate, degrade, or decrease upon successive repeats of the certification cycle beyond reasonable levels attributable to test-to-test variability. The emissions control system should not use substantially different control targets or strategies upon successive repeats of the certification cycle given the same or similar test conditions, except where AECDs are triggered according to conditions approved by the Executive Officer. For example, the emission level from the first Hot FTP following the Cold FTP should be statistically consistent with any emission level from a Hot FTP that was conducted as part of a series of back-to-back Hot FTP cycles up to the point the next regeneration is triggered. (EMA)

Agency Response: No changes to the Proposed Amendments were made in response to this comment. Please see Agency Response to Comment A.(I)vi.13 for justification for the proposed requirements with regards to emissions performance upon successive repeats of the certification cycle testing.

- (a)vii.4. Comment: All of the new provisions that CARB proposes to add to §1065.518 are not descriptions of acceptable measurement practice. Rather, they are requirements and limitations that should be defined in the relevant standard-setting part of the regulation. (EMA)

Agency Response: No changes to the Proposed Amendments were made in response to this comment. Please see Agency Response to Comment A.(I)vi.13

for justification for the proposed requirements with regards to including the language in the Diesel Test Procedures testing.

- (a)vii.5. Comment: 1065.680.B.1. The 30-Day Notice specifies that only manufacturers requesting and being granted Executive Officer approval to use “extra” (more than two) preconditioning cycles are required to include the preconditioning emissions from those extra preconditioning cycles (and only those extra preconditioning cycles) in the EF<sub>H</sub> measurement and calculation of infrequent regeneration adjustment factors (“IRAFs”). EMA supports this amendment to the 60-Day version of the regulation. EMA requests that CARB confirm that if no extra preconditioning cycles are approved, the preconditioning practices for the two (or fewer) “default” preconditioning cycles as applied today based on the federal provisions of 40 CFR 1065.680 are acceptable, and that IRAFs may be determined without including the emissions from those default preconditioning cycles. (EMA)

Agency Response: No changes to the Proposed Amendments were made in response to this comment. The commenter is misstating the language in the 30-Day Notice Amendments, and CARB staff does not agree that preconditioning cycles for inclusion in the IRAF calculation are limited to “only those extra preconditioning cycles” Please see Agency Response to Comment A.(a)vii.1 for response to a similar comment. If the preconditioning limits in §1065.680.B.1 have not been exceeded, then the IRAF calculations based on 40 CFR 1065.680 are acceptable.

#### **(a)viii. Idle Emission Standards**

30-Day comments were not received for this subsection.

#### **(a)ix. OBD System**

- (a)ix.1. Comment: Alternate NO<sub>x</sub> OBD thresholds are available only for engines certified to <0.10 g/bhp-hr NO<sub>x</sub>. Engines certified to Family Emissions Limits (FELs) lower than the current NO<sub>x</sub> standard of 0.20 g/bhp-hr but higher than 0.10 g/bhp-hr would be subject to more stringent OBD thresholds than engines certified to <0.10. CARB should allow use of the alternate OBD thresholds starting MY 2022 for engines certified to FELs lower than current standards, rather than just FELs <0.10 g/bhp-hr. CARB should also allow use of the alternate OBD thresholds for these MY 2022-2023 engines without requiring pull-ahead of future Omnibus requirements. (Cummins)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. Please refer to Agency Response to Comment A.(a)ix.6.

**(a)x. Optional 50-State-Directed Engine Standards**

- (a)x.1. Comment: CARB’s HD Omnibus Regulation contains a 50-state option for MY 2024-2026 NOx standards. TEMSA believes that these options will cause unnecessary complexity and regulatory uncertainty...during the design and production stages, it is not possible to foresee which state the vehicle will be registered to. Therefore it is very complicated to produce the vehicles with so many options. It could cause uncertainty and incompatibility. If the engine manufacturer chooses to provide the vehicle manufacturers two different engine types for US EPA states and CARB states regarding this proposed rule to be compliant. The vehicle manufacturer has to make investment to supply vehicle options for either EPA or CARB compliance. In addition to that this will cause financial burden, diversity of vehicles and complexity. (TEMSA)

Agency Response: No changes to the Proposed Amendments were made in response to this comment. Based on comments received during the initial 60-Day Notice and at the hearing and the Board’s direction at the hearing, CARB staff removed the 50-State option for MY 2024-2026 NOx standards. See Agency Responses in Comments A.(a)x.1 through A.(a)x.21 for a discussion on the rationale for removing the option.

**(a)xi. Transit Bus Diesel Engines**

30-Day comments were not received for this subsection.

**(a)xii. Optional Low NOx Standards**

30-Day comments were not received for this subsection.

**(b) Comments Related to HD In-Use Test Procedure Amendments**

**(b)i. General Comments on the Heavy-Duty In-Use Test Procedure Amendments**

- (b)i.1. Comment: EMA recommends that CARB apply the current “8-out-of-10” pass criteria and also adopt the new “SOS” approach across 10 vehicles, determining an engine family to be compliant if *either* of those criteria is met. Adopting EMA’s recommendation is a way to ensure that there is both an emissions exceedance generally violative of the standards (the average of the 10 vehicles is in exceedance), and that there is a consistent basis for the exceedance (more than 3 vehicles exceeding the same constituent threshold in the same bin). If CARB does not adopt the EMA-recommended approach, CARB should consider limiting the average emissions of the two engines exceeding the standard. For example, the average emissions from the two engines exceeding the standard (that is, (Engine1 emissions + Engine2 emissions) / 2) could be limited to 3-times the bin/constituent standard, but never more than the regulated MIL-ON threshold. (EMA)

Agency Response: CARB staff did not make changes to the Proposed Amendments based on this comment. The Amendments to HDIUT for determining engine family compliance use two evaluation methods. Under the first method, if three or more engines are emitting on average above the HDIUT compliance threshold (minimum of 150 percent above the emission standard) for the same pollutant and same bin (idle, low load or medium/high bin), then the engine family being tested would fail the standard over a portion of the test cycle, requiring the manufacturer to pursue corrective action. Three engines failing for the same pollutant and emissions bin would be indicative of a systematic problem requiring quick corrective action by the manufacturer to prevent excess emissions.

In the second method, if five of six vehicles tested pass HDIUT testing requirements, then the engine family passes. However, if two or more fail then ten engines would need to be tested and the average sum-over-sum emission of those ten engines for the same bin and pollutant would be evaluated with the HDIUT compliance threshold. This second method would evaluate how an engine family, on average, is complying with the HDIUT threshold. Even if one or two of the ten engines tested caused the engine family to fail the HDIUT sum-over-sum evaluation, it would be important that the manufacturer take corrective action to address why some of the engines have significant emission control failures. Thus, both methods to determine compliance are needed to meet California's air quality commitments and to protect impacted disadvantaged communities that have more than their fair share of trucks operating in their communities.

- (b)i.2. Comment: EMA supports the amendments to the definitions of “Automatic active regeneration” and “Manual active regeneration.” We note, however, that there is an editing error: the previous definition of “Manual Active Regeneration” was inadvertently retained. EMA questions the definition of the term “Telematics,” regarding whether these systems actually *collect* information. In our view the role of these devices according to the normal terminology is limited to data *transmission*. We also support the change to the definition of “intermediate useful life,” where the years component was reduced from 10 years to 8 years. (EMA)

Agency Response: CARB staff made changes to the Proposed Amendments in the 15-Day Notice Amendments based on this comment. CARB staff removed the previous “Manual Active Regeneration” definition that was inadvertently not deleted in the 30-Day Notice Amendments. CARB staff appreciates the support on the addition of the other definitions.

- (b)i.3. Comment: The provision relates to managing window concatenation when conditions exist that meet one or more of the various data-invalidation criteria. CARB's original language limited windows to 600 seconds in total

duration when seeking to accumulate 300 seconds of valid data within the window. The modified text requires that a window would not close unless more than 600 *continuous* seconds of invalid data are encountered; otherwise, the window should continue to accumulate data until 300 seconds of valid data are captured to close the window.

Careful management of the procedures regarding concatenation is very important, as an analysis of the WVU 100-vehicle Southern California fleet data shows that 23% of the windows recorded during that extensive in-use testing included periods of concatenated data (were greater than 300 seconds long). Further examination of that data shows that, when applying the proposed concatenation limits, 7 of the 9 vehicle categories tested had windows longer than 16.7 minutes (1,000 seconds) in duration, with linehaul (23 vehicles) and construction tractor (8 vehicles) categories having 0.25% and 1.1% of windows exceeding 16.7 minutes, respectively (across all test days). The longest measured window was 42 minutes, from the linehaul category.

The new provisions regarding concatenation limits will be infeasible and impractical. Long window durations loaded with invalid data segments can present a significant challenge for thermal management strategies to avoid NOx breakthroughs. CARB has made no demonstration of the technical feasibility of the concatenation provisions as proposed. On the basis of these concerns, EMA recommends that CARB restore the originally-proposed 600-second maximum window length. A second preference would be that CARB increase the maximum window duration to 900 seconds. If neither of those recommendations is acceptable, EMA recommends invalidating windows longer than 600 seconds that also have an average power level less than an appropriate threshold. (EMA)

Agency Response: CARB staff did not make changes to the Proposed Amendments based on this comment. It seems that there is a misunderstanding of the proposed regulation on the part of EMA. The proposed change to section 86.1370.B.6.2 does not extend the concatenation of data to create windows that are more than 600 seconds length. The modified text describes the handling of invalid data during window concatenation. That is, the modified text clarifies that long sequences of invalid data (greater than 600 seconds) would terminate the continuous window generation, if the maximum window length reaches 601 seconds or more. After such an event the creation of a new window sequence would begin once 300 seconds of valid data is encountered again. Thus, CARB's proposed concatenation limit follows the recommendation of the commenter and no further changes are needed.

- (b)i.4. Comment: 86.1370.B.6.3.1: To address manufacturer concerns EMA appreciates that CARB has heard our concerns on this matter, but recommends that CARB adopt a more direct, regulation-based approach to

accommodating those circumstances where the cold-start requirement was not met, rather than relying on Executive Officer approval. The issue is too unpredictable to be managed in the manner proposed. In our comments to the 60-Day Notice, EMA presented several arguments (reiterated) explaining why this provision is overly restrictive, and could needlessly lead to re-testing, with all the undesirable consequences of unplanned additional test-days:

There are still other complications raised by CARB's new proposed in-use testing requirements, including the requirement to include a cold-start. Conducting PEMS tests is very different from conducting test-cell tests. In the test-cell environment, nearly all measurement equipment can be connected and verified prior to starting the test. Test cells are not reliant on signals from the engine controller, such as those required to measure exhaust flow and fuel flow. In a test cell, measurement systems can be verified independently, without interaction with the test article, before engine start. Test cell equipment and functionality also benefit from not being removed from the test cell and test article, and re-installed for every test. That is not the case with PEMS testing.

When conducting in-use testing with PEMS, each test is similar to a test-cell installation and commissioning exercise. With that tremendous complexity, plus the dependency on new controller connections for each PEMS test, it often takes a number of attempts to get all of the systems working reliably. Reinitialization of data communication is often necessary because of engine shutdowns and the reliance on engine control module data (again, not necessary in the test cell environment). Those J1939 communication initializations often cause issues during PEMS testing. What all this means is that there is a high risk, under the requirements CARB has proposed, of a test being declared invalid due to equipment malfunction during a cold-start. The consequence of that outcome is that testing would have to be rescheduled for another day, with the very real possibility that the customer would not be able to accommodate the extended request during the course of the test team's travel itinerary. That also can damage the good will that helped in recruiting the fleet customer and vehicle in the first place.

Moreover, ambient conditions in Southern California are frequently >86°F, making it impossible to meet the cold-start criteria, especially for those tests having engine-start in the afternoon.

For all of the reasons presented here and in our earlier comments, EMA recommends that CARB increase the cold-start coolant temperature threshold to at least 104°F (40°C). Additionally, CARB should provide that the test is acceptable if coolant temperature is no more than 19°F (10°C)

higher than ambient temperature at cold-start. That said, there are unplanned fleet management issues that arise frequently that could make meeting even those modified provisions difficult, and therefore EMA additionally recommends that, without prior Executive Officer approval, a limited number of tests not meeting the requirement be permitted without invalidation. To be specific, EMA recommends that 2 out of 5, 3 out of 6, or 4 out of 10 vehicles be allowed to be reported as part of a test order even if they do not meet the cold-start coolant temperature conditions. (EMA)

Agency Response: No change was made in response to this comment. As part of CARB's 30-Day Notice Amendments, described in the Agency Response to Comment A.(b)vii.2, CARB staff added provisions in 86.1920.B.3.2 as a part of HDIUT Test Plan Approval process that allow manufacturers to request approval from the Executive Officer to begin the shift-day without a cold start if a manufacturer believes that conditions may be infeasible to meet the cold start requirements (for example, due to ambient temperatures that are too high or fleet procedures). The commentor reiterated their arguments regarding the challenges of PEMS tests, such as the need to connect and verify all equipment and the data communication prior to starting the test. However, those arguments have nothing to do with the coolant temperatures, i.e., the equipment needs to be set up properly regardless of the coolant temperature. Therefore, CARB staff believes those arguments do not justify the need to remove the cold start requirement.

The commentor further argued that ambient temperatures in Southern California, especially for those tests having engine start in the afternoon, may not meet the cold-start criteria. This is the type of problem addressed by the test plan approval process in 86.1920.B.3.2. Since the expected temperatures are reasonably known well in advance, CARB staff disagrees that it is "too unpredictable to be managed in the manner proposed" as the commentor claims.

Although the commentor recommended to modify the cold-start temperature requirements and allow a certain number of vehicles to be reported as part of a test order even if they do not meet the cold-start coolant temperature conditions, CARB staff believes the test plan approval process in 86.1920.B.3.2 sufficiently addresses the expected infeasibility.

- (b)i.5. Comment: §86.1370.B.6.3.2.3: CARB proposes that the minimum number of valid windows in any bin should be 2,400 for a valid test, and that if a test-day does not include at least 2,400 windows in each bin, the manufacturer should test additional days with that vehicle until 2,400 windows are accumulated. CARB has also removed the requirement that the test-day include at least 3 hours of non-idle operation.

In our August 25th, 2020, comment submittal, EMA recommended that CARB should specify a minimum valid window count threshold for any bin

from a test-day. It is important that the HDIUT requirements do not create a situation where an engine's emissions compliance is judged on the basis of a small sample of data, so EMA appreciates that CARB has attempted to address this matter. We also support the elimination of the requirement to have at least 3 hours of non-idle operation, as it is no longer necessary if a minimum window count is specified. EMA is, however, concerned about the specific provisions for minimum window count as proposed.

As an initial matter, we are concerned that the proposed 2,400 windows is insufficient to make a robust determination of compliance. EMA understands that this figure, which could represent as little as 40 minutes of data (though in most cases it will include more "real-time" data) is based upon the duration of typical test cell certification cycles. However, test cell certification cycles are not a good reference for this purpose, because there is much more randomness to the duty cycles, ambient conditions, engine operating conditions and other factors that can influence emissions during an in-use test compared to the strictly controlled cycle and conditions of a certification test. Data convergence to a reasonably representative level has to occur during the test-day. For this reason, we believe that much longer time periods (i.e., much longer than 40 minutes) are necessary for a fair and reasonable assessment in-use. CARB should demonstrate with representative data how many windows are sufficient to reasonably represent a vehicle's emissions performance in any bin during an in-use test.

To analyze the practical consequences of the proposed 2,400 window threshold, we can turn to real-world data as recorded by WVU on the 100-vehicle fleet in Southern California. Presented in the table below are the percentage of test-days where <2,400 windows were recorded for the day. The table includes the view for the entire fleet, and for two of the worst-case categories for bin window count.

Vehicle Category	Qty Vehicles Tested	Number of test days total	Percentage of test days having <2,400 Windows Idle Bin	Percentage of test days having <2,400 Windows Low Bin	Percentage of test days having <2,400 Windows M/H Bin
Fleet (all vehicles)	100	2077	42%	14%	17%
Food/ beverage/ distribution, heavy	15	309	90%	47%	70%
Drayage	17	414	0%	20%	34%

It is clear from this data that manufacturers will very frequently encounter test-days that fail to accumulate the proposed requisite number of windows in each bin. CARB proposes in 86.1912.B.2 that if a vehicle does not acquire 2,400 windows in each of the three bins, they should continue testing for as many days as may be required to accumulate 2,400 windows in each bin. Taking into consideration the “fleet” perspective (all 100 vehicles from multiple categories), a full 20% of the test-days accumulated <400 windows in the Idle Bin, meaning it would take *at least* 6 test-days to accumulate 2,400 windows. Indeed, 10% of the test-days have zero Idle Bin windows, and would therefore never accumulate 2,400 windows despite months of testing.

In light of the foregoing, EMA supports the proposed amendment that permits a manufacturer to “instruct the fleet to idle the test engine at the end of the shift day for a minimum of 40 minutes and a maximum of 60 minutes” as a reasonable approach to dealing with the idle bin not meeting the minimum window count requirement at the end of the test day. EMA recommends that the provision be revised to permit the manufacturer to “*request* the fleet” idle at the end of the test day, and that the duration be limited to that which is required to achieve the minimum window count criteria. The provision should further allow that the OEM technician be permitted to conduct the additional idle testing if the fleet does not agree to do so. (EMA)

Agency Response: CARB staff did not make changes to the Proposed Amendments based on this comment. CARB staff understands the idle bin may have regular inability to accumulate enough windows to meet the minimum window requirements. CARB staff believes the ability to idle after a test for up to 60 minutes is a sufficient solution. As indicated by the WVU data, there are occasional operations that would require multiple days of testing. CARB staff prefers additional real-world fleet route operation to generate the minimum number of windows by testing for an additional shift day. Although the commentor made additional recommendations to revise the provisions to allow an OEM technician to perform the additional idle testing to achieve the minimum window count criteria, CARB staff believes the provisions proposed as part of CARB’s 30-Day Notice Amendments in §86.1370.B.6.3.2 allow the necessary additional idling in practical conditions where the fleet operator initiates idling the engine and the technician can terminate the test once 40 to 60 minutes of idle is accomplished.

- (b)i.6. Comment: It must be recognized that the manufacturer has no control over how a vehicle will be operated on any single test-day. The data from the 100-vehicle Southern California fleet, like many other large [In-Use Testing] IUT datasets, tell us that emissions from one day to the next are highly variable, dependent upon many factors, such as route, traffic conditions, driver habits, ambient conditions, and more. A vehicle with a high-performing emissions control system may, on any given day, emit at levels higher than typical for

that vehicle under the influence of one or multiple of these factors. EMA therefore recommends that the IUT provisions allow a manufacturer to choose, solely at its discretion, to conduct additional test-days for a vehicle, and include the accumulated emissions measurements from all test days combined in the final results. (EMA)

Agency Response: CARB staff did not make changes to the Proposed Amendments based on this comment. CARB staff understands the variability of real-world in-use testing. CARB staff believes the engine family pass criteria provides sufficient buffer to reduce false failure of an engine family through the sum-over-sum averaging and the allowance that one failing test out of six tests is considered a pass for the engine family. The procedures require a clear pass/fail determination, and the commenter is seeking to add test days when a vehicle has shown to fail the compliance emission threshold. CARB staff does not agree with this suggestion.

- (b)i.7. Comment: It is critically important to resolve all of these issues regarding minimum data requirements to ensure the success of the in-use test program. For example, if multiple test days are routinely needed as a contingency depending on the first test day's window counts by bin, the outcome will be that many cooperative fleets will find it unmanageable to accommodate in-use testing into their working schedules, making recruiting efforts even more challenging than they are today. In addition, those vehicle categories and applications where minimally-populated bins are frequent will be routinely avoided in the recruiting process, potentially leaving a "blind spot" in the overview of in-use compliance. A separate analysis would be needed regarding impacts of the minimum 2,400 window count threshold for Otto Cycle engines (§86.1370.B.1.3.2). EMA is willing to work with CARB to develop data-based strategies to overcome the challenges associated with window count requirements. (EMA)

Agency Response: CARB staff did not make changes to the Proposed Amendments based on this comment. During the implementation of the Omnibus Regulation, CARB staff will continue to work with industry to provide testing flexibility where possible while maintaining testing integrity and data requirements. As part of the test plan approval process, CARB staff expects manufacturers to investigate the likely parameters for testing such as the route, time of day, drive characteristics, etc., as they select candidate fleets to satisfy these criteria. During the initial analysis, it should be determined if additional shift days of testing may be necessary based on the fleet vehicle characteristics to fulfill the requirements for a valid test. In-use data generated in a valid test as described in the test procedures will ensure robust data sufficient to determine compliance with in-use standards.

CARB staff does not foresee issues with the minimum window criteria for Otto-cycle engines. Due to the nature of single bin analysis, obtaining 2,400 windows

of operational analysis should be straightforward. There may be some need for subsequent testing for an Otto-cycle engine; however, the summing up of the bins from the WVU data presented in comment B.(b)i.5 suggests this to be a rare occasion.

- (b)i.8. Comment: §86.1370.B.6.3.3. requires that for MY 2024-2046 engines the average engine power over the test *must* be >10% of the engine's peak power for a valid test, and that the manufacturer should test additional days until a valid test is achieved. EMA recommends that the manufacturer be given the option to submit data and count the vehicle toward the requirements to satisfy the in-use test order even if the 10% average power threshold is not met. We further recommend that the manufacturer be permitted to select another test vehicle, or even another fleet, if, upon testing a second day, the 10% threshold is not met (and the manufacturer elects *not* to submit the data as tested.) The average power criteria could overlap with and be further confounded by the minimum window count criteria of §86.1370.B.6.2. The revisions EMA recommends will permit manufacturers to avoid testing multiple days to no avail if the selected fleets operations do not typically meet the average power criteria. (EMA)
- (b)i.9. Comment: Minimum 10% average power for test day: Manufacturer should have the option to submit the data. Alternative vehicles may be sought if criteria not met after 2 test days. (EMA)

Agency Response to Comments (b)i.8 and (b)i.9: CARB staff did not make changes to the Proposed Amendments based on these comments. CARB staff expects engines operating at less than the 10 percent engine peak power threshold to be mostly idle operation. Therefore, CARB staff expects the manufacturer can pre-screen to avoid selecting test vehicles that would likely fail meeting these criteria. The test plan approval requirements for manufacturers to send test plans in advance to the Executive Officer should identify the possibility of running into an invalid test average low load operation. CARB staff believes the provision for requiring 10 percent of the engine peak power protects the manufacturer from failing HDIUT for 2024 through 2026 MY engines and so manufacturers need to conform to this requirement when submitting HDIUT test results.

- (b)i.10. Comment: §86.1370.B.6.6.: CARB proposes to increase the in-use emissions conformity factor from 1.5 to 2.0 for model years 2024 through 2029. EMA supports the modification. EMA has long been a proponent of additional compliance margin during the early years of new standards. The proposed modification is directionally correct. However, even with this adjustment to the in-use conformity factor, the MAW in-use protocols have not been adequately verified as a viable compliance tool, and the technical feasibility of the in-use standards remains highly uncertain. Additionally, EMA stands by our position that PEMS measurement accuracy must be accounted

for in any PEMS-based in-use test program. The PEMS measurement accuracy should not be considered as “accounted for” within the Conformity Factor. It is an issue that is completely separate from the actual in-use standard, but critical to the assessment of compliance to that standard.

EMA specifically has concerns about the occasional and unavoidable impacts of low SCR temperatures on the Medium/High Power Bin average emissions. EMA recommends that any Medium/High Power Bin windows having at least one datapoint recorded where Texh measures 200°C or less should be reassigned to the Low Power Bin. There is no available technical solution ensuring adequate SCR temperatures in cases of return to service after long idling periods, coasting, or following extended key-off events. Such a provision as EMA recommends would protect against serious impacts on emissions results in the most stringent bin, the Medium/High Power Bin, while not *excluding* data, but merely assigning it to another bin. (EMA)

Agency Response: CARB staff did not make changes to the Proposed Amendments based on the comment. As described in the Agency Response to Comments A.(b)ii.2 through A.(b)ii.6, an uncertainty analysis was conducted including uncertainty from the gas analyzers, exhaust flow meter, time alignment, and drift correction. The conformity factor was demonstrated to account for the uncertainty in PEMS measurement of NOx emissions.

As described in the Agency Response to Comment A.(b)i.1, the average percent load of the window operation determines bin allocation. Binning of windows is not based on exhaust temperatures. The continuously overlapping windows of the MAW method distributes a specific emission event into appropriate bins while generating windows including the event. The averaging of data within a bin through the sum-over-sum analysis provides additional protection from non-compliance and that is not included in the current HDIUT program. CARB staff believes the HDIUT amendments provide the adequate margins and compliance determination methodology to properly control in-use emissions that are feasible to implement.

- (b)i.11. Comment: §86-1910.A.(6)(g)(ii): This provision regarding minimum window count criteria for each bin is redundant to §86.1370.B.6.2 (and §86.1912.B). (EMA)
- (b)i.12. Comment: §86.1912.B.: This provision regarding minimum window count criteria for each bin is redundant to §86.1370.B.6.2 (and §86.1912.A.6.(g)(ii)). This provision is also in conflict with §86.1370.B.6.2 (and §86.1912.A.6.(g)(ii)) because it permits only one (“an”) additional day of testing, rather than an unspecified number of additional days of testing. (EMA)

Agency Response to Comments (b)i.11 and (b)i.12: CARB staff made changes to the Proposed Amendments based on these comments. CARB staff

appreciates the identification on inconsistencies, conflicts, and redundancies. Redundant and conflicting language in sections in 86.1910 and 86.1912 was removed as part of the 15-Day changes.

- (b)i.13. Comment: §86.1915.B.5. describes engine family pass/fail criteria in the case of an in-use test order for 2024 and later model year engines. See our comments above related to similar provisions in 13 CCR §2140(c)(1) and (2). (EMA)

Agency Response: CARB staff did not make changes to the Proposed Amendments based on this comment. Language in both §86.1915.B.5 and in 13 CCR §2140(c)(1) and (2) match in determining the pass or failure criteria for an engine family based on in-use testing results.

#### **(b)ii. In-Use Idle Bin**

- (b)ii.1. Comment: The special consideration given to the idle bin is an important amendment; however, there may be cases where it does not resolve the issue. For example, if the vehicle is equipped with the automated 5-minute shutdown timer required by California provisions at §86.007-11.B.6.1., it will not idle for the required time of the proposed Amendment without shutting down. The same would be true if the fleet from which vehicle is being tested has programmed the vehicle for automated shutdown after a period of time. CARB should consider the options proposed by EMA below to overcome this limitation.

In addition to those issues related to acquiring 2,400 windows in the idle bin, there remain concerns with the low and medium/high power bins as well. EMA recognizes that there is a tension between having *enough* data to make a responsible judgment about bin compliance on a test article, while also needing to *limit* the data requirements to avoid an excessive number of test-days to fulfill the minimum data needs. There are, however, reasonable ways to resolve this situation.

There are other opportunities CARB should consider to address instances where the minimum window count criteria is not met. For example, if the number of windows is sufficiently below the minimum threshold (perhaps, lower than 50% of the threshold), the test vehicle would be considered a PASS for all constituents in that bin, because the data sample is not statistically sound enough to make a determination, and there's little chance to acquire the threshold minimum after a second test day (cumulatively). Alternatively, the PASS determination might be made only if the window count is less than, say, 30% of minimum, while an interval from 30% to 60% could be assessed after applying an adjustment to the standard (2x, for example) to accommodate the uncertainty associated with small data samples.

For the vehicles having, after a test-day, a window count in a single bin above the 60% threshold, the manufacturer could be obligated to test a second day. If, after the second day of testing, the minimum threshold is not met, the bin would be assessed on the basis of the accumulated windows against the adjusted standard (as was described for the 30% to 60% interval above).

All of the aforementioned options regarding how to respond to a test vehicle having less than the threshold minimum window count could also be conditioned upon how the bin had performed up to that point in prior tests from the test order. For example, if there are already 5 vehicles tested and all five had demonstrated compliance for all constituents in “bin x”, and the 6<sup>th</sup> vehicle did not meet the minimum data requirements for bin x, then the test could be considered a PASS and the test plan could continue to the next vehicle under the assumption of leaving the 6th unit out of an eventual 10-vehicle average. If, however, there were already a constituent having failed in bin x in a prior test, then the second test day could be required (again, but only if there were reasonable expectation to meet the threshold in the second day, so >60% of the threshold was acquired in the first day). The parameters expressed here (the “6th” vehicle) are only offered by way of example, but the concept could be applied with different conditional parameters.

Another possibility is to include a provision specifying that if the total window count from all bins in a test-day exceeds some threshold (a different, higher threshold than that discussed for a single bin), the vehicle would be assessed only on the basis of the bins having met the single bin window-count threshold, without additional days of testing. The bin not meeting the window-count requirement would be considered a PASS for reasons already described.

If the final rule provides for possibilities that a compliance determination is made on the basis of limited data (less than the regulated minimum threshold, but judged against 2x the in-use standard, for example), the manufacturer should have the option to include, or not, that bin’s data from that vehicle in a 10-vehicle average determination should one be necessary. That is, the 10-vehicle average may be based on less than 10 vehicles for the bins where window count threshold levels were not met. Vehicles having zero windows in a bin would be removed from the averaging for that bin. Any bins where the minimum window count was met for all 10 vehicles would include all 10 vehicles results for that bin(s). (EMA)

Agency Response: No change to the Proposed Amendments was made in response to this comment. CARB staff does not agree that automatic 5-minute shutdown timer required by California provisions at §86.007-11.B.6.1. (or as programmed by the fleet to automatically shutdown after a period of time) would

preclude the manufacturer from collecting the minimum required data from the test vehicle. This is because CARB's idling regulations allow the operator to continue idling for more than 5-minutes by simply acting on an override mechanism provided by the manufacturer (stepping on the gas pedal or pressing a button) before the 5-minute shutdown expires, if the vehicle is stopped and the parking brake is engaged or before the 15-minute shutdown expires if the vehicle is stopped, the transmission is in neutral, and the parking brake is not engaged.

The proposed Omnibus Regulation requires that each bin has a minimum of 2,400 valid windows. If the 2,400 valid windows in any bin is not achieved in a test day, the proposed regulation requires that testing be continued additional days as necessary to achieve the minimum window requirements for each bin. Furthermore, if testing on the first or subsequent shift-day fulfills the valid window requirements for the low load and the medium/high load bins, but does not fulfill the valid window requirements of the idle bin, then the manufacturer may instruct the fleet to idle the test engine at the end of the shift day for a minimum of forty minutes and a maximum of sixty minutes to satisfy the valid window requirement of the idle bin. For a vehicle programmed to shutdown after a period of time, running the engine at idle for 40 to 60 minutes can be accomplished, as described above, by overriding the shutdown system several times during the data collection period. Thus, CARB staff does not see the need to modify the proposed requirements to satisfy this requirement.

In addition to the engine shutdown issues related to collecting the minimum required number of windows for the idle bin, EMA also suggests several alternative solutions if the minimum number of windows is not met for the low load and the medium/high load bins. For reasons discussed below, CARB staff does not accept EMA's suggested solutions.

EMA's first suggested solution is to consider a vehicle as PASSED for all constituents in the bin if the number of windows is sufficiently below the minimum threshold (lower than 50 percent of the threshold). Alternatively, EMA suggests a vehicle to be considered PASS only if the window count is less than, 30 percent of minimum, while an interval from 30 percent to 60 percent could be assessed after applying an adjustment to the standard (2x, for example) to accommodate the uncertainty associated with small data samples. CARB staff considers EMA's suggested alternatives to be equivalent to passing a vehicle without even evaluating its emissions which defeats the purpose of the HDIUT program. This would be contrary to the objective of the in-use testing program which is to collect data large enough to make a statistically significant evaluation which CARB staff considers here to be a "*minimum*" of 2,400 windows for each bin and evaluate the data for compliance with the in-use requirements for each bin.

Other alternative solutions suggested by EMA are:

- *For the vehicles having, after a test-day, a window count in a single bin above the 60% threshold, the manufacturer could be obligated to test a second day. If, after the second day of testing, the minimum threshold is not met, the bin would be assessed on the basis of the accumulated windows against the adjusted standard (as was described for the 30% to 60% interval above).*
- *All of the aforementioned options regarding how to respond to a test vehicle having less than the threshold minimum window count could also be conditioned upon how the bin had performed up to that point in prior tests from the test order. For example, if there are already 5 vehicles tested and all five had demonstrated compliance for all constituents in “bin x”, and the 6th vehicle did not meet the minimum data requirements for bin x, then the test could be considered a PASS and the test plan could continue to the next vehicle under the assumption of leaving the 6th unit out of an eventual 10-vehicle average. If, however, there were already a constituent having failed in bin x in a prior test, then the second test day could be required (again, but only if there were reasonable expectation to meet the threshold in the second day, so >60% of the threshold was acquired in the first day). The parameters expressed here (the “6th” vehicle) are only offered by way of example, but the concept could be applied with different conditional parameters.*
- *Another possibility is to include a provision specifying that if the total window count from all bins in a test-day exceeds some threshold (a different, higher threshold than that discussed for a single bin), the vehicle would be assessed only on the basis of the bins having met the single bin window-count threshold, without additional days of testing. The bin not meeting the window count requirement would be considered a PASS for reasons already described.*
- *If the final rule provides for possibilities that a compliance determination is made on the basis of limited data (less than the regulated minimum threshold, but judged against 2x the in-use standard, for example), the manufacturer should have the option to include, or not, that bin’s data from that vehicle in a 10-vehicle average determination should one be necessary. That is, the 10-vehicle average may be based on less than 10 vehicles for the bins where window count threshold levels were not met. Vehicles having zero windows in a bin would be removed from the averaging for that bin. Any bins where the minimum window count was met for all 10 vehicles would include all 10 vehicles results for that bin(s).*

CARB staff does not accept EMA’s suggested solutions as alternatives to the proposed minimum bin data collection requirements or to the method of evaluating the bins to determine compliance with in-use thresholds. First, CARB staff believes sufficient emissions data needs to be collected to make a

statistically significant analysis of the collected bin data and make a determination of whether a bin passes or fails the in-use standard. Only a statistically significant data can provide the level of confidence needed for compliance determination. CARB staff believes a minimum of 2,400 windows per bin would achieve this objective. Secondly, CARB staff does not agree to add an additional adjustment factor to the already adjusted conformity factor. The proposed requirements already include conformity factors as multiples of the emissions standard, that is 2x the standard for 2024 to 2029 MYs and 1.5x the standard for 2030 and subsequent MYs. The higher conformity factor was provided as a flexibility to help manufacturers comply with the proposed requirements in the early years and to allow for learning the new 3B-MAW methodology.

**(b)iii. In-Use Idle Test**

30-Day comments were not received for this subsection.

**(b)iv. 3B-MAW**

- (b)iv.1. Comment: Another of EMA's concerns regarding the 3B-MAW in-use standards is that CARB has directly linked the NOx emissions limits of the Idle Bin to an *optional* idle-NOx standard. CARB "clean-idle" NOx standard is provided as an alternative to the automated 5-minute engine shutdown system of §86.007-11.B.6.1. The idle-NOx standard is not a mandatory standard, yet CARB has based the Idle Bin NOx threshold on this optional standard. Similarly, there are extended idle portions included in the new LLC certification test schedule that cannot be completed by an engine equipped with the automated 5-minute shutdown timer. This means that only engines designed to meet the optional clean-idle requirements are capable of completing the LLC. Otherwise, they would necessarily be equipped with the non-programmable timer that would force the engine to shutdown after any 5-minute idle period. Any demonstration of LLC compliance feasibility would be predicated on the condition that the engine would necessarily be designed to comply with CARB's optional clean idle standards, else it could not complete the LLC test so as to demonstrate compliance. CARB has, in effect, made compliance to the otherwise stated optional clean-idle standard a mandatory requirement. CARB failed to make the required rule-making record to support or justify the de facto conversion of the optional low-NOx idle standard into a mandatory standard under the Omnibus Regulations. As a result, those aspects of CARB's rule-making are invalid. (EMA)

Agency Response: No change to the Proposed Amendments was made in response to these comments. CARB staff does not agree with the above comment. It is true that the in-use threshold for the idle bin is based on the optional idle NOx standards. The purpose of the optional idle NOx standard is to control emissions during extended idling and NOx control is predicated on the

use of EGR and other engine controls rather than SCR. However, the idle bin of the 3B-MAW is comprised of mostly idle events but also some light load operation at low speeds (e.g., creep). These events are typically short in nature and the thermal condition of the catalyst is expected to allow for SCR control for the majority of time covered in the Idle bin.

Thus, the idle bin in-use threshold is set as a multiple of the optional low NOx standard (2 times for 2024 through 2029 MY engines and 1.5 times for 2031 and subsequent MY engines). SwRI Stage 3 program collected data on CARB Southern NTE route with a thermally aged Stage 3 aftertreatment system. A 3B-MAW analysis of the collected data resulted in a 0.80 g/hour NOx for the idle bin indicating active SCR control in that bin. The idle bin NOx result of 0.80 g/hour provides significant margin compared to the 10 g/hour in-use threshold for 2027-2029 MYs or the 7.5 g/hour in-use threshold for 2030 and subsequent MYs). Thus, CARB staff believes it is appropriate to base the idle bin in-use threshold to the optional idle NOx standard.

Furthermore, CARB staff does not see issues with running LLC certification tests on an engine equipped with an automated 5-minute shutdown timer. As stated on page I-7 of the ISOR, to date, all heavy-duty engine manufacturers have elected to comply with the Clean Idle Requirement by certifying engines to the optional 30 g NOx/bhp-hr standard, rather than installing automatic engine shutdown systems (AESSs). But if a manufacturer wants to certify an engine with the 5-minute AESS, then it can do so and work with a certification engineer on how to conduct the LLC test. The manufacturer could also disable or override the AESS during the certification test so that the engine continues to run during the extended idle segments of the LLC. The idling regulation in 13 CCR 1956.8(a)(6) (or section 11.B.6.1 of the diesel test procedures), does not require that the AESS be activated during certification tests. Manufacturers may demonstrate the AESS with an alternative test procedure approved by the Executive Officer. Thus, CARB staff does not agree with the comment that demonstration of LLC compliance feasibility would be predicated on the condition that the engine would necessarily be designed to comply with CARB's optional clean idle standards.

- (b)iv.2. Comment: §86.1370.B.1.3.2. requires that at least 2,400 valid windows be accumulated by the end of a test day, and that the vehicle must be tested for as many additional days as required until 2,400 valid windows in total are accumulated. The challenges of the 3B-MAW protocol to accumulate 2,400 windows in each bin over a test day are much greater than they are for an engine tested under the B-MAW protocol to accumulate at least that number of windows. It should be much easier to accumulate 2,400 windows within a test day under B-MAW requirements. This permits us to focus on the issue of having accumulated sufficient data to make a fair and reasonable assessment of the engine's emissions performance, with far less concern about being obligated to test additional days (due to insufficient window count in one of three bins). For this reason, EMA recommends that the B-MAW

in-use test provisions require a minimum of 3 hours of non-idle operation in a test day, as is applied today for the NTE-based in-use testing protocol. EMA further recommends that the Regulation permit that another vehicle or fleet may be tested if 3 hours of non-idle operation are not yet accumulated after two test-days, to avoid the risk of testing an application unlikely to reach the criteria after more than two days.

In the same way that CARB has provided for a CO enrichment exclusion in the Proposed Amendments to the Otto-Cycle Test Procedures (§86.1370.B.1.5), CARB should also allow a limited NOx exclusion for spark-ignited engines during fuel enrichment employed to reduce NOx upon throttle tip-in after a motoring/fuel cut-out condition. During engine brake operation, air flow through a spark-ignited engine and catalyst is significantly higher than during other fuel cutout events, causing the catalyst to oxidize and cool down at a faster rate. Restoring catalyst effectiveness is thereby even more challenging after braking events. The exclusion could be structured such that the raw data could be ordered from lowest to greatest NOx emissions rate (similar to the CO exclusion procedure), so that criteria pollutant data could be invalidated for the highest NOx data points up to the 5% limit. Allowing such an exclusion maintains a level-playing field across various spark-ignited applications and ensures that engine braking, a feature deemed critical by customers with certain duty cycles, remains an available option. (EMA)

Agency Response: CARB staff disagrees with the commenter's suggestion to add a 5 percent of daily shift windows exemption for NOx during rich tip-in events (i.e., sudden increase in the engine fuel rate). No change was made in response to this comment.

The commenter makes analogy to the allowance for CO during fuel enrichment, a situation typical of some engine protection AECDs. However, tip-in events are anticipated to be a part of normal engine operation and much more common than supposedly infrequent AECD triggering engine protection events.

While 5 percent of windows was perhaps suggested as a 'limited' number of 300 second windows, the corresponding NOx may not in fact remain a small fraction of the shift cumulative windowed NOx. The commenter directly asserts high NOx emission challenges during these specific windows, a condition which would increase their per window impact on emissions relative to the rest of the valid windows.

It is not difficult to imagine a retriggering duty cycle that could encounter such a tip-in event potentially once every 300 seconds of non-fuel cut operation thus assuring virtually all fueled engine operation contributes to exempted windows. Highly transient duty cycles characterize many urban delivery vocations typical for SI engine equipped commercial vehicles. For such a situation where tip-in related windows far exceed the commenter's suggested 5 percent, a

manufacturer may see the need to engineer robust NOx counter measures whether or not a 'limited' exemption were to be granted. If such counter measures are engineered for the many non-exempted tip-ins, why would they not as well be operative and controlling NOx in the 'limited' portion of suggested exempt tip-in windows? CARB staff has doubts that the commenter's suggestion would actually solve the commenter's concern as presented and concerns that the suggestion would open other potential emissions control program vulnerabilities.

The potential to exempt significant portions of normal operation specifically where increased NOx may be expected from some preexisting hardware configurations is contrary to the purpose of the B-MAW procedure. Exempting normal operation that is substantially increasing the sum-over-sum shift average emission performance of a vehicle would be especially concerning.

CARB staff notes a number of potential counter measure strategies to reduce catalyst cooling and oxidation including those increasing "EGR" flow and reducing air handling system flow. There are several different implementations of engine brakes on the market today with varying amounts of braking specific air flow to the aftertreatment system depending on chosen hardware and the control strategy applied to that hardware. The "EGR," airflow and engine brake technologies can be applied in combinations to complement each other.

A number of options exist at the vehicle level to supplement the foundation brakes beyond the array of engine brake implementations mentioned. Trends toward increasing electrification provide another opportunity for additional braking capacity in particular configurations. Certain heavy vehicle applications have a long history with automatic transmissions utilizing integrated retarders sharing a common fluid supply and heat rejection loop.

CARB staff expects that thermal management and airflow optimization will be important considerations in the systems integration design of robustly compliant engines and powertrains. As noted above, CARB staff does not believe the current B-MAW categorically precludes the use of engine brakes on SI engines.

**(b)v. 3B-MAW Fuel Specification**

30-Day comments were not received for this subsection.

**(b)vi. 3B-MAW and OBD Integration**

30-Day comments were not received for this subsection.

**(b)vii. General Comments on the Use of PEMS**

(b)vii.1. Comment: §1065.935.B.2.: CARB has proposed to modify the provisions related to PEMS drift correction for [nitrogen monoxide] NO, NO<sub>2</sub>, and NO<sub>x</sub>. EMA has a number of concerns regarding the proposed drift correction process, including the following issues.

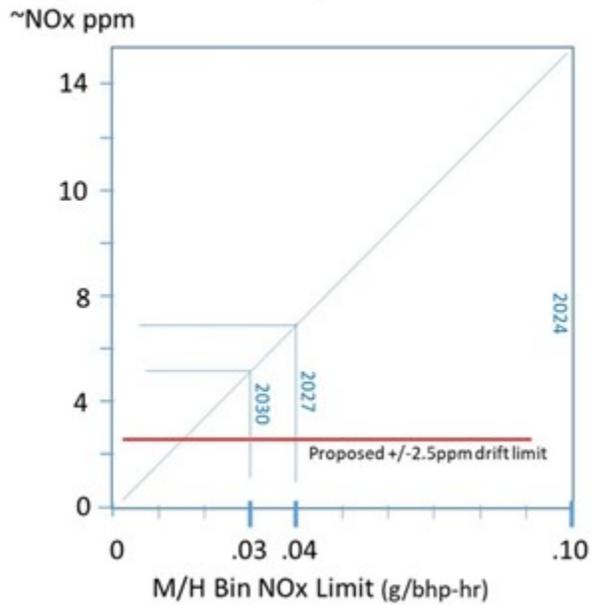
We appreciate that CARB has recognized the significant impact that PEMS NO<sub>x</sub> measurement drift can have on the measurement accuracy, which is critically important in the context of the very low NO<sub>x</sub> levels that PEMS will need to measure and record, and the very stringent standards established under the Omnibus Low NO<sub>x</sub> Regulations. This is especially true for the Medium/High bin, where the standard requires a maximum allowable average NO<sub>x</sub> concentration of 7 to 8 ppm (MY 2030 and later, when the conformity factor is reduced to 1.5). In light of that ultra-low standard, CARB has proposed to reduce the maximum allowable level of PEMS drift for NO, NO<sub>2</sub>, and NO<sub>x</sub>, from earlier proposed drift levels of +/-5 ppm, to +/-2.5 ppm at any zero-check (relative to the pre-test zero). Emissions recorded when the zero-check has exceeds +/-2.5ppm would be invalid. The remaining valid data would be corrected by Equation 1065.672-1.

As can be seen from the RMC emissions test results generated with the SwRI Stage 3 engine (set forth in the table below), NO<sub>x</sub> levels of 1 to 3 ppm will necessarily dominate most Bin 3 operation if compliance it the be achieved. Consequently, it will be critical to accurately measure those 1 to 3 ppm NO<sub>x</sub> levels, so that the day’s average emissions in the bin (including inevitable transient NO<sub>x</sub> breakthroughs, for example, during a “return to service” event following a period of extended idling or coasting), can reliably demonstrate a passing level. Very small errors of +1 to +2 ppm (after correction) when measuring 3 ppm or lower NO<sub>x</sub> levels, will almost certainly lead to determinations of Bin 3 noncompliance for engines which are actually meeting the standard. This issue goes to the core of the likely infeasibility of the Bin 3 requirements.

	A	B	C
<b>100</b>	1.6	2.5	2.0
<b>75</b>	2.6	1.9	1.4
<b>50</b>	2.3	3.3	2.3
<b>25</b>	2.3	8.6	1.6
<b>Idle</b>	5.1		

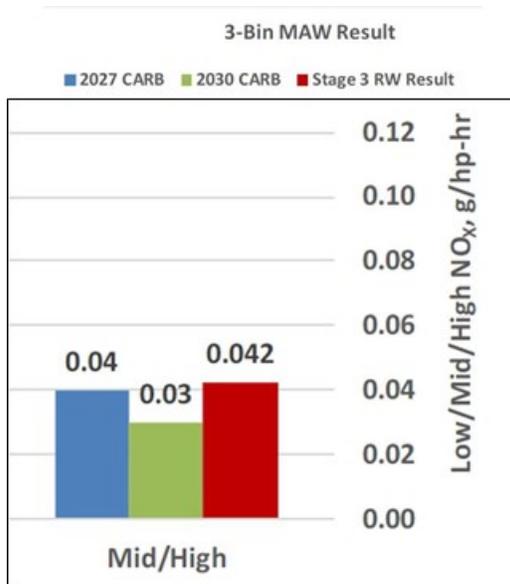
SwRI Stage 3 average NO<sub>x</sub> concentrations (ppm) at Ramped Modal Cycle test points

The scale of the maximum allowable PEMS NOx zero-drift during a test-day relative to the very stringent Medium/High Bin in-use NOx limits is shown in the following graph, and clearly reflects the extreme sensitivity of Bin 3 NOx compliance to zero-drift.

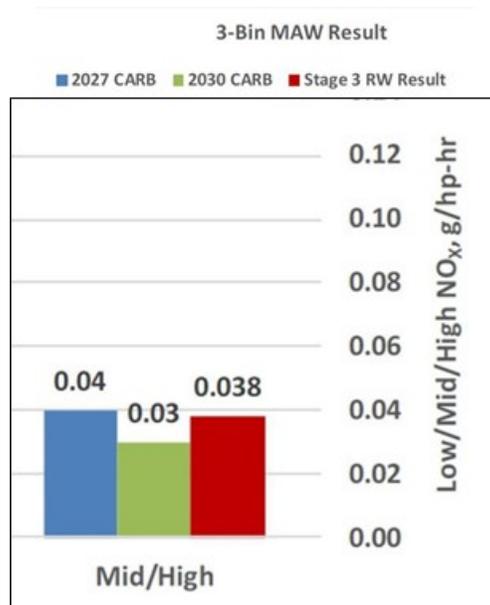


Proposed PEMS NOx zero-drift limit compared to in-use Medium/High Bin NOx standards.

The 3B-MAW Medium/High Bin NOx standards are so challenging that the SwRI Stage 3 engine and aftertreatment system developed and calibrated for the specific purpose of demonstrating the feasibility of the Omnibus Low NOx standards is actually incapable of meeting the 2031 and later in-use requirements for two of five routine road-cycle applications when assessed after 435,000 miles of aftertreatment aging (even before considering CARB's extended FUL and durability demonstration requirements). The Medium/High Bin results from SwRI's testing for the Drayage Cycle developed by West Virginia University are shown here:



The Medium/High Bin results from SwRI testing over a simulated European In-Service Conformity route also developed by West Virginia University are shown here, and also reflect similar non-passing results:



The other three road cycles had minimal margins of compliance to the 2031 Bin 3 in-use NO<sub>x</sub> standard, specifically in the range of 0.012 to 0.014 g/bhp-hr, and *no* margin to the 2031 standard when tested on CARB’s “Southern Route” that is routinely used for assessing manufacturer compliance to CARB’s HDOH emission standards. These results are perhaps not surprising, since the Stage 3 engine was non-compliant with the 2027 FTP, RMC, and LLC standards after 290,000 miles of aftertreatment aging, despite the aftertreatment system performing at a remarkable 99.3% and 99.5% NO<sub>x</sub>

conversion efficiency for the FTP and RMC cycles, respectively -- levels that will be extremely challenging, if not impossible, to ensure consistently in the field. All of these results clearly establish that highly accurate PEMS measurement capabilities are critical to any potential feasibility of the Omnibus Low NOx program, especially since CARB (unreasonably) does not intend to provide for any type of PEMS measurement allowance to compensate for measurement uncertainty.

Also, the PEMS drift limitations for NO, NO<sub>2</sub> and NOx do not place any limitations on span drift. Similarly, there are no limitations on drift correction (as are applied in the case of correction for other constituents, for example, according to §1065.550(b)). Discussions in the EMA Emissions Measurement and Testing Committee, and communications with PEMS manufacturers, have raised other issues related to measurement and correction processes. The setting of limits on drift and drift correction should also be informed by the results of the ongoing PEMS Measurement Allowance Study being conducted by SwRI.

The above open questions, in combination with the need for very accurate measurement capability at ultra-low NOx levels at issue, require that CARB state in the Final Statement of Reasons that they commit to reviewing, and revising as necessary, the provisions of §1065.935.B.2 and related regulations. Among other things, those revisions will be required to account for and incorporate any necessary measurement allowances and other test-procedure improvements that result from the collaborative and multi-stakeholder PEMS Measurement Allowance research project that Southwest Research Institute is currently conducting. (EMA)

Agency Response: No changes were made in response to this comment. CARB staff recognizes the importance of PEMS measurement accuracy and measurement drift. CARB staff has worked with PEMS manufacturers regarding PEMS measurement accuracy and drift since 2017 when SwRI was demonstrating low NOx emission capability down to the 0.020 g/bhp-hr NOx levels.

Since 2016, CARB staff has performed in-house in-use compliance testing following the same HDIUT requirements and CARB's PEMS have been able to maintain measurement drift in the 0.5 to 2 ppm range for a shift day. Also, CARB staff has reviewed recent HDIUT data submitted by the manufacturers and the +/-2.5 ppm measurement drift limit is usually met with their PEMS.

In addition, CARB staff continues to work with PEMS manufacturers to implement further improvements with reducing measurement drift and improve the accuracy of emission measurements. Over the last decade, CARB staff developed its own environmentally controlled and portable boxes that house PEMS to significantly reduce measurement drift and improved measurement

accuracy. Currently, CARB is in the process of procuring commercially available PEMS that includes an environment controlled enclosure, along with other system improvements. Thus, CARB staff believes that PEMS are capable to measure accurately at the low levels expected under the Omnibus requirements and that further improvements will be introduced prior to the most stringent 0.020 g/bhp-hr NO<sub>x</sub> levels in 2027 (also please see Agency Response to Comments A.(b)viii.6 and A.(k)i.9 regarding PEMS capabilities and development).

Regarding EMA's concern about span drift limitation, CARB staff did not include span validation criteria for NO, NO<sub>2</sub>, and NO<sub>x</sub>. The impact of span drift is minimal based on span drift specifications of current PEMS. This is also supported by CARB staff's analysis with span drift data using the current PEMS data submitted by the manufacturers to CARB under the current HDIUT program.

Also, it should be noted that CARB staff has proposed a generous conformity factor of 2 times the standard for 2024 through 2029 MY engines that provides a 100 percent margin for instrument accuracy and field instrument variability, as well as using a much longer emissions averaging period than allowed under the current NTE program that also reduces the impact of instrument variability.

CARB staff are members of the ongoing industry and regulatory agency Emissions Measurement and Testing Committee that evaluates potential testing issues that sometimes needs to be resolved through test procedure modifications. If the Emissions Measurement and Testing Committee was to discover new issues that require U.S. EPA and CARB to resolve and CARB is in agreement, CARB staff would bring any needed test procedure modification to the Board for approval. This has been a long-standing practice with U.S. EPA and CARB and there is no reason why this would not continue to be the case in the future.

- (b)vii.2. Comment: Recognizing that the final data, conclusions and recommendations from the PEMS Measurement Allowance project will not be available in time to make all of the required revisions to CARB's currently proposed PEMS NO<sub>x</sub> drift correction and validation procedures before the Omnibus Regulations are finalized, EMA recommends that proposed section §1065.935.B.2 be reworded as follows:

For 2024 and subsequent model year engines, take the following steps after in-use emission sampling is complete.

For NO, NO<sub>2</sub>, and NO<sub>x</sub> measurements, instead of applying the drift validation criteria in §1065.550(b)(3)(i) or (b)(4), invalidate any data

recorded between two consecutive zero-drift checks if either of them is not within +/-2.5 ppm of the pre-test zero. All valid NO, NO<sub>2</sub>, and NO<sub>x</sub> data shall be drift-corrected using Eq. 1065-672-1 prior to calculating bin emissions as described in section 86.1370.B.6.6. Invalidate all NO, NO<sub>2</sub>, and NO<sub>x</sub> data if the post-test gas analyzer response to the span gas concentration is not within ±4% of the pre-test response.

For criteria emissions other than NO, NO<sub>2</sub>, and NO<sub>x</sub>, only drift corrected data that meet the verification criteria of §1065.550(b)(3)(i)(A), and CO<sub>2</sub> drift-corrected data that meet the verification criteria of §1065.550(b)(3)(ii), may be included in the bin emissions calculations described in section 86.1370.B.6.6.

These data-validation criteria will be revised in the future to account for any additional measurement allowances that may be required to ensure that the PEMS used to measure and quantify in-use emissions accurately account for the variability of such in-use measurements at the low emission levels and limits established for 2024 and subsequent model year engines, particularly with respect to NO<sub>x</sub>. (EMA)

Agency Response: No changes were made in response to this comment. As explained in the Agency Response to Comment B.(b)vii.1 regarding section §1065.935.B.2, CARB staff does not see any need to revise the section.

Regarding how to apply drift verification requirements, CARB staff believes that §1065.550(b) already provides it in detail and CARB staff does not see any need to reiterate how to apply drift verification requirements in §1065.935.B.2 and to limit the requirements of NO, NO<sub>x</sub>, and NO<sub>x</sub> only to 1065.550(b)(3)(i)(A).

CARB staff believes that the conformity factor of 2 is more than adequate to account for PEMS measurement accuracy. However, as also mentioned if new issues arise that require test procedure adjustments, CARB staff would propose any needed changes to the Board.

#### **(b)viii. Use of PEMS Adjustment Factor and Conformity Factor**

30-Day comments were not received for this subsection.

#### **(b)ix. Otto-Cycle Engine In-Use Test Methodology**

- (b)ix.1. Comment: The Omnibus Low-NO<sub>x</sub> Regulations introduce rigorous new in-use compliance procedures for gasoline engines involving binning of emissions captured over “moving average windows” (“BMAW”). While EMA has numerous overarching concerns about CARB’s B-MAW requirements, of note

here is the fact that CARB has done little to demonstrate the feasibility of the B-MAW standards on gasoline engines. We recommend that CARB include commitments in the Final Statement of Reasons to monitor EPA's rulemaking activity regarding application of B-MAW to gasoline engines, and to subsequently harmonize with the EPA requirements. (EMA)

Agency Response: No change to the Proposed Amendments was made in response to this comment. The commenter's concerns for the feasibility of the B-MAW standards on gasoline engines and for the harmonization of the proposed amendments with U.S. EPA's CTI rulemaking have been addressed in Agency Response to Comments A.(b)ix.1 through A.(b)ix.3.

- (b)ix.2. Comment: Amend requirements for Executive Officer approval for potential cases where Engine Coolant Temperature exceeds 86 deg F at start of test. Otto-Cycle exceptions to the requirement should be same as those for Diesel engines. (EMA)

Agency Response: No change to the Proposed Amendments was made in response to this comment. CARB staff did not make the amendment requested by the commentor because the coolant restriction only applies to CARB's HDIUC testing. Since manufacturers do not do this testing, CARB staff is keeping it more stringent for CARB to run the test.

#### **(b)x. In-Use Emission Data Collection**

30-Day comments were not received for this subsection.

#### **(b)xi. Sensor-Based Torque and NOx Measurements**

30-Day comments were not received for this subsection.

#### **(b)xii. In-Use Testing Temperature Requirements**

- (b)xii.1. Comment: For MY 2024-2026 engines, CARB proposes to include cold coolant operation as invalid data for window calculations, not only as encountered following cold start, but also if encountered at later points during the test day. Data would be invalid whenever the coolant temperature is less than 158°F, and varies by more than +/-3.6°F over a five-minute interval.

EMA supports the proposed modification. However, we propose that the provision should not sunset after MY 2026. There is no known technology that nearly immediately raises SCR temperatures to levels that ensure high NOx conversion efficiency following a cold start. There will be operators who start a cold engine and, within a minute or so, are under heavy load pulling onto the highway. It is entirely feasible that much of the excess NOx generated under such a condition will be placed in the (most stringent)

medium/high power bin, and that the impact of several minutes of windows at engine-out NOx levels could easily lead to a failure in that bin. Catalysts for heavy-duty diesel engines are much larger and have much more thermal mass than in automotive gasoline applications. Also, exhaust temperatures are inherently lower due to higher compression ratios and lean-burn combustion. “Close-coupling” the catalyst helps to increase diesel-application SCR temperatures more rapidly, but not sufficiently to overcome these concerns, especially in colder ambient temperatures. Keep in mind that close-coupling is not physically possible in some vehicle applications. Moreover, SCR NOx reduction relies on DEF injection that requires sufficient heat and time to stabilize before starting. CARB has not demonstrated near-instant NOx control upon cold start, especially in colder ambient temperatures. Until technology is demonstrated to be capable of overcoming this condition, the coolant temperature exclusion should apply. Accordingly, this provision should not sunset after the 2026 model year. (EMA)

Agency Response: No change to the Proposed Amendments was made in response to these comments. In the above comment, EMA is proposing that the provision for 2024-2026 MY engines to include cold coolant operation as invalid data for window calculations be continued for 2027 MY and subsequent engines. EMA’s justification for this proposal is that there is no known technology that nearly immediately raises SCR temperatures to levels that ensure high NOx conversion efficiency following a cold start. As demonstrated in the SwRI’s Stage 3 program, CARB staff disagrees with EMA’s justification to continue the cold coolant provision beyond 2026 MY engines.<sup>246</sup>

The Stage 3 demonstration program evaluated a number of calibration and hardware strategies that raise exhaust gas temperatures quickly during cold starts. This was evaluated by SwRI because one-seventh of the FTP test weighted emissions included the influence of engine cold start so manufacturers need to consider engine designs and controls to minimize cold-start emissions to comply with the FTP standards. The strategies evaluated included modified engine calibration, air gap insulated exhaust manifold, EGR cooler bypass, CDA, and SuperTurbo. Among the parameters observed to evaluate these strategies included time to reach 180°C Turbo-out temperature, time to reach 150°C DOC-out temperature, CO2 increase from baseline, cumulative engine out NOx, and other parameters. With these strategies the time needed to reach 180°C Turbo-out temperature ranged between 28 to 47 seconds with SuperTurbo at 28 seconds and CDA at 34 seconds. This temperature represents when DEF dosing could begin upstream of a close coupled SCR catalyst. The time needed to reach 150°C DOC-out temperature ranged between 56 to 70 seconds, with SuperTurbo at 56 seconds and CDA at 68 seconds. The DOC-out temperature of 150°C represents the minimum operating temperature for NOx control by the light-off

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<sup>246</sup> Sharp, Christopher. “Further Development and Validation of Technologies to Lower Oxides of Nitrogen Emissions from Heavy-Duty Vehicles. Low NOx Demonstration Program Stage 3. Final Report.” SwRI® Project Number 03.23379. Pages 86-87.

SCR. SwRI ranked the strategies in terms of CO<sub>2</sub> penalty, engine-out NO<sub>x</sub>, time to reach temperature, and other parameters and found out that CDA to rank at the highest level.

CARB staff expects CDA to be one of the strategies to be used in HD engines to meet the 2027 Omnibus Regulation requirements. As demonstrated by SwRI with CDA, cold start temperatures could be increased rapidly within a minute to reach the light-off SCR operating temperatures and control cold-start emissions. Thus, CARB staff believes that it is appropriate to remove the cold coolant provisions beginning with the 2027 MY engines since technologies exist that raise the exhaust temperatures rapidly to reach light-off SCR NO<sub>x</sub> emission control to meet the emission standards during in-use testing.

- (b)xii.2. Comment: Cummins appreciates CARB’s amendments to recognize regenerations and low coolant temperature conditions beyond cold starts as invalid data (though the coolant temperature provision should not sunset after MY 2026). CARB should additionally consider invalidating tests or data when the MIL is on. It is not appropriate to include such data in the in-use compliance determination when the MIL is indicating the emission control system is not operating properly. (Cummins)

Agency Response: No change to the proposed Amendments was made in response to these comments. The commentor requested that the coolant temperature provisions regarding the cold starts not sunset after MY 2026. The Agency Response to Comment (b)xii.1 addresses this comment.

Regarding the comment on invalidating tests or data when the MIL is on, as described in the Agency Responses to Comments A.(b)i.10 and A.(b)i.11, the flexibility for manufacturers to deal with MIL-ON events during in-use testing currently exists in the test procedures under 86.1910.A.b and will continue to be available for 2024 and subsequent MY engines.

## **(c) Comments Related to Warranty Period Amendments and Useful Life Period Amendments**

### **(c)i. Warranty Period Amendments**

- (c)i.1. Comment: CARB should consider varying warranty periods to address different types of components and avoid a “one size fits all” approach to warranties. (Allison)

Agency Response: No changes were made in response to this comment. It would be impractical to vary warranty periods on a parts basis because of the extensive number of emissions-related parts on modern HD vehicles. Binding warranty to the vehicle as a whole makes it easier for truck owners to know whether a malfunction is covered simply by checking the odometer and knowing the age of the vehicle. This confidence of warranty coverage translates into better maintenance and timely

repairs, which helps reduce emissions. Vehicle-based warranty periods are appropriate because the vehicle is demonstrated to comply with applicable emission standards as a whole, not by virtue of its individual parts.

Provisions already exist that allow engine manufacturers to specify maintenance intervals within the warranty period in the event some parts cannot be reasonably engineered to remain durable throughout the vehicle engine's useful life. Manufacturers may petition the Executive Officer to allow such parts to be replaced at the vehicle owner's expense, making part-specific warranty periods unnecessary and superfluous. Furthermore, as part of the modifications to the Board adopted regulations and test procedures, CARB staff has added flexibility to the maintenance scheduling in the years such as MY 2027 when the standards become more stringent and the useful life periods are lengthened. This flexibility would help to alleviate the industry concerns regarding the new technologies and how they might be integrated with the existing components. See § 86.004-25 of the Heavy-Duty On-Road Test Procedures for details.

- (c)i.2. Comment: CARB should reconsider and eliminate provisions in 13 CCR §2035(b) that extend warranty and useful life provisions to trailers and 2027 and later heavy-duty vehicles "regardless of whether they are registered in California." CARB has not provided a sufficient legal or policy rationale for such requirements. (Allison)

Agency Response: No changes were made in response to this comment. The elimination of the registration requirement in §2035 ensures that trailers certified in accordance with the provisions of 17 CCR 95663(c) and 2027 and later MY HD vehicles originally certified to the proposed California warranty and useful life periods in 13 CCR 2036 (c)(4) and (c)(8), even though registered out of State, would remain subject to these longer periods while operating in California as many HD vehicles and trailers routinely engage in interstate travel. HD vehicles and trailers that are originally sold and registered in California may later be resold and reregistered outside of California. These vehicles often either return to California, or travel in and out of California, during their normal course of doing business. This is an important aspect to consider because EMFAC estimates that out-of-state Class 8 vehicles will account for 63 percent of California VMT in 2027. Under the current regulations, once a vehicle is reregistered outside of California, the California warranty ceases to apply. By removing the registration requirement, the warranty would remain with the vehicle even if it is reregistered outside the state.

Longer warranty periods provide a greater incentive for HD vehicle owners to repair malfunctioning emission-related parts in a timely manner because the owner does not have to pay for the repair, and this is especially true when the malfunctions do not adversely affect the vehicle's ability to do work. Chapter III, section A.4.7 of the Staff Report provides additional rationale for expanding the applicability of the California warranty coverage to California-certified vehicles

even if they are not registered in California. Requiring the California warranty to stay with the vehicle would also enable vehicles to maintain a higher value commensurate with the higher purchase price paid for the California-certified vehicle compared to its federal counterpart, i.e., the longer warranty and useful life periods were paid for by the consumer at the time of sale.

CARB disagrees with the commenter's assertions that it lacks the authority to establish emission warranty requirements for new motor vehicles and new motor vehicle engines certified to California emission standards, and that such requirements must be limited to new motor vehicles and new motor vehicle engines registered and operated within California.

CARB is authorized to adopt standards, rules, and regulations, and to perform such acts as may be necessary for the proper execution of the powers and duties granted to and imposed upon the Board by law (California Health and Safety Code (H&SC) sections 39600 and 39601). H&SC sections 39002 and 39003 place the responsibility for controlling air pollution from motor vehicles on CARB, and H&SC section 38560 directs CARB to adopt rules and regulations to achieve the maximum technologically feasible and cost-effective GHG emission reductions from sources, including mobile sources.

CARB is also authorized to adopt and implement emission standards for new motor vehicles that are necessary and technologically feasible (§43101), to adopt test procedures and any other procedures necessary to determine whether vehicles and engines are in compliance with the emissions standards established under Part 5 of the Health and Safety Code (§43104), and to not certify a new motor vehicle or motor vehicle engine unless the vehicle or engine meets the emission standards adopted by the ARB pursuant to Part 5 of the Health and Safety Code under test procedures adopted pursuant to section 43104. § 43102. Certification specifically encompasses requirements that motor vehicle and motor vehicle engine manufacturers must warrant to ultimate purchasers and to subsequent purchasers that new heavy-duty motor vehicles and motor vehicle engines are designed, built, and equipped to conform with applicable emission standards for a period of use determined by CARB, and are free from defects in materials and workmanship that cause such motor vehicles and motor vehicle engines to fail to conform with applicable requirements for the same or lesser period of use determined by CARB. § 43205.5. Notably, § 43205.5 does not limit the aforementioned warranty requirements to motor vehicles or motor vehicle engines that are registered for use in California, but rather broadly applies to motor vehicles and motor vehicle engines that are produced on and after the 1990 model year that are certified to California emission standards.

## (c)ii. Useful Life Period Amendments

- (c)ii.1. Comment: Hours are included as a limit to emissions useful life periods only for HHD engines. Cummins requests to add hours to emissions useful life for other engine categories to address low vehicle speed, vocational-type applications, using similar rationale as used by CARB for setting hours limits for emissions warranty periods. Cummins has provided recommended hours values for useful life and supporting data. Additionally, the hours limits already in place for HHD engine useful life are effectively removed by reverting back to years or miles limits once the hours are reached. These secondary years or miles limits should be removed to avoid rendering the hours limit ineffective. Finally, key-on/engine-off time does not count for purposes of identifying the end of emissions warranty or useful life periods. CARB should allow key-on/engine-off time to count for cases such as hybrids where the hybrid components are still active even when the engine is off. (Cummins)

Agency Response: The useful life provisions that are being referred to by Cummins are based on the existing language in §86.004-2 (4)(v) that states:

For an individual engine, if the useful life hours limit of 22,000 hours is reached before the engine reaches 10 years or 100,000 miles, the useful life shall become 10 years or 100,000 miles, whichever occurs first, as required under CAA section 202(d).

The intent behind the existing language is to specifically address only HHD engines that would go into vehicles such as buses, trash trucks, etc., and experience the really extreme case in which they operate for many hours each day yet either travel at very slow speeds or not at all (i.e., power-take-off situations). CARB typically conducts in-use compliance testing on vehicles that have odometer mileages below their applicable useful lives, which for HHD engines is currently 435,000 miles. CARB staff believes that this provision offers reasonable protection to a manufacturer for such vehicles that accumulate a great number of hours but a small number of miles, while still ensuring that the engines meet the emission standards over the useful life.

The operational hours are meant to account for vocational vehicles that are used mainly in stop/start, or idling operations that result in a much greater accumulation of hours than odometer miles. The lower weight engine categories for LHDD and MHDD do not currently have an operational hour period for their useful lives, and the Omnibus Regulation did not seek to introduce one because, even in 2031 under the second phased-in periods, the proposed useful life mileages for these categories would remain at less than half of the proposed HHDD useful life mileage (i.e., 270,000 miles and 350,000 miles for LHDD and MHDD versus 800,000 miles for HHDD). Hence, CARB staff believes LHDD or MHDD vehicles would be much less likely to accumulate unreasonably high

operational hours before exceeding their useful life mileage, and so including an hours period is not necessary at this time.

The existing and amended language maintain the requirement of specifying useful life based on how quickly the vehicle accumulates hours of operation. This technique is designed to normalize manufacturer liability for applications that accumulate service miles slowly (e.g., urban buses, and vocational vehicles such as concrete mixers, refuse haulers and street sweepers, etc.), while simultaneously preventing applications that accumulate miles quickly (e.g., non-vocational vehicles such as line haul tractors, delivery vehicles, and furniture movers, etc.), from prematurely exceeding useful life periods. The original provision reduces the useful life miles period to 100,000 miles (from 435,000 miles) for engines that accumulate 22,000 hours of operation before reaching the 100,000 mile mark. In this case, hours would no longer be used to limit useful life. This technique establishes a more balanced determination of useful life for non-vocational applications that are likely to exceed the useful life mileage period relatively quickly because of frequent highway operation (higher average vehicle speed translates into quicker mileage accumulation). Accordingly, vocational vehicle manufacturers are not penalized with substantially longer useful life liability than non-vocational manufacturers for the same operational periods of use.

CARB staff modeled the Omnibus provisions on the existing language, but adjusted it to reflect the longer warranty and useful life periods under the Proposed Amendments. The Omnibus provisions do not negate the inclusion of hours in useful life, but instead ensure high hour, low mileage vehicles have a reasonable useful life.

CARB staff did not change the Proposed Amendments in response to Cummins's comment that key-on/engine-off time should count for cases such as hybrids where the hybrid components are still active. Hybrid systems are generally designed to work in tandem with the conventional drivetrain in a HD hybrid vehicle in specifically designed roles. Different hybrid architectures and different levels of hybrid integration affect how the hybrid system interface with the combustion engine and other vehicle components. Depending on the design parameters, a range of hybrid system is possible, from a weak hybrid, such as in an engine stop/start system, to a strong hybrid, where the hybrid system has the primary role in the vehicle's operation, including providing motive power with the combustion engine fully disconnected from the drive axles. Because of the existence of these two separate, but interrelated systems, there could be operational regimes where the engine is off with the hybrid system on, and vice versa, or when both systems are operating at the same time. Depending on the hybrid design, a key-on/engine-off event does not necessarily involve the hybrid system being rigorously operational. The hybrid system in this situation could be passively utilized to maintain the desired temperature range of an aftertreatment system, or it could stay dormant awaiting signals from the vehicle's computer to

turn the engine back on. In these situations, the hybrid system's operation does not really equate to engine operation. In addition, some of the hybrids on time could be spent with the conventional engine as well as with the electric drive train components not moving such as in idle mode, so it cannot be claimed that hybrid on time equals engine on time. However, as previously inferred, for some hybrid systems and in specific situations, key-on/engine-off could be considered engine on time. CARB staff plans to investigate this issue in a future rulemaking, in consultation with U.S. EPA during its CTI rulemaking process, to provide a uniform and consistent nationwide set of requirements for these specific situations.

- (c)ii.2. Comment: CARB's proposed extension of intermediate useful life for vocational vehicles is also warranted and should be adopted to recognize the varied vehicle use patterns in the vocational versus long-haul truck market. (Allison)

Agency Response: CARB staff agrees. As discussed in the 30-Day Notice Amendments, the intermediate useful life in years was reduced from 11 years to 8 years to take into account the relatively low annual mileage accrued by vocational vehicles compared to long-haul trucks. The proposed modification would reduce the number of years that vocational vehicles would be subject to the stringent in-use threshold requirements compared to line-haul trucks.

- (c)ii.3. Comment: §86.004-25.A.(b)(7)(ii) permits manufacturers to request new scheduled emissions-related maintenance intervals for 2024, 2027 and 2031 model year families, with provisions to carry-over the scheduled maintenance for limited additional model years. The extended Useful Life provisions, coupled with the very stringent emissions standards of the Omnibus Rule, will almost certainly compel manufacturers to add new emission-related service maintenance, including replacement of certain emissions-related components within the Useful Life. The rule provides that the Executive Officer will only approve new maintenance procedures upon reviewing "detailed evidence supporting the need." With the implementation of the Omnibus Rule, the goal of component maintenance will shift from preventing component failure to avoiding component performance degradation to the point that tailpipe emissions approach or exceed the in-use requirements, even if the component is still within the manufacturer's specifications. Examples may include NO<sub>x</sub> sensor drift, NO<sub>2</sub>/NO<sub>x</sub> ratio of a DOC catalyst, or turbocharger performance, depending on the system design.

The new emissions-related maintenance provisions are problematic in several ways. First, it will be extremely difficult for manufacturers to gather sufficient data and analysis to provide "detailed evidence supporting the need" for new maintenance. Manufacturers are already incentivized by customer-satisfaction concerns to limit the overall maintenance requirements for their products, so they will not request any additional maintenance unless

there are sufficient compliance risks to justify them. Under these circumstances, it is appropriate that CARB permit manufacturers the ability in these transition years to implement new emissions maintenance requirements without Executive Officer approval. This policy would be consistent with what CARB describes in Attachment A to the 60-Day Notice, “Staff Suggested Changes”, page 7.

If CARB does finalize the Regulation including the requirement to seek Executive Officer approval to require new emissions-related maintenance, CARB should accept manufacturers’ reasonable explanations and data submittals, rather than “detailed evidence supporting the need,” as sufficient for Executive Officer approval.

Additionally, EMA proposes that the new provisions also be permitted to apply to “nonreplaceable” components or systems, but that the manufacturer should not be responsible to pay for that maintenance. As explained earlier, manufacturers will only establish new emissions maintenance requirements if they foresee risks of non-compliance without them, and if the consequences of a future non-compliance determination is so extreme that manufacturers feel compelled to implement a number of new maintenance requirements to avoid those extreme consequences. The repair costs of non-replaceable components, which must, by current Regulation, be paid for by the manufacturer, will necessarily be recovered in the purchase price of the vehicle. In this case, the “service” charges to the customer also will bear the cost of the 12% Federal Excise Tax that is assessed on the purchase price, compounding the cost “surcharge” effect. These additional customer costs will be borne on top of the other very significant cost increases compelled by the Omnibus Low NOx Rule. The original purchaser may not gain any benefit for this initial cost increase due to the maintenance occurring after the vehicle is resold. Historically, the additional cost is seldom recouped from the second purchaser. By eliminating the requirement that the manufacturer pay for this emissions-related maintenance, a manufacturer will be able to incentivize owners to adhere to those maintenance requirements in ways that do not drive significant increases in purchase price -- increases that cause prospective buyers to purchase out-of-state, from the used truck market, or simply to retain vehicles longer. (EMA)

- (c)ii.4. Comment: Request for new emissions-related maintenance without Executive Officer approval, or at least with lesser requirements than “detailed evidence supporting the need” (EMA)

Agency Response to Comments (c)ii.3 and (c)ii.4: No changes were made in response to these comments. Additional maintenance flexibility has already been proposed by CARB staff during the transitional years following a change in the standards to address the concerns raised by the commenter. Although the commenter states it will be extremely difficult for manufacturers to gather

sufficient data and analysis to provide “detailed evidence supporting the need” for new maintenance, the requirement for “detailed evidence supporting the need” has already been included under the existing provisions in section 86.094-25 (b)(7)(ii), of the Test Procedures. CARB staff believes there is no justification to remove the requirement to provide detailed evidence supporting the need for new maintenance in the Omnibus Regulation.

CARB staff disagrees with EMA’s claim that the manufacturer should not be responsible to pay for the maintenance of nonreplaceable components. As discussed in the Agency Response to Comment A.(i).2, it is important to understand that the Omnibus Regulation emissions standards for HHDD engine allow for expected additional emissions deterioration between the current 435,000 miles useful life to the longer 600,000 and 800,000 mile full useful life for 2027 and 2031 MY engines, respectfully (see ISOR, p. III-8, Table III-3. Proposed Heavy-Duty Diesel- and Otto-Cycle Engine NOx Standards for 2027 and Subsequent). Also, engine manufacturers will have several years to develop more durable emission control systems to meet the proposed standards. Thus, CARB staff does not believe assuming the nonreplaceable parts to fail during the useful life is a reasonable assumption given that proper engineering has been employed. The financial implications related to these parts, should they need to be replaced during useful life or redesigned and sold at additional cost, have already been taken into account in CARB staff’s economic analysis in the Staff Report and appendices. The parts designated nonreplaceable, i.e., catalyst beds, DPFs, EGR systems, and turbochargers, are critical for maintaining emissions control in-use, and requiring them to be designed durable throughout useful life, or requiring the manufacture to pay for replacements, is necessary for keeping emissions within the standards over the service life of the engine. Such is already the case for catalyst beds and DPFs under current regulations both federally and in California.

### **(c)iii. Warranty Provisions on Out-of-State Vehicles**

- (c)iii.1. Comment: EMA was pleased to see that in the informal draft change notice dated December 27th, 2020, CARB proposed to remove this proposed unilateral extension of its authority regarding emissions warranty by removing references to the applicability to vehicles and engines “regardless of whether they are registered in California.” Unfortunately, this modification to the Omnibus Proposal was not, in fact, included in the 30-Day Notice of May 5th, 2021. EMA maintains our position that CARB does not have the authority to enforce warranties outside the State’s own borders, and recommends that CARB remove the problematic language to reflect the modification contained in the December 2020 draft. (EMA)

Agency Response: Please see the response to B(c)i.2, which is incorporated by reference herein.

**(c)iv. Generation of Additional Data for Warranty Information**

- (c)iv.1. Comment: We thank CARB staff for their ongoing work to convene an industry group to work to reduce the uncertainty with costs associated with future warranty requirements. As U.S. EPA works on the proposed federal low-NOx Regulation, we encourage continued collaboration and discussion between CARB and U.S. EPA so that California and federal durability and warranty requirements can be harmonized on a feasible timeline that is based on the best available data. There remain some vehicle operation and use characteristics that are still not well understood, including characteristics of vehicle operation by second and third owners. (MECA)

Agency Response: Although CARB staff appreciates MECA's comment, no changes were made in response to this comment. CARB staff continues to collaborate with U.S. EPA., in the hopes that California and federal requirements can be harmonized as much as possible. At the Board's request, CARB staff convened an industry stakeholder work group that worked over a nine-month period to analyze and study the various differences in the cost estimate methodologies used for estimating warranty costs. While there is merit in studying characteristics of vehicle operation and use by second and third owners, CARB staff is unable to conduct such a study at this time. However, CARB staff may evaluate the feasibility of doing so as future opportunities arise. Finally, CARB staff encourages MECA members to work with their customers, i.e., manufacturers; trucking associations; and truck owners to gather any needed information on vehicle operation and use characteristics.

- (c)iv.2. Comment: In our August comments, Cummins also expressed concerns about the more stringent 2024 warranty reporting and corrective action provisions and the lengthening of emissions warranty and useful life periods in 2027 and 2031. We urged CARB to not finalize the proposed changes which would raise vehicle costs, further exacerbating cost increases associated with introducing new technology to meet new NOx standards at the same time. Cummins called on CARB to instead conduct a comprehensive study to assess the cost implications, including impacts on new technology adoption, of these changes which could have the unintended consequence of discouraging emissions improvements if customers cannot afford to buy new vehicles. The Board ultimately approved the proposed warranty and useful life changes, but it also directed staff to undertake the study. However, few modifications are included in the 30-day notice, and we believe that is because CARB's study has not yet focused on considering more cost-effective regulatory alternatives. Cummins urges CARB to continue engaging in discussions about more cost-effective solutions. (Cummins)

Agency Response: No changes were made in response to this comment. As described in Agency Response to Comments A.(c)iv.1 through A.(c)iv.5, the Board directed CARB staff to engage with stakeholders by participating in a

cooperative study designed to provide information regarding the costs attributable to the warranty-related elements of this rulemaking action to industry. However, the Board expressly did not propose amending any of the warranty elements in this rulemaking action nor did they request that the warranty cost study evaluate more cost-effective regulatory alternatives. After convening an industry stakeholder work group that worked over a nine-month period to analyze and study the various differences in the cost estimate methodologies used for estimating warranty costs, CARB staff concluded the Omnibus Regulation's cost estimates were well-supported and appropriate and therefore did not amend the cost estimates. Although the commenter suggests that CARB consider more cost-effective regulatory alternatives, CARB staff believes the evaluation of regulatory alternatives in section X of the ISOR meets CARB's obligations, and further consideration of regulatory alternatives is outside the scope of the study. CARB staff is open to continue engaging in discussion about more cost-effective solutions for future rulemakings.

#### **(d) Comments Related to EWIR and Corrective Action Procedure Amendments**

##### **(d)i. General Comments Related to EWIR**

- (d)i.1. Comment: CARB should also reconsider regulatory amendments to 13 CCR §2143 to eliminate the current "regulatory default" for recalls and to ensure CARB can consider existing recall criteria before recalls are ordered. (Allison)

Agency Response: No change was made in response to this comment. Please see the Agency Response to Comments A.(d)i.1 and (d)i.2, which are incorporated by reference in this response.

##### **(d)ii. Field Information Report**

30-Day comments were not received for this subsection.

##### **(d)iii. Corrective Action**

- (d)iii.1. Comment: CARB's 60-day Notice prohibited carryover of a family that failed an in-use test order or had an un-resolved corrective action requirement following EWIR failure threshold. exceedances. The 30-Day Notice permits such a carry-over if the manufacturer extends the emissions warranty on the failed component to Full Useful Life for that family or test group.

EMA recommends that the specific situation for each engine family for which a carryover or carry across application is submitted, and for which the corrective action is not fully implemented, be evaluated on a case-by-case basis. Consideration should be given to, for example, the failure rate, the actions taken to date, the schedule for implementation of (additional) corrective actions, and the emissions impact of the failure. In certain cases,

upon considering these factors, the carryover or carry across should be permitted without extending the emissions warranty. (EMA)

- (d)iii.2. Comment: The EMA comments in the “Diesel Test Procedures” for section §86.xxx-30.B.1. have direct applicability to the provision of the “Otto-Cycle Test Procedures”: Full Useful Life warranty for carryover/carry-across certificates should be managed on a case-by-case basis. (EMA)

Agency Response to Comments (d)iii.1 and (d)iii.2: No change was made in response to these comments. The amendments do not prohibit the carryover of data generated by an engine family if corrective action requirements were not fulfilled after an emission control component exceeded the corrective action threshold for the previous MY. The amendments prohibit carryover of data generated by an engine family if the engine family is equipped with an emissions control component that exceeded the corrective action threshold for the previous MY and was not improved for the MY for which is the application is for. CARB will consider improvements made to a component before requiring an extended warranty. Manufacturers would not be required to provide an extended warranty if they redesigned, recalibrated, or manufactured a component differently in order to demonstrate that it will not experience failures as it did for the previous MY. This may be achieved through modifications of hardware or software. The proposed amendment clarifies that improvements to the component should address known defects from the previous MY. If the component is not improved, the manufacturer would be required to provide an extended warranty for that component in order to carry over the engine family.

- (d)iii.3. Comment: CARB should reconsider regulatory amendments to 13 CCR §§2143, 2146 that lowered Emission Warranty Information Reporting thresholds and altered the regulatory consequences of exceeding such thresholds by effectively requiring that “automatic” corrective actions be taken. (Allison)

Agency Response: CARB staff did not change the Proposed Amendments in response to this comment. As an initial matter, the comment is beyond the scope of the notice, because CARB did not propose amendments to either 13 CCR 2143 or 2146 in the 30-day notice. Notwithstanding that fact, the defined reporting thresholds are not lowered from current thresholds for most engine families. The thresholds have only been modified to account for small volume engine families. For example, the reporting threshold for the emission warranty information report will be changed from 1 percent or 25 unscreened warranty claims (whichever is greater) to 1 percent or 12 unscreened warranty claims (whichever is greater). If 1 percent of an engine family’s population is greater than 12 the engine family would not be impacted by the modification.

Please see the Agency Response to Comments A.(d)i.1 and (d)i.2, and (d)i.3, which are incorporated by reference in this response.

#### **(d)iv. EWIR Definitions**

30-Day comments were not received for this subsection.

#### **(e) Comments Related to Emissions ABT Program Amendments**

##### **(e)i. General Comments Related to ABT Program Amendments**

- (e)i.1. Comment: §86.007-15.B.4. allows, within the Averaging, Banking and Trading provisions, manufacturers to apply credit multipliers when they certify a family to new lower standards in a model year prior to the model year where the new standards take effect. For example, a manufacturer may earn credit multipliers when certifying a MY 2023 family to the 2024 standards. EMA is very supportive of this incentive. We request that CARB clarify that, in this example, the credit multipliers are applied also if the manufacture were to certify the MY 2023 family to an FEL higher than the 2024 standard, such as a NOx FEL of 0.08 g/bhp-hr, using all of the (other) standards, test procedures, and other regulatory provisions applicable to the 2023 model year -- for example, an optional idle NOx standard of 30 g/hr, and compliance to NTE provisions. The same principle should apply also to the other standards' change years, and we request that CARB clarify that in the Regulation. Similar provisions should also be clarified in the case of Otto-cycle engines. (EMA)

Agency Response: Based on this comment CARB staff added additional clarification and an example to subsections §86.xxx-15.B.4(b) of the Diesel Test Procedures, and subsection §86.xxx-15.B.3(b) of the Otto-Cycle Test Procedures.

It should be noted that EMA's interpretation of the specified eligibility requirements is incorrect. In the example provided by EMA, the 2023 MY engine family must certify to an FTP NOx FEL of 0.050 g/bhp-hr or lower. Certifying at any emissions levels above the corresponding MY emission standards (for example 0.080 g/bhp-hr) would mean that the manufacturer would not meet the eligibility criteria for early compliance credit multipliers.

- (e)i.2. Comment: Cummins is especially troubled by CARB's June 2020 proposal to restrict manufacturers from using any NOx credits generated prior to 2010. We strongly disagree with CARB's basis that a 1997 EPA document responding to public comments supports CARB's proposal. In fact, that EPA document expressly supports and defends finalizing unlimited credit life as an environmental benefit. (See Appendix for details.) Cummins agrees with EPA's conclusion and urges CARB to reconsider; especially because declaring already banked credits valueless significantly decreases the incentive for any manufacturer to generate credits in the future. In lieu of

restricting the use of pre-2010 credits, Cummins recommends CARB take a more measured approach by balancing the amount of credits needed to avoid the impacts of limited product offerings with the amount of credits that remain available in the averaging sets. CARB then should implement appropriate sales volume limits, time limits, and credit discounts for the use of pre-2010 credits in a way that both ensures product availability and environmental benefits. Cummins is confident that our hard-earned emissions credits would ensure both product availability and significant environmental benefits during an appropriate transition period. (Cummins)

(e)i.3. Comment: Pre-2010 Credits – Regarding CARB’s proposal to bar the use of pre-2010 credits, page III-73 of CARB’s June 23, 2020 Low-NOx Omnibus ISOR states, “CARB staff’s rationale for this amendment is based on action previously taken by U.S. EPA. As noted earlier in Chapter I, section B.7, federal-ABT credits generated prior to the 2004 MY were subject to a three-year credit life limit (U.S. EPA, 1997b). Starting with the 2004 MY, U.S. EPA removed these credit life provisions altogether from the federal regulations. U.S. EPA rationalized that even with an unlimited lifetime, all existing credits generated after the 2004 MY were expected to be used anyway by the 2010 MY (U.S. EPA, 1997b). In other words, U.S. EPA assumed the credits should be used within 6 years or less. CARB staff agrees, and thus used this rationale for the basis for CARB staff’s proposal. CARB staff believes that the absence of a credit life requirement would lead to undermining the benefits of emission standards as manufacturers will continue to use the credits to certify engine families to FELs above the applicable standards.” Cummins maintains a strong view that CARB inappropriately declared hard-earned and environmentally beneficial pre-2010 credits as valueless. The EPA document CARB cited expressly supported and defended unlimited credit life, and it included a hypothetical example of a manufacturer earning and using credits over a 12-year period, not six. In that document EPA also contemplated that a “large bank” could be saved for use only in emergencies and that it could be an environmental benefit. If CARB were to allow the use of pre-2010 credits at some discounted rate, then the environmental benefit would be real, and those credits could be used to avoid the impacts of limited product offerings. Refer to the EPA document originally cited by CARB and see:

- P. 15-16, Figs. 1-2. EPA’s example of a manufacturer banking and using credits over a 12-year period, not six.
- P. 20 “EPA believes that an unlimited credit life is appropriate and beneficial for several reasons. There is no advantage environmentally to forcing or encouraging credits to be used [via expiration] because credit use results in higher emitting engines. EPA does not agree that allowing an unlimited credit life unduly delays the introduction of technology.”
- P. 21 “Another long-term consideration is the possibility that a large bank of credits could be accumulated for use to be used against a future standard.... Once credits are generated, it is likely that manufacturers will hold some

credits for emergencies, which could result in a benefit to the environment.”  
(Cummins)

Agency Response to Comments (e)i.2 and (e)i.3: CARB staff did not make any changes to the Proposed Amendments based on these comments.

As referenced in the U.S. EPA document EPA-420-R-97-102<sup>247</sup>:

“EPA also received comments that unlimited credit life was inappropriate. Health and environmental groups recommended that the modified program expire in 2004 and that all credits generated under the modified program be transferred back to the current program at that time, be subject to a three year credit life limit, and expire in 2007”.

However, U.S. EPA decided to remove the existing three-year credit life limit because:

“EPA does not agree that allowing an unlimited credit life unduly delays the introduction of technology”.

CARB staff disagrees with the rationale stated by U.S. EPA, and believes that allowing manufacturers to use pre-2010 federal credits in 2024 and subsequent MYs would indeed lead to a delay in introduction of new technologies. For example, manufacturers have in recent years certified heavy-duty-diesel engines to FTP NO<sub>x</sub> certification levels below 0.100 g/bhp-hr, which indicates they could potentially use pre-2010 federal credits (generated from existing heavy-duty diesel engines) to certify 2024 model year heavy-duty diesel engines to the FTP NO<sub>x</sub> FEL cap of 0.100 g/bhp-hr. The allowance to use such pre-2010 federal credits could therefore allow manufacturers to rely on existing technology instead of relying on technology advances to meet the 2024 model year 0.050 g NO<sub>x</sub>/bhp-hr FTP standard. As such, CARB staff believes that those credits should not be used in that manner.

Furthermore, the Board has already directed CARB staff to not allow transfer of any pre-2010 federal credits into the CA-ABT program during the Board Hearing. With regard to the use of pre-2010 credits, please see also the Agency Response to Comments A(e)i.4 and (e)i.5, and C.(m)i.8 through C.(m)i.9 below, which are hereby incorporated into this response.

- (e)i.4. Comment: The HHDD engine maximum NO<sub>x</sub> FTP FEL levels (“FEL caps”) of 0.100 and 0.050 g/bhp-hr are expressed as figures ostensibly comparative to the 2024 through 2026 MY FTP NO<sub>x</sub> standard of 0.050 g/bhp-hr, and the 2027 and later MY FTP NO<sub>x</sub> standard of 0.020 g/bhp-hr, respectively. EMA

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<sup>247</sup> Summary and Analysis of Comments: Control of Emissions of Air Pollution from Highway Heavy-Duty Engines, EPA-420-R-97-102, September 1997. Page 20.  
<https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockkey=P100QQFN.pdf>

believes that CARB intended that that these FEL caps are the maximum allowable levels of the Intermediate Useful Life (IUL) standards, rather than the FUL standards shown in the table of 86.007-11.B.5.3.3., and discussed in the provisions for determining Intermediate Useful Life FELs in §86.xxx-15.B.3.(i)(4). For consistency of approach, and recognizing that the NOx standards as described in the table 86.007-11.B.5.3.3. are actually FUL standards, and also that the FEL calculation methods of §86.xxx-15.B.3.(i)(4) are based on the FUL NOx standards, EMA recommends that CARB establish the NOx FEL caps for 2027 and later MYs as FUL FEL caps. By CARB’s proposed requirements of §86.xxx- 15.B.3.(i)(4), the FUL NOx FEL caps would be as follows:

<b>MY</b>	<b>FUL NOx standard</b>	<b>FUL NOx FEL cap</b>
2024-2026	0.050 g/bhp-hr	0.100 g/bhp-hr
2027-2030	0.035 g/bhp-hr	0.065 g/bhp-hr
2031 and later	0.040 g/bhp-hr	0.070 g/bhp-hr

If CARB were to accept EMA’s recommendation regarding the NOx FEL calculation methods of §86.xxx-15.B.3.(i)(4) below, then the 2027 FUL NOx FEL cap would be as follows:

<b>MY</b>	<b>FUL NOx Standard</b>	<b>FUL NOx FEL Cap</b>
2024-2026	0.050 g/bhp-hr	0.100 g/bhp-hr
2027-2030	0.035 g/bhp-hr	0.088 g/bhp-hr
2031 and later	0.040 g/bhp-hr	0.100 g/bhp-hr

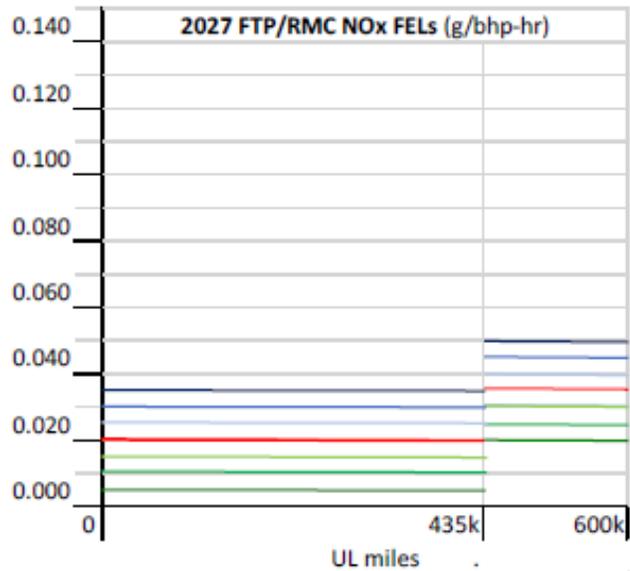
(EMA)

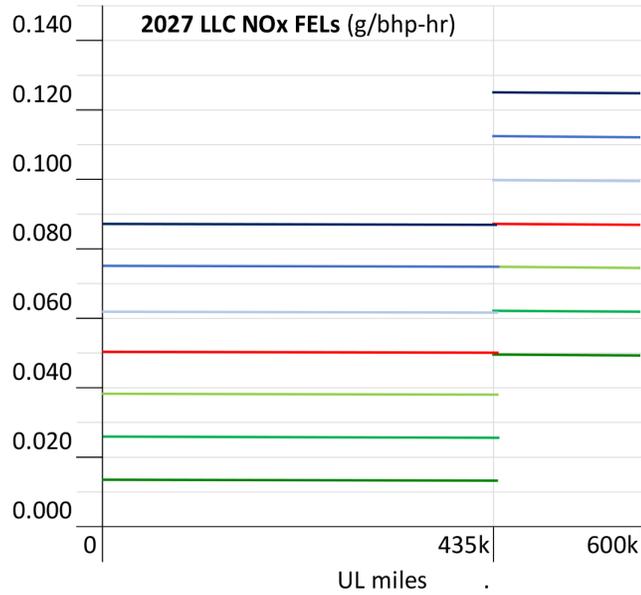
- (e)i.5. Comment: §86.xxx-15.B.3.(i)(4) proposes a method for determining MY 2027 and later Intermediate IUL NOx FELs based on the FUL NOx FELs to which the family is being certified. (The RMC and LLC Full Useful Life NOx FELs are determined based on the Full Useful Life FTP NOx standard as described in §86.xxx-15.B.3.(i)(2) and (3)(A).) The calculation process proposed produces an outcome where the difference (in g/bhp-hr) between the Intermediate Useful Life NOx FEL and the Intermediate Useful Life NOx standard is set to be equal to the difference between the Full Useful Life NOx FEL to which the family is being certified and the Full Useful Life NOx standard.

Below is a table of FTP and LLC NOx FELs for a range of potential Full Useful Life NOx FELs for MY 2027-2030 standards (the figures in red are the actual standards), calculated according to the proposed method:

2027 FTP NOx emission standard (FUL)	Delta to standard	FTP NOx FEL <sub>IUL</sub>	FTP NOx FEL <sub>FUL</sub>	LLC NOx FEL <sub>IUL</sub>	LLC NOx FEL <sub>FUL</sub>
0.035	0.015	0.035	0.050	0.088	0.125
0.035	0.010	0.030	0.045	0.075	0.113
0.035	0.005	0.025	0.040	0.063	0.100
<b>0.035</b>	<b>0.000</b>	<b>0.020</b>	<b>0.035</b>	<b>0.050</b>	<b>0.088</b>
0.035	-0.005	0.015	0.030	0.038	0.075
0.035	-0.010	0.010	0.025	0.025	0.063
0.035	-0.015	0.005	0.020	0.013	0.050

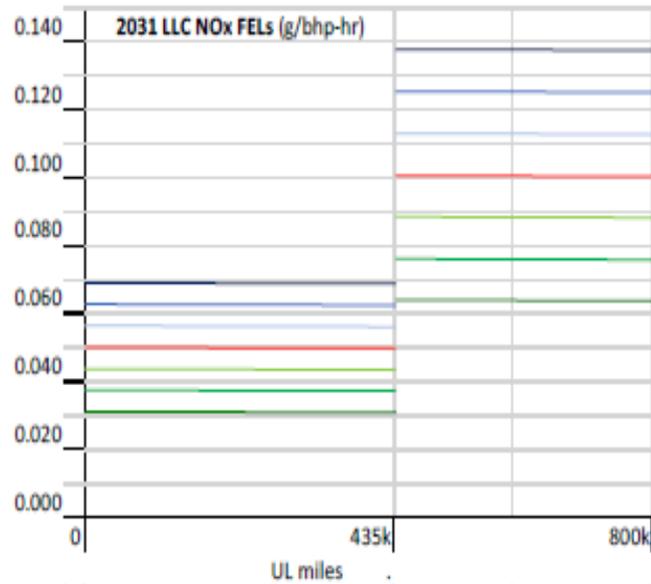
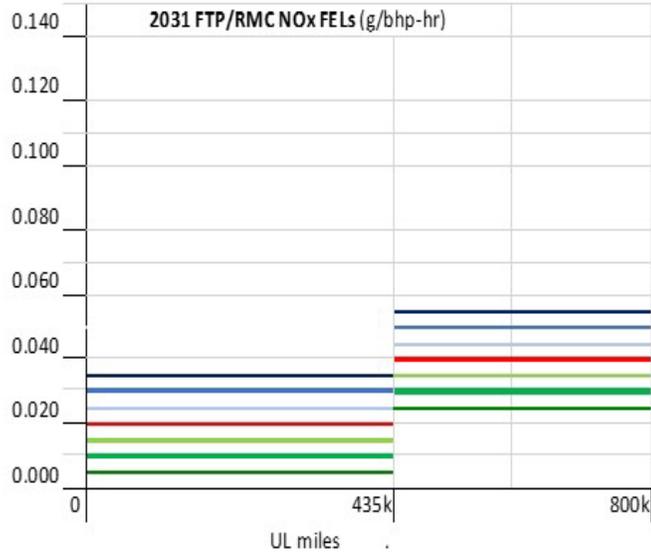
The same FELs are represented graphically below, first for the FTP NOx FELs (and RMC FELs, which, by the regulation, are equivalent to the FTP NOx FELs), then for the LLC NOx FELs (the red line is the actual standard).





A similar table of potential NOx FELs for 2031 and later standards, and similar graphical representations of those FELs, are shown here:

2031 FTP NOx emission standard (FUL)	Delta to standard	FTP NOx FEL <sub>IUL</sub>	FTP NOx FEL <sub>FUL</sub>	LLC NOx FEL <sub>IUL</sub>	LLC NOx FEL <sub>FUL</sub>
0.040	0.015	0.035	0.055	0.088	0.138
0.040	0.010	0.030	0.050	0.075	0.125
0.040	0.005	0.025	0.045	0.063	0.113
<b>0.040</b>	<b>0.000</b>	<b>0.020</b>	<b>0.040</b>	<b>0.050</b>	<b>0.100</b>
0.040	-0.005	0.015	0.035	0.038	0.088
0.040	-0.010	0.010	0.030	0.025	0.075
0.040	-0.015	0.005	0.025	0.013	0.063



EMA believes that establishing IUL NOx FELs based on the ratio of the FUL to IUL standards is a more rational approach than the one proposed in the 30-Day Notice. EMA recommends CARB adopt this preferred approach for determining FELs in the Final Rule. (EMA)

Agency Response to Comments (e)i.4 and (e)i.5: Based on these comments, CARB staff has revised the FEL caps for 2027 and subsequent MY HHDD engines to establish parity with other primary intended service classes.

For 2027 through 2030 MYs, the HHDD engine FTP NOx FEL cap was raised to 0.065 g/bhp-hr. For 2031 and subsequent MYs, the HHDD engine FTP NOx FEL cap was increased to 0.070 g/bhp-hr. These FEL caps provide additional

flexibility to manufacturers to certify products with higher compliance margins if needed.

CARB staff does not agree with EMA’s analysis, which is focused on maintaining the same ratio between the FEL caps and the standards at intermediate and full useful life. The emission standards were based on deployment of the best available emission control technology, and the FEL caps were meant to provide additional margins for some products that use the same emission control technology. The EMA proposed FEL cap of 0.100 g/bhp-hr is not stringent enough for the type of emission control technology that was used in the SwRI Stage 3 program.

CARB staff believes that raising HHDD engine FEL caps to 0.100 g/bhp-hr could lead to a scenario where future products could be certified while not using the best available emission control technology.

The term “useful life” in the regulations refers to the applicable full useful life of an engine family. The term “intermediate useful life” is exclusively used in the regulations to refer to the intermediate useful life of 2027 and subsequent MY HHDD engines. All credit calculations are based on the useful life of an engine family to represent all credits and deficits generated throughout the full useful life of an engine family.

#### **(e)ii. General Comments Related to ZEV ABT Credits**

- (e)ii.1. Comment: The proposed amendment includes a modification to the calculation of emissions credits, introducing a new distinction between “Applicable Useful Life” and “Model Year Useful Life.” The distinction is introduced to support scenarios where a manufacturer elects to certify products to the requirements of a future model year having more stringent requirements than the current model year for which the certification is being sought. (To use the example in the Regulation, “...for a 2027 model year HHD diesel engine family certified to 2031 model year requirements...” ) The modification to the calculation of credits is as follows:

$$Emissions\ Credits = (Std - FTP\ FEL) \times CF \times AUL \times Sales \times 10^{-6}$$

Emissions credit equation in 60-Day Notice:

Amended emissions credit equation proposed:

$$Emissions\ Credits = \left( Std - FTP\ FEL \times \frac{MYUL}{AUL} \right) \times CF \times AUL \times Sales \times 10^{-6}$$

The modified equation effectively increases the credits generated when certifying to future model year requirements that have a longer Useful Life.

EMA is supportive of the amendment, but believes some clarification is needed.

As an initial matter, there is ambiguity as to whether the standards and FELs to be included in the credit equation should be IUL or FUL standards and FELs. Considering EMA's comments that follow regarding FEL caps under §86.xxx-15.B.3.(i)(1) and the calculation of IUL FELs pursuant to §86.xxx-15.B.3.(i)(4), it is likely that the FUL (not the IUL) standards and FELs are the more appropriately used in the calculation of credits. This issue requires more analysis and clarification before EMA can make any final recommendation.

Additionally, the definition of "Std" (standard) following the equation should be modified to make it clear that the standard to be used in the equation is that of the *current* model year (the model year for which certification is being sought). The proposed definition of "Std" includes the term, "applicable", which is the same term used to describe the Useful Life requirements of the *future* model year (*italics* for emphasis):

Std = the *applicable* FTP cycle NO<sub>x</sub> or particulate emission standard in grams per brake horsepower hour for the *applicable* model year,

AUL = *applicable* useful life for the engine family or optionally certified diesel hybrid powertrain family in miles as defined in section I.2.A of these test procedures. For example, the AUL for a 2027 model year HHD diesel engine family certified to 2031 model year requirements is 800,000 miles,

In the first case, "applicable" is referring to current standards, and in the second it is referring to the future requirements. EMA recommends the definition of "Std" be modified to clarify this point, for example, by using the same term, "current", as is used in the definition of "MYUL", and a similar example (*italics* for emphasis):

MYUL = *current* model year useful life requirement for the engine family or optionally certified diesel hybrid powertrain family in miles as defined in section I.2.A of these test procedures. For example, the MYUL for a 2027 model year HHD diesel engine family certified to 2031 model year requirements is 600,000 miles,

Also contributing to the uncertainty on the issue of which standard to use in the credit calculation equation is the section related to early compliance credit multipliers (§86.xxx-15.B.4.), which includes the following:

... Manufacturers that produce and certify engines and optionally certified hybrid powertrains that comply with future model year requirements in title 13, CCR, sections 1956.8, 1968.2, 1971.1, 2035,

2036, 2112 and 2139 on a voluntary basis will be eligible for early compliance credit multipliers subject to the following limitations:

Citing 13 CCR 1956.8 implies that the standards must be effectively pulled ahead for the credit multipliers to be allowably applied. Section §86.xxx-15.B.4.(b) continues (*italics* for emphasis):

For example, to get a 1.5 multiplier, an eligible 2025 model year engine family must demonstrate compliance with the 2027 model year emission *standards*, useful life, durability, warranty, in-use testing requirements, OBD requirements, etc. in order to participate in the program.

EMA recommends the early compliance credit multiplier provisions also be improved for greater clarity.

EMA supports the credit multipliers of §86.xxx-15.B.4 as a credible means to incentivize early adoption of future standards and requirements. EMA also supports the amendment proposed to the emissions credit calculation equation at §86.xxx-15.B.3.(g) that also incentivize early adoption of future MY requirements. Improving the clarity of these provisions will be helpful to manufacturer planning and implementation of these important aspects of the AB&T program. (EMA)

Agency Response: Based on this comment, CARB staff has revised the regulatory language in subsections §86.xxx-15.B.3(g) of the Diesel Test Procedures, and subsection §86.xxx-15.B.2(f) of the Otto-Cycle Test Procedures. In both subsections, the term “Std” is defined to refer to the current MY FTP cycle emissions standard. For additional clarification, an example is provided in the definition of the term “Std.”

CARB staff appreciates EMA’s support for modifying the equation for calculating the credits and believes that the above clarification addresses EMA’s request.

In terms of ambiguity around “full useful life” and “intermediate useful life,” the term “useful life” refers to the full useful life of an engine. The term “intermediate useful life” refers to the intermediate useful life for 2027 and subsequent MY HHD engines.

With regards to credit multipliers please see the Agency Response to Comment B.(e)i.1.

- (e)ii.2. Comment: CALSTART encourages CARB, in this final stage of the rulemaking, to carefully consider the interplay between the Advanced Clean Trucks Rule and this rulemaking. Currently we find that this rulemaking seems to be sending some mixed signals to our industry partners through the CA-ABT provisions (Appendix B-1, §15.B, pp 34-44). We encourage CARB to

focus on the fundamentals: we need clean air and GHG reductions as quickly as we can get them. Given the existence of the ACT rule, this Regulation should provide a pathway to encourage manufacturers to exceed compliance with ACT, and rather than discourage ZET development by favoring other technologies. This proposed regulation is an emission-based regulation aimed at reducing criteria air pollutants. It is a simple fact that ZEVs reduce pollution the most, because they bring tailpipe emissions to zero. It is better for the environment, local air quality and climate to get as many ZETs on the road as quickly as possible. Our primary concern is that the ABT scheme will have the opposite effect by encouraging the use of legacy technologies over ZETs, rather than putting them on more even footing. (CALSTART)

- (e)ii.3. Comment: If we want to encourage long haul tractors, for example, these trucks just have begun to come to market before the 2026 MY and deep penetration of heavy tractors in regional use will be just ramping up. So, this rule will not provide much “credit” to the manufacturers who are spending billions on R&D to develop these new vehicles. We encourage CARB not to be concerned about this somehow being “too easy” for manufacturers to comply with. It will not be easy to certify super low emission class 8 trucks, or to design and build a zero-emission tractor capable of long haul. This is going to be challenging. If CARB maintains that it is absolutely critical to eliminate credits, the phase-down approach should be developed based on a phase down by weight segmentation of the vehicle categories coming to market, rather than all ZEV credits dropping “off a cliff” in the 2026 model year.

One potential alternate path would be phase out periods for credits based on vehicle types, and their suitability for electrification. For example, a modified rule could provide increased credits in early categories to medium-duty ZETs with favorable [total cost of ownership] TCOs, in lieu of credits for non-zero emission medium-duty trucks, to encourage this segment to turn-over faster. Because ZE Tractors will be slower coming to market and will require more demonstration and pilot projects, these ZETs should maintain their credits the longest. All credits could be weighted higher in earlier years (based on when model availability is expected) and then phased down by vehicle category over a period of 4-5 years.

This rulemaking could reference the TCO calculations from the ACT rule, for example, to determine a phased schedule for ZEV credit model years. As written, CALSTART thinks that phase-out after 2026 sends the wrong message and could be counter-productive to the state’s goals. California should be encouraging manufacturers to phase-out combustion engines in many applications where it is currently clear that zero-emission vehicles will be most viable, not encouraging the persistence of combustion engines in certain classes longer than is necessary. Unfortunately, this rule does not support achieving that as much as it could. (CALSTART)

Agency Response to Comments (e)ii.2 and (e)ii.3: CARB staff did not make any changes to the Proposed Amendments based on these comments.

During the August 27, 2020 hearing, the Board directed CARB staff to expire all credits in the HD zero-emission averaging set by the end of the 2026 MY. For additional analysis regarding the impacts of the HD-ZEP credits on the statewide emission benefits, please refer to the Agency Response to Comments A.(e)i.8 and A.(e)ii.8. Furthermore, although the ACT Regulation broadly applies to the same category of on-road vehicles as those affected by this rulemaking action, within the same time period and impact the same manufacturers, this rulemaking action addresses different purposes and provides utility that is distinct and independent from the utility provided by the ACT regulation. See section I.B.7.2 of the ISOR.

### **(e)iii. Expiration of ZEV ABT Credits**

- (e)iii.1. Comment: EMA opposes the proposed amendment that terminates the ZEV NO<sub>x</sub>-credit program after the 2026 MY, instead of the 2030 MY as originally proposed. CARB's Omnibus Low-NO<sub>x</sub> Regulations and the ACT impose huge and overlapping burdens on heavy-duty engine and truck manufacturers, and include numerous requirements that will be extremely difficult to fulfill. Manufacturers need *more* flexibilities structured into those regulations if they are to have any chance to comply, not fewer. Adding value to ZEVs in the form of more flexible NO<sub>x</sub> credits would be supportive of the Governor's demand for increased penetration of electric vehicles. The "value-add" of NO<sub>x</sub> credits with each ZEV sale would have the potential to offset price increases due to electrification, and could reduce somewhat the demand for incentives. While some manufacturers of electric vehicles that are not also in the diesel market are not regulated under the ACT, granting NO<sub>x</sub> credits, credits that could be sold to HDOH diesel engine manufacturers, would increase market penetration for the ZEV-only vehicle manufacturers as well. Accordingly, CARB should not specify a sunset date for earning and using NO<sub>x</sub> credits in the Omnibus Regulations. At a minimum, CARB should maintain the original sunset date, keeping the NO<sub>x</sub>-credit program in place through the 2030 MY. (EMA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment.

Please see the Agency Response to Comments B(e)ii.2 and (e)ii.3.

- (e)iii.2. Comment: While EMA opposes early sunset of ZEV NO<sub>x</sub> credits, there is another important aspect of ZEV NO<sub>x</sub> credits that CARB should reconsider. The concern is clearly highlighted in the material presented on page 34 of CARB staff's presentation to the Board at the August 27th hearing. The slide reports that HD ZEVs, the ultimate solution CARB envisions for the future,

earn significantly fewer NOx credits for early introduction than early introduction of HD combustion engines:

**Credits** **Proposed Changes**

### Credits for HD ZEV, Clean Natural Gas & Diesels (Opportunity for Early Action/Over-compliance)

- In 2022-2023 model years:
  - Zero-emission HD vehicle could generate
    - 0.44 Mg NOx credit for manufacturer
  - A single clean combustion engine meeting 2031 requirements could generate
    - 1.6 Mg NOx credit for manufacturer
    - 1.6 Mg of NOx credits could be used to certify 14 engines at 0.100 g/bhp-hr (instead of 0.050 g/bhp-hr) during the 2024-2026 model years

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There are two reasons for this outcome. The primary reason is the availability of Early Compliance Credit Multipliers applied for early introduction of HD engines subject to the Omnibus Regulations. For example, an engine certified prior to MY 2024 in compliance with all the requirements of the 2027 standards, can apply a credit multiplier of 2.0. (This example is an introduction two regulatory standard steps ahead of requirements; introductions one step ahead can apply a multiplier of 1.5, and introductions three steps ahead can apply a multiplier of 2.5.). EMA supports the availability of these credit multipliers as a strong incentive for manufacturers to develop and certify products with environmental benefits before they're compelled by regulation.

The second factor is that the ECF relating vehicle miles to FTP cycle work is lower for Class 8 ZEVs than for HHDD engines for the same amount of cycle work (see new §86.007-15.B.3.j.2, where ECF is determined by dividing cycle work by 6.8 for ZEVs, compared to dividing by 6.5 for [heavy-duty diesel engines] HDDEs).

The combination of Early Compliance Credit Multipliers applicable only to combustion engines and lower ECFs for ZEVs has the illogical effect of earning manufacturers significantly more NOx credits per sale of vehicles with early introduction combustion engines than they can earn from early introduction of ZEVs. CARB should apply NOx credit multipliers, or similar regulatory means, to permit ZEVs to earn at least as many credits per sale as combustion engines when introduced prior to regulatory requirements. Similar incentives should be applied to sales of ZEVs in excess of the annual minimum percentages required by the Advanced Clean Truck Regulation. (EMA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment.

Regarding the sunset date for HD-ZEP credits, please see the Agency Response to Comments A.(e)i.8 and A.(e)ii.8.

In terms of HD-ZEP credits rationale and the applicability of early compliance credit multipliers for combustion engines meeting future MY requirements, please see the Agency Response to Comments A.(e)vi.2 and A.(e)vi.3.

With regards to the numerical value of the ECFs, it should be noted that the FTP cycle for engines and the Vehicle-FTP cycle for powertrains are different cycles. For HD diesel and Otto-cycle engines, the FTP cycle equivalent mileage was derived from the 40 CFR §86.004-15(c)(2)(i) to be 6.5 miles (diesel) and 6.3 miles (Otto-cycle).

For Vehicle-FTP cycle, the equivalent mileages are determined based on the integration of the vehicle speed profiles specified in Appendix II to part 1036 paragraph (c) of the Diesel Test Procedures (6.8 miles), and in Appendix II to part 1036 paragraph (b) of the Otto-Cycle Test Procedures (6.9 miles).

Given the differences between the applicable cycles, CARB staff believes that the applicable equivalent mileage for each cycle should be based on the specific details of each cycle. On the contrary, using the same equivalent mileage for the engine cycles and powertrain cycles, as suggested by the comment, would not be appropriate.

- (e)iii.3. Comment: ZEV NOx credits should sunset after MY 2030, not MY 2026 (EMA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment.

During the August 27, 2020 hearing, the Board directed CARB staff to expire all credits in the HD zero-emission averaging set by the end of the 2026 MY. For further information, please see the Agency Response to Comments A.(e)i.8 and A.(e)ii.8.

- (e)iii.4. Comment: The rule as proposed provides incentives for conventional engines that do not apply to zero emission technology. For example, the proposed rule allows a conventional engine, which emits NOx, to generate credits through the life of the rule; but only allows a zero emission vehicle, which produces no NOx, to generate credits until the year 2026. The rule also currently allows credits generated from conventional engines to last longer than credits from a zero emission rule. DTNA has three recommended changes to avoid incentivizing combustion engines over electric vehicles:

First, DTNA recommends CARB removes the expiration date associated with electric vehicle credits, and allow them to expire according to the same schedule as their combustion-engine counterparts.

Second, DTNA recommends electric vehicles continue to generate credits after the 2026 cutoff as currently planned.

Third, DTNA recommends that CARB clarify that credits in a manufacturer's credit pool should be consumed in the order in which they would otherwise expire, rather than in the order in which they were first generated. Otherwise, NOx credits from electric vehicles sold in the later years of the program will likely expire before they could be consumed, and are effectively valueless, providing no incentive to the sale of those vehicles in California. (DTNA)

Agency Response: Based on this comment, CARB staff has made modifications to the Proposed Amendments.

Regarding the comments to modify HD-ZEP credit life period and the date HD-ZEP credits are eliminated from the Omnibus Regulation, during the August 27, 2020 Hearing, the Board directed CARB staff to expire all credits in the HD zero-emission averaging set by the end of the 2026 MY. For additional analysis regarding the impacts of the HD-ZEP credits, please refer to the Agency Response to Comments A.(e)i.8 and A.(e)ii.8.

With regards to the comment requesting flexibility on how HD-ZEP credits are consumed, CARB staff has modified the regulatory language so that either HD-ZEP credits or credits from combustion engines can be used to offset deficits for an engine family in any order of choice. The modified regulatory language can be found in section I.15.B.3.(b) of the Diesel Test Procedures.

- (e)iii.5. Comment: We also recommend that, at a minimum, if a manufacturer is exceeding its ACT sales requirements, it should absolutely be receiving credits for those vehicles under the Omnibus Rule beyond the year 2026. If an OEM exceeds their ACT compliance percentage in a given year, those "extra" vehicles should count for this regulations ABT scheme. It is appropriate to give credits to the manufacturer's producing the cleanest possible vehicles.

Upon review of the 30-day notice and appendices, many of our members are also still struggling with the rationale of providing multipliers to hybrid diesel trucks, but not ZETs (Appendix B-1, p. 44). The multipliers for diesel hybrids should at least apply to ZEVs in the earlier years of the rulemaking (2022-2024), and frankly should be greater. When the emissions of a ZEV are factually lower than a hybrid, giving them fewer credits in spite of their lower emissions appears arbitrary. While we are extremely supportive of hybrid technologies, and see their continuing necessity for certain applications, a

hybrid diesel truck still has higher emissions than a ZEV. This point cannot be argued.

We have not seen any analysis produced which demonstrates that there is a material risk of ZEV credits “watering down” the rule and making it possible for OEMs to somehow sell a significant quantity of dirtier diesel trucks. In reviewing the rulemaking documents, we are not sure that CARB has justified its concerns, or explained why it is not arbitrary to give ZEVs lower credits, or phase out credits faster, than for higher emitting vehicles.

Finally, while we cannot find a discussion of this in the 30-day notice, CALSTART encourages CARB to allow credits to be generated for ZET manufacturers not otherwise regulated under the rule. (ie, ZEV only OEMs), as they are under light duty emissions standards. For all the reasons stated above, CARB should be encouraging the sales of ZETs as quickly as possible. If there is some analysis showing how this could potentially undermine the efficacy of the rule statewide, we would appreciate staff publishing such an analysis. (CALSTART)

- (e)iii.6. Comment: The Volvo Group does not believe that it is appropriate to sunset the provision for generation of NOx credits from zero-emission powertrains, nor that those credits should expire immediately after model year 2026 since this does not align with CARB’s desire to incentivize heavy-duty zero-emission vehicle sales. The Volvo Group also believes that the continued generation of ZEP NOx credits is warranted from the standpoint of actual localized NOx reductions, especially in disadvantaged communities in congested areas near ports, warehouse districts, and highways where zero-emission vehicles are primarily targeted to operate. NOx reductions gained from ZEVs introduced in 2027 are no less valuable than those generated in 2026, and ZEVs reduce NOx emissions even more than a compliant low-NOx engine? Given this, we request that, at a minimum, zero-emission powertrain NOx credits be allowed to be generated until 2030 as previously proposed and that they only expire after five years from the model year in which they were earned. (Volvo)

Agency Response to Comments (e)iii.5 and (e)iii.6: CARB staff did not make any changes to the Proposed Amendments based on these comments.

During the August 27, 2020 hearing, the Board directed CARB staff to expire all credits in the HD zero-emission averaging set by the end of the 2026 MY. For additional analysis regarding the impacts of the HD-ZEP credits on the statewide emission benefits, please refer to the Agency Response to Comments A.(e)i.8 and A.(e)ii.8.

In terms of HD-ZEP eligibility for credit multipliers, please note that under the current regulatory structure, HD-ZEPs are not eligible to generate any credits

while cleaner-than-required engines are eligible for generating credits. As described in the agency response to comment A.(e)i.8 and as shown in Figure IV.A.(e)i.8.1, the introduction of HD-ZEP NO<sub>x</sub> credits leads to a small dis-benefit in terms statewide NO<sub>x</sub> inventory. Addition of credit multipliers to the HD-ZEP NO<sub>x</sub> credit program would only magnify the level of dis-benefits to the environment. CARB staff developed a balanced ABT program for HD-ZEPs by providing the ability to participate in the CA-ABT program while minimizing the environmental impacts. The addition of credit multipliers would lead to further deterioration of the heavy-duty Omnibus emission benefits and is therefore not warranted.

#### **(e)iv. Averaging Set of ZEV ABT Credits**

- (e)iv.1. Comment: Clarify that multipliers apply in MY 2022 and MY 2023 for FELs to 0.20 g/bhp-hr NO<sub>x</sub>, NTE requirements, and related standards for those model years. (EMA)

Agency Response: Based on this comment CARB staff added additional clarification and an example to subsections §86.xxx-15.B.4(b) of the Diesel Test Procedures, and subsection §86.xxx-15.B.3(b) of the Otto-Cycle Test Procedures. It should be noted that EMA's interpretation of the specified eligibility requirements is incorrect. In the example provided by EMA, the 2023 MY engine family must certify to an FTP NO<sub>x</sub> FEL of 0.050 g/bhp-hr or lower. Certifying at any emissions levels above the corresponding MY emission standards (for example 0.20 g/bhp-hr) would mean that the manufacturer would not meet the eligibility criteria for early compliance credit multipliers.

Additionally, in order to meet the 2024 MY HDIUT requirements, engine manufacturers must use the 3B-MAW method, not the NTE method. In order to be eligible for early compliance credit multipliers, engine manufacturers must meet all applicable future MY requirements as stated in the Regulation.

#### **(e)v. Federal ABT Credits**

30-Day comments were not received for this subsection.

#### **(e)vi. Early Multiplier Credits**

30-Day comments were not received for this subsection.

#### **(e)vii. ABT Credits and Incentive Funding**

- (e)vii.1. Comment: California has signaled that we want and need as many ZEVs on the road as quickly they can be deployed. Given the limited nature of legislative budget appropriations, many companies may need to buy ZEVs without incentives, and the availability of incentives may continue to be

uncertain in the coming years. The industry does not have certainty that incentives will exist from one-year to the next, and was not provided certainty that incentives would continue after ACT timelines begin. To meet ACT, some OEMs may end up selling ZEVs at a loss. Therefore, it is not problematic to “incentivize” OEMs to produce more ZEVs by giving them credits under this rule that are at least equivalent to hybrid trucks, and that at least last as long as the credits for hybrid trucks. Indeed, we believe ZEVs should receive the highest NOx compliance credit and be strongly rewarded in the early years to encourage deep penetration. (CALSTART)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on these comments.

During the August 27, 2020 hearing, the Board directed CARB staff to expire all credits in the HD zero-emission averaging set by the end of the 2026 MY. For additional analysis regarding the impacts of the HD-ZEP credits on the statewide emission benefits, please refer to the Agency Response to Comments A.(e)j.8 and A.(e)ii.8.

**(f) Comments Related to HD Certification Engine Durability Demonstration Program and In-Use Emissions Data Reporting Amendments**

**(f)i. Leadtime for the HD Engine Durability Demonstration Program**

30-Day comments were not received for this subsection.

**(f)ii. HD Engine Durability Demonstration Program**

- (f)ii.1. Comment: §86.004-26.B.1.1.1.3.2. through B.1.1.1.4.4: EMA supports the addition of new options for MHDDE and HHDD engine manufacturers to fulfill the durability demonstration requirements for the 2024-2026 model years. This additional flexibility is likely to be critical to certifying manufacturers’ ability to deliver certified products within the 2-year lead-time for MY 2024 products. EMA recommends that a similar abbreviated testing option be made available to MDE and LHDD engine manufacturers as well. (EMA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment.

The 2024-2026 MY aging requirements for a MDE is 3,400 hours and for LHD engine is 2,500 hours. These required aging hours are not long enough to need to have any type of accelerated aging procedures.

- (f)ii.2. Comment: While the new abbreviated DF testing options will be helpful, the requirement to provide in-use emissions and OBD data from 50% or more of

the manufacturer's California sales volume for three consecutive model years is overly burdensome (see §86.004-26, B.1.1.1.3.2 and B.1.1.1.4.3). CARB already is planning to finalize provisions within the Inspection and Maintenance ("I&M") Rule that will require periodic submittal of in-use data from the same vehicles. To also require manufacturers to submit the same data, on such a large volume of their California-sold vehicle population, is simply unnecessary. If CARB finalizes the Inspection and Maintenance rule to require periodic submittal of in-use data, CARB should also modify the Omnibus Rule to no longer require the same in-use data to enable abbreviated DF testing options in the same rulemaking effort. (EMA).

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. For further information, please see the Agency Response to Comment A.(f)iii.1.

### **(f)iii. In-Use Emissions Data Reporting Amendments**

30-Day comments were not received for this subsection.

### **(g) Comments Related to Powertrain Certification Test Procedures for HD Hybrid Vehicles Amendments**

#### **(g)i. General Comments Related to Powertrain Certification Test Procedures for HD Hybrid Vehicles Amendments**

- (g)i.1. Comment: Proposed Amendments for warranty, useful life, averaging sets, maintenance, durability demonstration, and labeling for optionally certified diesel hybrid powertrains base these requirements primarily on vehicle GVWR. For engines, however, these requirements are based on the primary intended service class definitions of §1036.140 which consider not only vehicle GVWR, but also engine characteristics and typical vehicle body types, applications, and duty cycles, which are also important criteria for assigning the appropriate requirements. Omnibus Amendments to §1036.140 already instruct manufacturers to identify a single primary intended service class for each optionally certified diesel hybrid powertrain family that best describes the vehicles for which it is designed and marketed. To be consistent with how engines are treated for both criteria pollutant and GHG emissions, the requirements for optionally certified diesel hybrid powertrains should also be based on the powertrain family's primary intended service class, not primarily on vehicle GVWR. (Cummins)

Agency Response: CARB staff did not change the Proposed Amendments in response to this comment. The commenter references the Proposed Amendments to 40 CFR §1036.140 requiring manufacturers to identify a single primary intended service class for each optionally certified diesel hybrid powertrain family that best describes the vehicles for which it is designed and

marketed. The commenter draws a parallel to similar requirements for how manufacturers of engines are required to do the same. The commenter argues that the requirements for warranty, useful life, averaging sets, maintenance, durability demonstration, and labeling should thus follow established requirements for engines, which are based on the primary intended service class and not on the vehicle GVWR as required for optionally certified diesel hybrid powertrains. This argument, while appealing from a consistency perspective, is not a valid reason to take the requirements for engines and apply them to optionally certified hybrid powertrains. This is because, although functionally similar in that both types of power platform can be used to power HD vehicles, there are sufficient dissimilarities between how each power platform is designed and how they could be utilized in a HD vehicle that they should not be considered the same. One cannot call a heart a diamond simply because they are both red.

The primary intended service class, as described in 40 CFR §1036.140, describes three groups of vehicle service classes, based on GVWR, that a HD engine is normally installed in. As described in §1036.140, a LHD engine is normally installed in vehicles with GVWR at or below 19,500 pounds, a MHD engine is normally installed in vehicles with GVWR ranges from 19,501 to 33,000 pounds, and a HHD engine is normally installed in vehicles with GVWR exceeding 33,000 pounds. For conventional vehicles, the primary intended vehicle classes work as intended as the engines that are installed in these vehicle classes are normally properly sized for the vehicle service class. For hybrid vehicles, that may or may not be the case.

Although the descriptions of “primary intended service class” in §1036.140 are quite broad, they do generally correlate well to the type of engines that is typically installed in a particular category of vehicles. For example, the primary intended service class for HHD engines in §1036.140(a)(3) is described as “[V]ehicles in this group are normally tractors, trucks, straight trucks with dual rear axles, and buses used in inter-city, long-haul applications. These vehicles normally exceed 33,000 pounds GVWR.” For this primary intended service class, for conventional vehicles, a HHD engine is typically employed to power the vehicle and, thus, all the warranty, useful life, averaging sets, maintenance, durability demonstration, and labeling requirements for the engine would match with the primary intended service class. The same situation cannot be inferred with certainty for optionally certified hybrid powertrains. This is because a hybrid powertrain could be designed with different levels of hybrid integration, with varying degrees of contribution from the combustion engine, and, thus, the engine used in such a hybrid system could be the same engine as typically used for the given primary intended service class or an engine from a different primary intended service class. Hybrid powertrains, due to their design differences compared to conventional engine power platform, are less married to the specific primary intended service class described in §1036.140. Thus, a hybrid powertrain from a given primary intended service class could utilize an engine

from a different primary intended service class, a situation that does not commonly exist for conventional engines.

For an optionally certified hybrid powertrain certified to the same primary intended service class, although it is likely that a HHD engine would be utilized in such a vehicle in the case of a mild hybrid system, that may or may not be the case in a strong hybrid system where a smaller engine, such as a MHD engine, could potentially be used. The latter possibility provides the justification for the Proposed Amendments requiring the warranty, useful life, averaging sets, maintenance, durability demonstration, and labeling requirements to be based on the vehicle GVWR and not on the engine primary intended service class. If these requirements were based on the primary intended service class, as suggested by the commentor, a vehicle with a GVWR greater than 33,000 pounds, if powered by an optionally certified hybrid powertrain using a MHD engine, would only have to comply with the less stringent requirements specified for MHD engine instead of the more stringent requirements for HHD engine, that are typically used for vehicles in this GVWR range. This would create an inconsistency in stringency requirements for vehicles in this GVWR range and would give rise to an equity issue in terms of differential treatment for one power platform type over another power platform type.

To further elaborate, using useful life requirements, it is prudent to again note that a hybrid powertrain may be designed with a smaller engine than would “normally” be expected to be installed in a vehicle with a given GVWR. For the scenario discussed above, a hybrid powertrain may use a MHD engine coupled with a hybrid system and be installed in a vehicle with a GVWR greater than 33,000 pounds. In this example, the power requirements of the vehicle may be met by the aggregate power output of the hybrid powertrain, which combines the power outputs of both the MHD engine and the hybrid system. For 2031 and subsequent MY HD engines, if the useful life requirement, for example, followed the engine category as suggested by the commenter, there would be a mismatch in the useful life of the MHD engine (12 years or 350,000 miles) versus the useful life of a HHD engine (12 years or 800,000 miles) that would normally be installed in that vehicle. If the useful life, and other certification requirements, were not tied to the vehicle’s GVWR, a purchaser of a HD hybrid vehicle would not have the length of useful life requirements that are normally expected for that vehicle GVWR.

Overall, the warranty coverage and useful life requirements for hybrid powertrains are intended to be technology neutral while providing the consumers with similar protection for any power platforms they choose to purchase.

- (g)i.2. Comment: For the same reasons discussed above pertaining to §2036(c)(10) and §2112(l)(23), the requirements for Useful Life, averaging sets, maintenance, durability demonstration, and labeling for optionally certified

diesel hybrid powertrains should also be based on the powertrain family's primary intended service class, not primarily on vehicle GVWR. (EMA)

Agency Response: CARB staff did not change the Proposed Amendments in response to this comment. This comment is similar to Comment B.(g)i.1. for which CARB staff has provided an Agency Response. Please see Agency Response for Comment B.(g)i.1. immediately above.

- (g)i.3. Comment: EMA also supports amendments to the definitions of "Ramped Modal Cycle (RMC)" and "Vehicle-RMC" to allow manufacturers the option of using either the test cycle in §86.1362 or the cycle in §1036.505 for demonstrating compliance with criteria pollutant standards in MY 2024 and later. CARB should add language to confirm they will use the same cycle chosen by the manufacturer for confirmatory and audit testing. (EMA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. Given that the manufacturer would have the option to choose either one of the referenced test cycles in §86.1362 or the cycle in §1036.505 for certification and demonstrating compliance with criteria pollutant standards, the same chosen cycle would be applicable for confirmatory or audit testing as well.

- (g)i.4. Comment: 13 CCR §2036(c)(10) and §2112(l)(23): These modifications are proposed to clarify that the warranty and useful life periods for optionally certified diesel hybrid powertrains used primarily in vehicles with a specified GVWR range are the same as for the heavy-duty diesel engines that are certified for use in that same vehicle GVWR range. For heavy-duty diesel engines, however, the warranty and useful life requirements are applied according to the engine's primary intended service class as defined in §1036.140. Primary intended service class considers not only vehicle GVWR, but also engine characteristics and typical vehicle body types, applications, and duty cycles, which are also important criteria for assigning the appropriate warranty and useful life requirements. Omnibus Amendments to §1036.140 already instruct manufacturers to identify a single primary intended service class for each optionally certified diesel hybrid powertrain family that best describes the vehicles for which it is designed and marketed. To be consistent with how engines are treated for both criteria pollutant and GHG emissions, the warranty and useful life periods for optionally certified diesel hybrid powertrains should also be based on the powertrain family's primary intended service class, not primarily on vehicle GVWR. (EMA)
- (g)i.5. Comment: For the same reasons discussed above pertaining to §2036(c)(10) and §2112(l)(23), the requirements for Useful Life, averaging sets, maintenance, durability demonstration, and labeling for optionally certified diesel hybrid powertrains should also be based on the powertrain family's primary intended service class, not primarily on vehicle GVWR. (EMA)

Agency Response to Comments (g)i.4 and (g)i.5: CARB staff did not change the Proposed Amendments in response to this comment. This comment is similar to Comment B.(g)i.1. that CARB staff has provided an Agency Response. Please see Agency Response for Comment B.(g)i.1. above.

- (g)i.6. Comment: §86.004-26.B.2.7.: The amendment includes a potentially inaccurate reference, “1.26.” (EMA)

Agency Response: No change was made in response to this comment. The reference noted by the commenter is a correct reference to “1.26,” which is the section on durability demonstration. The purpose of this subparagraph §86.004-26.B.2.7 is to require the durability demonstration of engine and emission-related components, including hybrid-related components, for optionally certified diesel hybrid powertrain families.

## **(h) Comments Related to Medium-Duty Engine Clarifications and Amendments**

### **(h)i. General Comments Related to Medium-Duty Engine Clarifications and Amendments**

- (h)i.1. Comment: 13 CCR §2112.(l)(22)(A) and (D): References to MY 2023 should be changed to MY 2024 to be consistent with §2112.(l)(18) and (19) delay of new Useful Life requirements as described above. (EMA)

Agency Response: CARB staff appreciates the commenter’s correction to 13 CCR 2112(l)(22)(A) and (D), which are the Otto-cycle useful life requirements for engines used in medium-duty vehicles with a GVWR from 10,001 to 14,000 pounds. As suggested by the commenter, the 15-Day Notice included the correction in 13 CCR 2112(l)(22)(A) and (D) to MY 2024.

## **(i) Comments Related to Economic Impact Analysis**

### **(i)i. General Cost Comments**

30-Day comments were not received for this subsection.

### **(i)ii. Standardized Regulatory Impact Assessment (SRIA)**

30-Day comments were not received for this subsection.

### **(i)iii. Direct Costs for Low NOx and PM Standards**

30-Day comments were not received for this subsection.

**(i)iv. Direct Costs for Lengthened Warranty and Useful Life, and EWIR**

30-Day comments were not received for this subsection.

**(i)v. Costs Related to a Pre-Buy/No-Buy Scenario**

30-Day comments were not received for this subsection.

**(i)vi. Cost to Businesses**

30-Day comments were not received for this subsection.

**(j) Comments Related to Emissions and Health Benefits**

**(j)i. State and District Attainment Goals**

30-Day comments were not received for this subsection.

**(j)ii. Other Comments**

30-Day comments were not received for this subsection.

**(k) Comments Related to the EA**

30-Day comments were not received for this subsection.

**(l) Miscellaneous Comments**

**(l)i. Harmonized National Low NOx Program**

30-Day comments were not received for this subsection.

**(l)ii. CAA and Federal Waiver of Preemption**

30-Day comments were not received for this subsection.

**(l)iii. Implementation of Early Low NOx Technology**

30-Day comments were not received for this subsection.

**(l)iv. Fuel Issues**

30-Day comments were not received for this subsection.

#### **(I)v. Impact on Dealerships and Trucking Fleets**

30-Day comments were not received for this subsection.

#### **(I)vi. Other Miscellaneous Comments**

- (I)vi.1. Comment: The Volvo Group believes that the issues raised here conflict with CARB's historical concern for a level playing field among OEMs and its stated goal of accelerating heavy-duty ZEVs in the marketplace and unless corrected, warrant another hearing before the Board as noted on page 3 of the 30 Day Notice. (Volvo)

Agency Response: No change was made in response to this comment. Page 3 of the 30-Day Notice Amendments states that the Board directed the Executive Officer to consider written comments submitted during the public review period and make any further modifications that are appropriate available for public comment for at least 15 days, and present the regulation to the Board for further consideration if warranted. The Executive Officer determined that the modifications in the 30-Day Notice Amendments did not warrant another Board Hearing, because the 30-Day Notice Amendments were consistent with the Omnibus Regulation. For the issue regarding level playing field among OEMs, please refer to the Agency Response to Comment B.(a)i.6, and for the HD ZEVs issue, please see the Agency Response to Comments B.(e)iii.5 and B.(e)iii.6.

- (I)vi.2. Comment: I have a pre 1960 Commercial vehicle and pre 1960 Engine, both of these are fall out of the data for reporting and consideration of engine manufacture year and truck manufacture year. I propose an exemption for a heavy duty truck that falls within these standards, especially for a small business of owner operator type that have a small number of trucks, and is trying to start a grass roots business. I could use a car that's pre 1975 and does not have to be smogged to run a business, or a diesel pick-up truck that is pre 1997 and doesn't have to be smogged. A Semi-truck that is pre 1960, should be allowed the same exemption. (Gookin)

Agency Response: No change was made in responses to this comment. The Omnibus Regulation requirements apply to new engines produced by manufacturers and do not retrospectively apply to engines that are already in service or in use. Thus, the comment is outside the scope of the Omnibus Regulation, including its 30-Day Notice Amendments.

- (I)vi.3. Comment: We urged CARB to review the U.S. EPA final CTI (HD low-NOx) rule and consider harmonizing tailpipe limits and evaporative and refueling control requirements for gasoline engines as part of future heavy-duty Omnibus Amendments. HD gasoline engines should be subject to the same PM standards as HD diesel engines. Furthermore, we believe that an opportunity exists to significantly reduce VOC emissions from gasoline

heavy-duty engines by expanding ORVR to incomplete [heavy-duty gasoline vehicles] HDGVs rated over 14,000 lbs. GVWR. Finally, we believe that technology available for reducing exhaust emissions from light-duty vehicles and medium-duty chassis certified vehicles has advanced significantly and can be applied to engine certified products, and we support CARB's current efforts in Advanced Clean Cars II to align chassis certification standards with engine certification standards through harmonization of the MAW in-use testing requirement. (MECA)

Agency Response: This comment is outside the scope of the 30-Day Notice Amendments. As noted in the Agency Responses to Comments A.(I)j.1 through A.(I)j.6 and to Comments A.(I)iv.7 and A.(I)iv.8, CARB staff will continue to work with U.S. EPA to harmonize California's HD requirements as much as possible with the final CTI requirements.

- (I)vi.4. Comment: We suggested that CARB consider funding an on-road demonstration of the low-NOx engine from SwRI after installation in a vehicle. There is likely to be an on-road low-NOx demonstration through a collaboration between U.S. EPA, industry and other air quality agencies. We appreciate any support CARB may provide to this effort. (MECA)

Agency Response: This comment is outside the scope of the 30-Day Notice Amendments. Please refer to the Agency Response to Comment A.(I)vi.7, regarding CARB's collaborative on-road demonstration project.

- (I)vi.5. Comment: We encouraged CARB to continue development of a robust heavy-duty I/M program. To ensure truck engines and aftertreatment systems are properly maintained and operating over their full useful life especially after the warranty has expired will require periodic inspection. This is particularly true for large class 7 and 8 tractor trailer trucks that may be on their second or third owner. MECA has been engaged in the heavy-duty I/M workshops and supports CARB's activities to develop a HD I/M program. (MECA)

Agency Response: This comment is outside the scope of the 30-Day Notice Amendments. However, CARB appreciates the feedback from MECA. The regulatory development of the HD I/M program is currently in progress and is scheduled for Board consideration on December 9-10, 2021.<sup>248</sup>

### **C. Comments Received During the 15-Day Comment Period**

Table IV.C.1 lists the commenters who submitted comments in response to the second 15-Day Notice Amendments, arranged in the time order in which the comments were received. The table identifies the date in which the comments were submitted, commenter name, and affiliation. Following the list is each objection or recommendation

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<sup>248</sup> More information can be found at: <https://ww2.arb.ca.gov/our-work/programs/heavy-duty-inspection-and-maintenance-program>

from these commenters, together with an agency response providing an explanation of how the proposed action has been changed to accommodate the objection or recommendation, or the reasons for making no change. In addition, many of the commenters provided comments in support of certain elements of the 15-Day Notice Amendments. These comments of support are appreciated by CARB staff but are not summarized below in this section. To easily find comments by topic, the 15-Day comments have been arranged by topic with the same headings and subheadings as the comments received before or at the hearing in section A, and the first 30-Day Notice comments in section B. Additionally, a new section (m) has been added for legacy engine comments and agency responses.

**Table IV.C.1. Written Comments Received During the 15-Day Comment Period**

<b>Commenter</b>	<b>Affiliation</b>
Fromm, Laurence (June 25, 2021)	Achates Power, Inc. (Achates)
Cole, Victoria (June 29, 2021)	California Bus Association (CBA)
Babik, Robert (July 6, 2021)	General Motors Company (GM)
Bretecher, Brad (July 6, 2021)	New Flyer and MCI
Ochs, Michael (July 6, 2021)	RV Industry Association (RVIA)
Fenton, Dawn (July 6, 2021)	Volvo
French, Timothy (July 6, 2021)	EMA
Yeager, Jackie (July 6, 2021)	Cummins
Sinnamon, Hilary (July 6, 2021)	EDF
Geller, Michael (July 6, 2021)	MECA
Portillo, Patricio (July 6, 2021)	NRDC <sup>249</sup>

**(a) Comments Related to NOx and PM Standards for 2024 and Subsequent MY HD Engines**

**(a)i. New 2024 Through 2026 MY NOx and PM Emission Standards for HD Engines**

15-Day comments were not received for this subsection.

**(a)ii. Aftertreatment System Used to Demonstrate the New 2024 Through 2026 MY NOx Standards for HD Engines**

15-Day comments were not received for this subsection.

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<sup>249</sup> In addition to NRDC, the signatories to this comment letter include The Greenlining Institute, Union of Concerned Scientists, Regional Asthma Management and Prevention, Central Valley Air Quality Coalition, NAACP San Pedro-Wilmington Branch # 1069, West Long Beach Association, Central California Asthma Collaborative, Ceres, International Brotherhood of Electrical Workers Local 569, Coalition For A Safe Environment, Earthjustice, Community Dreams, EMeRGE, The Center for Energy Efficiency and Renewable Technologies, East Yard Communities for Environmental Justice, San Pedro & Peninsula Homeowners Coalition, Dream Corps Green For All, California Kids IAQ, and Environmental Entrepreneurs (E2).

### **(a)iii. Fuel Economy and GHG Emissions Related to the 2024 MY Standards**

(a)iii.1. Comment: EMA requested that CARB to fully align on Title 40, CFR, sections 1036.150, 1036.230, 1036.235, 1036.701, 1037.501, and 1037.660 from the finalized U.S. EPA Improvements for Heavy-Duty Engine and Vehicle Test Procedures, and Other Technical Amendments. Specifically:

- “§1036.150(q) and §1036.235(c): CARB should align with the final EPA Technical Amendment package for these provisions related to fuel map confirmatory test procedures.
- §1036.230(f): CARB should align with EPA’s provision to allow engine families to be divided into subfamilies with respect to compliance with CO2 standards, as amended in the final EPA Technical Amendment package.
- §1036.701(j): CARB should allow for carry-over of Phase 1 vocational engine credits when recalculated against the revised Phase 2 baseline, in alignment with the final EPA Technical Amendment package.
- §1037.501(i): CARB should align with EPA’s provisions related to declared GEM inputs and compliance margins.
- §1037.660: CARB should align with EPA’s provisions related to partial credits for neutral-at-idle technology and should include the additional stop-start overrides, in alignment with EPA.” (EMA)

(a)iii.2. Comment: Volvo requested that CARB to fully align on Title 40, CFR, sections 1036.150, 1036.235, 1036.701, 1037.501, and 1037.660 from the finalized U.S. EPA Improvements for Heavy-Duty Engine and Vehicle Test Procedures, and Other Technical Amendments. Specifically:

- “1036.150(p): Alternative 2024-2026 model year vocational engine standards for manufacturers who participated in the 2020 pull-ahead of the 2021 engine standards.
- 1036.150(q): 2% engine fuel map confirmatory testing variability
- 1036.235: Align with the EPA June 29th, 2021 Federal Register publication version (86 FR 34308) to provide for updated test procedure and allowance determination of 1036.150(q).
- 1036.701(j)(2): Carry-over of Phase I MHD and HHD vocational engine credits when recalculated against the Phase II vocational engine baselines.
- 1037.501(i): Language regarding EPA’s expectations that manufacturers of regulated components would not apply error margins to all component certification data they provide to OEMs. EPA envisions that the OEM would apply a single margin to the FEL that would account for the maximum possible error from any single component under audit or confirmatory test. A margin on each component would artificially increase stringency.
- 1037.660: EPA’s changes to this section specify how to claim partial credit for neutral-at-idle technology that does not fully disengage the

torque converter, as well as updated safety over-ride conditions for Automatic Engine Shutdown systems, Engine Stop-Start, and Neutral-at-idle.” (Volvo)

Agency Response: No change was made in response to these comments as part of the Proposed Amendments because, due to the very recent release of U.S. EPA’s Phase 2 GHG amendments, there was not adequate time to get all Phase 2 amendments into the Omnibus Regulation. However, CARB staff is planning to eventually amend CARB’s Phase 2 GHG Regulation to align with U.S. EPA on the following sections 1036.150(p), 1036.230(f), 1036.701(j), 1037.501(i), and 1037.660 as part of a future HD rulemaking anticipated to align with U.S. EPA’s CTI.

However, as discussed in the submitted comments on the Notice of Proposed Rulemaking for U.S. EPA’s Improvements for Heavy-Duty Engine and Vehicle Test Procedures, and other Technical Amendments, CARB staff has serious concerns in section 1036.150(q), as well as some provisions in section 1036.235, regarding effectively giving away 2 percent of a 5 percent CO<sub>2</sub> benefit from the Phase 2. There is no need to replace a manufacturer’s fuel maps during confirmatory testing if the measured fuel maps are within 2 percent of the manufacturer’s maps. This means manufacturers could exceed the standards by 2 percent and still technically be in compliance.

**(a)iv. New 2027 and Subsequent MY NO<sub>x</sub> Emission Standards for HD Engines**

15-Day comments were not received for this subsection.

**(a)v. Aftertreatment System Used to Demonstrate the New 2027 and Subsequent MY NO<sub>x</sub> Emission Standards for HD Engines**

15-Day comments were not received for this subsection.

**(a)vi. Cylinder Deactivation Technology**

15-Day comments were not received for this subsection.

**(a)vii. LLC**

15-Day comments were not received for this subsection.

**(a)viii. Idle Emission Standards**

15-Day comments were not received for this subsection.

**(a)ix. OBD System**

15-Day comments were not received for this subsection.

**(a)x. Optional 50-State-Directed Engine Standards**

15-Day comments were not received for this subsection.

**(a)xi. Transit Bus Diesel Engines**

15-Day comments were not received for this subsection.

**(a)xii. Optional Low NOx Standards**

15-Day comments were not received for this subsection.

**(b) Comments Related to HD In-Use Test Procedure Amendments**

**(b)i. General Comments on the Heavy-Duty In-Use Test Procedure Amendments**

15-Day comments were not received for this subsection.

**(b)ii. In-Use Idle Bin**

15-Day comments were not received for this subsection.

**(b)iii. In-Use Idle Test**

15-Day comments were not received for this subsection.

**(b)iv. 3B-MAW**

- (b)iv.1. Comment: §86.1370.B.6.3.3. requires that for MY 2024 through 2046 engines the average engine power over an in-use test must be >10% of the engine's peak power for a valid test, and that a manufacturer should test additional days until a valid test is achieved:

For 2024 through 2026 model year engines only, the average engine power over the test must be equal to or greater than 10% of the engine's peak power for a valid test. In the event of an invalid test, the manufacturer shall retest the vehicle additional days until a valid test is achieved.

EMA recommends that manufacturers be given the option to submit data from an in-use test if the 10% minimum average power threshold is not met, and to count the vehicle toward the requirements to satisfy the in-use test

order. The invalidation of a test day where the average power is <10% is a provision that was included to give manufacturers three model years of experience under the new 3B-MAW requirements before being liable for compliance at such very low average power levels. The <10% average power exclusion sunsets with MY2027. There is no harm, and, in fact, there is an environmental benefit demonstrated if a manufacturer is compliant even at low average power levels. This modification would also reduce the number of occasions where manufacturers would face the burden and inconvenience of adding additional test days, which also has damaging effects on the relationship with the fleet that has voluntarily cooperated with the manufacturer to accept the inconvenience of in-use testing with their property, and on their premises. EMA therefore recommends that manufacturers be permitted to count a test having <10% average power over the test day toward the obligations under an In-Use test order should they so choose.

Also related to the provisions of §86.1370.B.6.3.3., EMA further recommends that a manufacturer be permitted to select another test vehicle, or even another fleet, if, following a second day of testing, the 10% threshold is not met (and the manufacturer elects not to submit the data as tested.) The average power criteria could overlap with and be further confounded by the minimum window count criteria of §86.1370.B.6.2. The revisions EMA recommends will permit manufacturers to avoid testing multiple days to no avail if the selected fleet's operations do not typically meet the average power criteria. (EMA)

Agency Response: No change to the Proposed Amendments was made in response to this comment. It is true that the invalidation of a test day where the average power is <10 percent was provided to protect manufacturers for the first three MYs from being liable for non-compliance with the requirements due to the average load of the test day being very low. However, CARB staff does not believe that manufacturers should be allowed to count a test having <10 percent average power over the test day toward the obligations if it does not impact emissions negatively. The procedures by which compliance are determined need to remain the same and consistent across the industry as well as with CARB's in-use compliance determination which would follow the procedures in the Omnibus Regulation. Manufacturers must ensure that the fleet they select for in-use testing has operations that will provide the necessary data to conduct in-use evaluation. CARB staff expects engines operating at less than the 10 percent engine peak power threshold to be mostly idle operation. Hence, CARB staff believes such operations can easily be pre-screened out by the manufacturer to avoid selecting test vehicles that would likely fail meeting these criteria. Also, please see Agency Response to Comments B.(b)i.8 and B.(b)i.9.

- (b)iv.2. Comment: §86.1910.A.(g)(ii): CARB proposes to remove the redundant language related to minimum window count requirements per bin. EMA

supports elimination of this redundant language, but recommends that the sentence from the proposed deleted section that reads, “Evaluate the data combined from the day(s) of testing as described in section 86.1370.B.6.”, be added to the retained provisions of §86.1910.A.(g) to make it clear that manufacturers should use the combined windows accumulated over multiple test days to demonstrate compliance to the minimum window count requirement (and to include the multiple-days’ test data). Note that the reference to §86.1370.B.6 does not provide the needed clarity, as those provisions at §86.1370.B.6.3.2 are equally ambiguous, and should be similarly modified as well. (EMA)

Agency Response: No change to the Proposed Amendments was made in response to this comment. CARB staff agrees that the statement “*Evaluate the data combined from the day(s) of testing as described in section 86.1370.B.6.*” provides some additional clarity on how manufacturers should use the combined windows accumulated over multiple test days to demonstrate compliance to the minimum window count requirement (and to include the multiple-days’ test data). However, the current language does not prohibit using the data from multiple test days and without adding the deleted section, manufacturers can still combine windows accumulated over multiple days to demonstrate compliance to the minimum window requirement.

**(b)v. 3B-MAW Fuel Specification**

15-Day comments were not received for this subsection.

**(b)vi. 3B-MAW and OBD Integration**

15-Day comments were not received for this subsection.

**(b)vii. General Comments on the Use of PEMS**

15-Day comments were not received for this subsection.

**(b)viii. Use of PEMS Adjustment Factor and Conformity Factor**

15-Day comments were not received for this subsection.

**(b)ix. Otto-Cycle Engine In-Use Test Methodology**

15-Day comments were not received for this subsection.

**(b)x. In-Use Emission Data Collection**

15-Day comments were not received for this subsection.

**(b)xi. Sensor-Based Torque and NOx Measurements**

15-Day comments were not received for this subsection.

**(b)xii. In-Use Testing Temperature Requirements**

15-Day comments were not received for this subsection.

**(c) Comments Related to Warranty Period Amendments and Useful Life Period Amendments**

**(c)i. Warranty Period Amendments**

15-Day comments were not received for this subsection.

**(c)ii. Useful Life Period Amendments**

15-Day comments were not received for this subsection.

**(c)iii. Warranty Provisions on Out-of-State Vehicles**

15-Day comments were not received for this subsection.

**(c)iv. Generation of Additional Data for Warranty Information**

15-Day comments were not received for this subsection.

**(d) Comments Related to EWIR and Corrective Action Procedure Amendments**

**(d)i. General Comments Related to EWIR**

15-Day comments were not received for this subsection.

**(d)ii. Field Information Report**

15-Day comments were not received for this subsection.

**(d)iii. Corrective Action**

15-Day comments were not received for this subsection.

**(d)iv. EWIR Definitions**

15-Day comments were not received for this subsection.

**(e) Comments Related to Emissions ABT Program Amendments**

**(e)i. General Comments Related to ABT Program Amendments**

15-Day comments were not received for this subsection.

**(e)ii. General Comments Related to ZEV ABT Credits**

15-Day comments were not received for this subsection.

**(e)iii. Expiration of ZEV ABT Credits**

15-Day comments were not received for this subsection.

**(e)iv. Averaging Set of ZEV ABT Credits**

15-Day comments were not received for this subsection.

**(e)v. Federal ABT Credits**

15-Day comments were not received for this subsection.

**(e)vi. Early Multiplier Credits**

15-Day comments were not received for this subsection.

**(e)vii. ABT Credits and Incentive Funding**

15-Day comments were not received for this subsection.

**(f) Comments Related to HD Certification Engine Durability Demonstration Program and In-Use Emissions Data Reporting Amendments**

**(f)i. Leadtime for the HD Engine Durability Demonstration Program**

15-Day comments were not received for this subsection.

**(f)ii. HD Engine Durability Demonstration Program**

15-Day comments were not received for this subsection.

**(f)iii. In-Use Emissions Data Reporting Amendments**

15-Day comments were not received for this subsection.

**(g) Comments Related to Powertrain Certification Test Procedures for HD Hybrid Vehicles Amendments**

15-Day comments were not received for this subsection.

**(h) Comments Related to Medium-Duty Engine Clarifications and Amendments**

15-Day comments were not received for this subsection.

**(i) Comments Related to Economic Impact Analysis**

**(i)i. General Cost Comments**

15-Day comments were not received for this subsection.

**(i)ii. Standardized Regulatory Impact Assessment (SRIA)**

15-Day comments were not received for this subsection.

**(i)iii. Direct Costs for Low NOx and PM Standards**

15-Day comments were not received for this subsection.

**(i)iv. Direct Costs for Lengthened Warranty and Useful Life, and EWIR**

15-Day comments were not received for this subsection.

**(i)v. Costs Related to a Pre-Buy/No-Buy Scenario**

15-Day comments were not received for this subsection.

**(i)vi. Cost to Businesses**

15-Day comments were not received for this subsection.

**(j) Comments Related to Emissions and Health Benefits**

**(j)i. State and District Attainment Goals**

15-Day comments were not received for this subsection.

**(j)ii. Other Comments**

15-Day comments were not received for this subsection.

**(k) Comments Related to the EA Comments**

15-Day comments were not received for this subsection.

**(l) Miscellaneous Comments**

**(l)i. Harmonized National Low NOx Program**

15-Day comments were not received for this subsection.

**(l)ii. CAA and Federal Waiver of Preemption**

15-Day comments were not received for this subsection.

**(l)iii. Implementation of Early Low NOx Technology**

15-Day comments were not received for this subsection.

**(l)iv. Fuel Issues**

15-Day comments were not received for this subsection.

**(l)v. Impact on Dealerships and Trucking Fleets**

15-Day comments were not received for this subsection.

**(l)vi. Other Miscellaneous Comments**

(l)vi.1. Comment: Based on engine measurements and analysis, the 10.6 L opposed-piston diesel engine generates 0.021 g / bhp-hr NOx over CARB LLC, 60% below the 2027 ultralow NOx limit (98% below some current engines).

- The engine also emits 4 g/hr NOx at idle, 20% below the 2027 limit (99.9% below the current optional CARB Clean Idle standard)
- The engine can meet all 2027 CO2 and criteria emissions from U.S. EPA and CARB with considerable margins.
- The measured results are achieved with a conventional single SCR, underfloor aftertreatment systems providing a significant advantage in cost and complexity vs. other ultralow NOx solutions. (Achates)

Agency Response: CARB staff did not change the Proposed Amendments in response to the comment. The comment is beyond the scope of the proposed changes in the 15-Day Notice Amendments. However, CARB staff appreciates Achates Power providing technical data that demonstrates and supports the

technical feasibility of CARB’s 2027 MY exhaust emission standards. Achates has previously reported that the Achates 10.6-liter multi-cylinder opposed-piston engine is capable of meeting CARB’s 2027 MY FTP NOx and CO2 standards using the conventional underfloor aftertreatment system.<sup>250</sup> With the results reported in the above comment, Achates further demonstrates that the Achates 10.6-liter multi-cylinder opposed-piston engine is capable of meeting CARB’s 2027 MY standard for the LLC and the idle NOx standard with significant compliance margins.<sup>251</sup> Again, the above reported emission performance is achieved with conventional underfloor aftertreatment system providing a significant reduction in cost and complexity compared to the dual-dosing split SCR system.

## **(m) Comments Related to Legacy Engine Amendments**

### **(m)i. General Comments Related to Legacy Engine Amendments**

- (m)i.1. Comment: In the 15-day proposal, manufacturers must first attempt to offset legacy engine deficits with zero-emission powertrain credits they have generated themselves or bought from other manufacturers. The sale of HD ZEV and the availability of zero-emission credits are uncertain, especially in MY 2022 and 2023, when manufacturers stand to earn more credit from ZEV sales compared to MY 2024 or later, but CARB’s Advanced Clean Trucks ZEV sales mandates have not yet taken effect. In the 15-day change notice, CARB acknowledges the uncertainty associated with acquiring zero-emission credits by offering manufacturers a potential fallback plan of using traditional diesel engine credits from the same averaging set to offset legacy engine deficits. However, Cummins is not aware of the existence of any banks of MY 2010 or later diesel NOx or PM credits. Because we are not expecting sufficient credits from either the zero-emission or diesel averaging sets to be available, Cummins’ most significant concern with CARB’s 15-day proposal is the uncertainty related to the manufacturer’s mitigation project plan. (Cummins)
- (m)i.2. Comment: Without regulatory certainty that manufacturers can obtain CARB approval of mitigation plans before they release legacy engines, we do not see a workable path for manufacturers to offer these engines to customers. Cummins urges CARB to make changes in the regulatory text to provide the necessary certainty to ensure customers for these engines are not underserved. (Cummins)

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<sup>250</sup> “Achates Power Opposed-Piston Heavy-Duty Diesel Engine Demonstration Performance Results – Ultralow NOx without additional hardware,” Achates Power, December 17, 2020. <https://achatespower.com/wp-content/uploads/2020/12/Achates-Power-Opposed-Piston-Heavy-Duty-Diesel-Engine-Demonstration-Performance-Results-Ultralow-NOx-without-additional-hardware.pdf> – accessed 3/8/2021

<sup>251</sup> “Ultralow NOx during Low-loads and Idle.” Achates Power, June 25, 2021 (<https://www.arb.ca.gov/lists/com-attach/102-hdomnibus2020-UTBUMVI7UmBXJVQx.pdf> - accessed 7/9/2021)

(m)i.3. Comment: We are aware that Cummins and CARB have been discussing potential strategies to resolve this dilemma. However, as written, the proposed fix in CARB's latest amendments fails to provide Cummins the certainty needed to commit to building engines for the RV industry, as the total costs of the mitigation strategy measures are unknown. Furthermore, CARB's proposal to cap credit costs at \$4,000 per MHDD far exceeds CARB's earlier projected cost increases for MHDD vehicles like motorhomes. Table IX-34 in the Statement of Reasons projected an increase in purchase price of \$2,469. This is what the RV industry expected to be the impact of the Omnibus Low NOx rule, not \$4,000, and certainly not \$4,000 plus some additional unknown mitigation expense and unknown expense for HHDD engines.

Motorhome manufacturers are making engine purchase decisions now for their future Model Years, so regulatory certainty is needed immediately. They cannot wait for the issue to be addressed some time down the road by either CARB or Cummins.

Given the information discussed above, and recognizing that motorhomes are only operated on average about 2,000 mile per year (a fraction of the annual miles traveled by typical commercial trucks, RVIA believes that MHDD and HHDD motorhome engines should be exempt from the regulation for the 2024 and 2025 model years. Without such an exemption, the RV industry and its customers will be unfairly harmed by the measure, either via extraordinary cost increases or lack of product. (RVIA)

Agency Response to Comments (m)i.1 through (m)i.3: CARB staff did not make any changes to the Proposed Amendments based on these comments.

The proposed mitigation process for offsetting legacy engine emissions deficits is comprised of three separate options in order to provide the manufacturers with the maximum allowable flexibility and certainty. The \$4,000 price cap for sufficient HD-ZEP credits to offset a MHDD means that if the credit price exceeds that value, the engine manufacturer would have the ability to offset the deficits via the other two options. Given that all HD-ZEP credits would expire by the end of the 2026 MY, CARB staff believes that the owners of HD-ZEP credits would be incentivized to sell those credits before their expiration date.

CARB staff believes that the three mitigation options would remediate any uncertainty mentioned and presents a balanced and effective approach to offsetting the legacy engine deficits. CARB staff believes that any manufacturers that wish to sell legacy engines in 2024 to 2025 using the legacy engine provisions will find plenty of HD-ZEP credits to do so. Based on a recent study

by ICCT,<sup>252</sup> a total of 1,098 units of HD ZEVs were sold in 2020 in California. This number is only expected to increase as manufacturers prepare to comply with the ACT regulation.

It should be noted that each qualified 2022-2023 MY HD-ZEP sale in California can generate sufficient NOx credits to offset 1.33 legacy engines in the same primary intended service class.

The list of companies that are anticipated to be offering HD zero-emission products in California is also very diverse and includes:

- Proterra
- BYD
- New Flyer
- Phoenix Motorcars
- GreenPower
- Lightning Systems
- Lion Electric
- Bluebird
- Motiv
- SEA
- Workhorse
- Freightliner
- Navistar
- Peterbilt, and
- Volvo

In the unlikely event that there is a shortage of such credits, the legacy provisions provide several other avenues for moving forward with legacy engine sales, including the extremely flexible mitigation plan option.

- (m)i.4. Comment: As proposed, it is not until the end of MY 2026 that a manufacturer submits a mitigation project plan for CARB Executive Officer approval. The provisions allow for a manufacturer to submit a contingency plan earlier, but only to be “assessed” by CARB, not “approved”. As written, that would not work, but because the remainder of that regulatory section pertains to approvals, CARB should clarify its intent by replacing the word “assessed” with “approved”. Otherwise, manufacturers would not participate in this space by offering MY 2024 and 2025 legacy engines without knowing up front what their financial liability would be, in the likely event that sufficient zero-emission and/or diesel engine credits would not be available. Without changes to the currently proposed regulation, we see no viable path for manufacturers to appropriately price and sell legacy engines. Because the mitigation plan’s cost would remain unknown until the plan is approved at the

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<sup>252</sup> Zero-emission bus and truck market in the United States and Canada: A 2020 update. May 2021. <https://theicct.org/sites/default/files/publications/canada-race-to-zero-FS-may2021.pdf>

end of 2026 (as written), there would be no certainty of financial liability, which is needed now for pricing and selling MY 2024 and 2025 legacy engines. As a result, applications requiring legacy engines may go unserved. Therefore, we recommend that the regulatory language should prescribe an explicit path for manufacturers to seek and gain early CARB final approval for mitigation projects at any time, without waiting until 2026. Only after CARB final approval of a mitigation plan would any manufacturer be able to assess the financial liability of the transitional flexibility for the purpose of appropriately pricing and selling legacy engines. To clarify, even once a manufacturer receives CARB's approval for its post-2026 mitigation plan, the manufacturer still would be required to use ZEV credits and other credits first, to the greatest extent specified in CARB's regulations, through 2026. (Cummins)

- (m)i.5. Comment: For all the foregoing reasons, the proposed series of restrictive methods available for legacy engine emissions-recovery (ZEV credit generation, ZEV credit purchase, and NOx credit generation on the US10 platform) do not provide manufacturers with the certainty they require to launch a legacy engine plan to continue to serve the California market. Simply put, without certainty, there can be no legacy engine launch plan, because there is not a complete business case for a manufacturer to evaluate. That leaves only the final step in the series of emission-recovery methods — an Executive Officer-approved mitigation plan — to provide the necessary certainty. As currently proposed, however, the requisite certainty is not assured through the “last-stop” mitigation plan, since it is impractical to sell a product with no view of the total cost to bring it to market. The only way the flexibility provisions (proposed to avoid the troubling consequences of unserved markets) can be workable is if CARB includes procedures to approve manufacturers' mitigation plans prior to the date by which market pricing for legacy engines must be set. (EMA)
- (m)i.6. Comment: It is important to note that the flexibility provisions could, and should, be framed up to ensure that all stakeholders can achieve positive outcomes. Those stakeholders include the customers that will see product availability in what might otherwise be unserved markets, manufacturers that can streamline a pathway to compliance even in the face of minimal lead time, and also CARB, which can have a means to avert the undesirable outcomes stemming from overly aggressive regulatory demands. To ensure these positive outcomes are realized, the flexibility provisions should be finalized to foster a cooperative effort to provide engines to vital market segments otherwise left unserved. The only way to do that is to provide that manufacturers' mitigation plans will be approved in advance.

In light of these concerns, EMA recommends that CARB modify §1956.8(a)(2)(C)3.b.iii.3.B to read, “The manufacturer may submit contingency plans to be approved in advance under the provisions set forth

in this subsection”, or, preferably, “Contingency plans may be submitted for approval in advance.” (EMA)

Agency Response to Comments (m)i.4 through (m)i.6: CARB staff did not make any changes to the Proposed Amendments based on these comments because it appears that commenters have misinterpreted the text of section 1956.8(a)(2)(C)3.b.iii.3.B and misunderstood the intent of the legacy engine provisions. It appears the commenters fail to realize that the Proposed Amendments do allow a manufacturer to submit a contingency plan for approval in advance (demonstrating that a proposed project will sufficiently offset specified quantities of emissions in a California disadvantaged community or communities within five years) to CARB’s Executive Officer prior to the 2026 model year.

As CARB staff discussed in meetings both with EMA and Cummins, manufacturers may submit such contingency plans prior to the 2026 model year, provided the manufacturer has completed all the necessary steps laid out in the regulatory language. Section 1956.8(a)(2)(C)3.b.iii.3 specifies that if a manufacturer does not have a sufficient quantity of credits at the end of the 2026 model year, it must meet the criteria in subsections A, B, and C. Subsection B specifies that the manufacturer must submit a plan for CARB’s Executive Officer (EO) approval that both benefits disadvantaged communities and offset emissions in five years, specifies the criteria that CARB’s EO will utilize to evaluate whether a plan meets the criteria, and then states that the manufacturer may submit contingency plans “to be assessed on the same standard as set forth in this subsection.” The term “assessed” therefore refers to CARB EO’s determination whether a given contingency plan meets the criteria stated in subsection B – it does not obviate the requirement that CARB’s EO must approve or disapprove contingency plans.

As noted by the comments, engine manufacturers are expected to go through a three-step evaluation process. The three steps are as follows: (1) use HD zero-emission credits, (2) use combustion engine credits, and then, only if needed – (3) perform environmental projects, in that specific order to offset any deficits generated by selling legacy engines in California.

Engine manufacturers have the option to submit a contingency plan (including well before the 2026 MY), that describes their compliance plans in detail to CARB. The contingency plan would be assessed by CARB’s EO to determine if it conforms with the three-step mitigation criteria and fits within the framework of the regulations. For example, the transmittal of the contingency plan would need to make clear that performing environmental projects to offset emission increases would only be pursued after the first two steps (i.e., attempting to buy HD-ZEP credits and combustion engine credits) were completed. CARB’s EO would review and respond to the contingency plan in a timely manner, and would

not delay reviewing or issuing a decision for timely submitted contingency plans until the 2026 MY.

Section 1956.8(a)(2)(C)3.b.iii.B requires CARB's EO to base his or her determination that a contingency plan meets the criteria upon documentation provided by the manufacturer and "the exercise of good engineering judgment that the plan would benefit disadvantaged communities, and would fully offset the excess emissions due to the credit deficit balance within 5 years." Consequently, any decisions by CARB's EO to approve contingency plans submitted prior to the 2026 MY would necessarily be premised upon determinations that in model year 2026, each of the facts supporting the approval of a specified contingency plan (e.g., the existence of a funding mechanism, the identification of organization(s) implementing the proposed projects, etc.) will be in existence, and will substantially identical to the facts described in the documentation supporting the contingency plan.

- (m)i.7. Comment: The proposed amendments specify a \$4,000 cost threshold above which a manufacturer is not required to buy zero-emission credits and may seek approval to use diesel engine credits to offset legacy engine deficits. The \$4,000 cost cap is described by CARB as the cost of credits sufficient to offset one MHD legacy engine. The cost of credits to offset one HHD legacy engine is not defined. Cummins believes that the proposed cost cap of \$4,000 will be too high for many of our customers. In Table IX-5 of the Initial Statement of Reasons released with its 60-day proposal, CARB estimated the incremental cost for diesel engines to meet the proposed MY 2024 and 2025 standards as \$1,550 for MHD engines and \$2,466 for HHD engines. Those are the costs CARB used in its cost-to-benefit analysis to justify the Omnibus Rule. Manufacturers and their customers should not be forced to pay more for credits to offset legacy engines than what CARB projected it would cost to comply with the standards. Therefore, the cost cap for zero-emission credits should be set at \$1,550 for MHD engines and \$2,466 for HHD engines. CARB's proposed cost cap is more than double, effectively creating a "two-for-one" credit requirement. Furthermore, it is important to specify the cost cap for HHD engines in the regulation as well as MHD, so manufacturers have clarity on how much they may need to spend to acquire zero-emission credits to price HHD legacy engines accordingly. (Cummins)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment.

As mentioned in the 15-Day Notice Amendments,<sup>253</sup> the proposed price cap for credits to offset a MHDD engine is set at approximately 20 percent of the cost of the engine in 2021 MY (\$4,000). CARB staff anticipates the Executive Officer

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<sup>253</sup> Second Notice of Public Availability of Modified Text and Availability of Additional Documents Proposed Amendments to the Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments. June 18, 2021. <https://ww3.arb.ca.gov/board/15day/hdomnibuslownox/2nd15daynotice.pdf>

would use the same methodology for LHDD and HHDD engines. For example, the proposed price cap for credits to offset a HHDD engine would be 20 percent of the average cost of a 2021 MY HHDD engine that the manufacturer offered for sale in 2021.

Furthermore, the cap provided for the maximum price required to purchase HD zero-emission credits is a cap and is not the expected price engine manufacturers will pay for these credits. CARB staff anticipates that engine manufacturers with the ability to sell legacy engines in California will be reaching out to independent ZEV manufacturers to establish agreements for their expected future product deployments well ahead of completing the sale of 2024 MY engines. In fact, California fleets also have the option of reach out to ZEV manufacturers. Fleets could, for example, enter into binding agreements to procure their future credits and provide those credits to the engine manufacturer for their legacy engine needs.

CARB staff's desired outcome would be for engine manufacturers to produce compliant engines for all vehicle applications in California. Lowering the credit cost limit as suggested by commenter (Cummins) would further encourage the delay of producing compliant engines for the California market. However, if a manufacturer decides not to make the product planning investments in advance, they would be faced with a situation where they would have to comply within the framework of the three-step mitigation process. As such, there is no connection between the costs for product planning investment scenario versus the three-step mitigation process.

- (m)i.8. Comment: As noted above, the proposed restrictions requiring the use of zero-emission credits and MY 2010 or later diesel credits, neither of which exist today, do not provide the certainty needed by manufacturers to ensure product availability for customers. Cummins has offered CARB recommendations intended to provide additional certainty around the availability of credits. Our June comments in response to CARB's 30-day notice called for CARB to allow the use of manufacturers' hard-earned pre-2010 credits, even if at a discount. As noted in our comments, U.S. EPA envisioned an unlimited lifetime for those credits. By declaring them valueless, CARB decreases the incentive for manufacturers to generate credits in the future. CARB should change the requirements to allow manufacturers to use pre-2010 credits to offset legacy engine deficits. At a minimum the retirement of pre-2010 credits should be considered in the mitigation plan. (Cummins)
- (m)i.9. Comment: Another existing source of credits are engines already certified to CARB's Optional Low NOx standards. Currently, CARB prohibits those from generating NOx credits, even though they are certified well below today's standard (e.g., natural gas engines certified to 0.02 g/bhp-hr NOx). CARB should recognize the investment by manufacturers to develop those engines, and their positive impact on the environment, by allowing those engines to

generate credits and still qualify for incentive programs. CARB should remove its restrictions on participating in ABT programs in §1956.8 and §86.xxx-11.B that prevent those engines from earning credits. At the very least, CARB should remove the two-year pull-ahead of MY 2024 requirements associated with alternate OBD thresholds, which are certification roadblocks to earning credits in MY 2022 and 2023, even without incentives. (Cummins)

Agency Response to Comments (m)i.8 through (m)i.9: CARB staff did not make any changes to the Proposed Amendments in response to these comments. As an initial matter, these comments are beyond the scope of the 15-day notice, because CARB did not propose amendments to either the transfer mechanism for federal ABT credits into the CA ABT program, or the ability of engines certified to the optional NOx standards to generate credits in that notice.

Notwithstanding that fact, in response to the comment that regarding the proposed allowance to use “hard-earned pre-2010 credits,” please see the Agency Response to Comments A(e)i.4 and (e)i.5, which are incorporated by reference in this reply. CARB also notes that the use of such credits is inconsistent with the continued need for new emissions reductions that is driving this set of regulatory action. Moreover, CARB staff does have concerns with the ultimate integrity of very old credits, as in-use compliance testing continues to evolve and become more rigorous – meaning credits from more than a decade prior do not necessarily reflect the same standards that would be applied today. Cummins, for example, just in 2018 and 2019 recalled 500,000 MY 2010 to 2015 vehicles with faulty emissions equipment (i.e., degraded SCRs).<sup>254</sup> Thus, in light of evolving and improving testing standards, and of technological and pollution control standards for vehicles, motivated by the need for new reductions in response to continued and intense air quality needs, and in the absence of the time or resources for a full review of the circumstances under which these credits were generated, CARB declines to make changes to enable the use of these credits.

In terms of the ability of low NOx engines to participate in the incentive funding programs, it should be noted that under current regulatory structure, cleaner-than-required engines have two pathways to certification. The first option is to certify to optional low NOx standards and become eligible for incentive funding through the Moyer program. Manufacturers that use this pathway would not be eligible to generate any emission credits. The second option is to certify the engine to an FEL below the applicable standard and generate emission credits. Manufacturers using the second option would not be eligible for incentive funding through the Moyer program. As of today, all NG vehicle manufacturers have chosen to use the first option for certification to help offset the additional higher cost associated with NG vehicles fuel storage cost and other costs. Please see

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<sup>254</sup> CARB investigation leads to nationwide recall of 500,000+ Cummins heavy-duty trucks. July 31, 2018. <https://ww2.arb.ca.gov/news/carb-investigation-leads-nationwide-recall-500000-cummins-heavy-duty-trucks>

the Agency Response to Comments A.(a)xii.1 and A.(a)xii.2, which are hereby incorporated by reference into this response.

- (m)i.10. Comment: Finally, similar to provisions in CARB's ACT rule, CARB should encourage the transition to zero-emissions powertrains by allowing up to 75% NOx/PM credit in the Omnibus Program for near-ZEV such as range-extended battery-electric powertrains, based on the all-electric range. (Cummins)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment.

The Omnibus Regulation already proposes a new optional certification pathway for hybrid powertrains and so the changes suggested by the commenter are not needed. Using that pathway, range-extended battery-electric powertrains would be eligible to generate NOx and PM credits if they are certified to an FEL below the emission standard. The provision of legacy engines is designed to avoid market disruption as manufacturers adjust to the Omnibus standards as well as to support the state's transition to heavy-duty ZEVs. Hybrids and cleaner combustion engines generating emission credits can be used under the legacy provision but only if the zero-emission credits are exhausted or that the price of those credits exceed the price cap.

- (m)i.11. Comment: As proposed, a manufacturer's sales volumes of legacy engines in MY 2024 and 2025 are limited as percentages of their total California diesel sales. Limiting the volumes based on diesel sales does not encourage or recognize manufacturers' investments in other technologies to meet California standards and customers' needs. CARB should allow manufacturers to include their heavy-duty Otto-cycle engines in total California sales for the percentage calculations, not just diesel engines. (Cummins)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment.

The legacy engine provisions are only applicable to HD diesel engines. Similar provisions were not incorporated in the HDO test procedures, because CARB staff does not believe that a product availability issue exists in that technology sector. As such, there is no reason for the inclusion of HDO engine sales in the manufacturer's calculation of total HD engine sales to support more legacy diesel engines.

- (m)i.12. Comment: §1956.8(a)(2)(C)3.a and §86.xxx-11.B.5.3.5.1 set forth proposed criteria for certification of legacy engine families. The criteria appropriately allow for legacy engines to meet 2023 requirements in several areas. However, there are many other provisions not mentioned where 2023 (rather

than 2024) requirements should be applicable to legacy engines, such as §86.xxx-30.B carry-over provisions, §86.010-38 fuel requirements, Subpart T manufacturer-run in-use testing, §1065.518.B pre-conditioning, §1065.680.B IRAF calculations, §1065.935.B range and drift provisions, §2140 in-use compliance testing, Title 13 warranty reporting and corrective actions, and perhaps more. Additionally, the new in-use idling compliance test of §86.1370 B.7 should not apply to legacy engines. CARB should revise the legacy engine requirements such that 2023 requirements will apply for these provisions and others that may be identified after a more thorough review. The most straightforward remedy would be for CARB to follow a similar approach as taken in §1956.8(a)(2)(C)2.a in specifying requirements for certifying engines at or above 525 hp. (Cummins)

(m)i.13. Comment: Also related to the flexibility provisions, §1956.8(a)(2)(C)3.a. details the various regulatory programs for which model year 2023 requirements (in lieu of the 2024 model year requirements) will be applicable to legacy engines. For the flexibility provisions to be workable, however, CARB should also specify in §1956.8(a)(2)(C)3.a. the model year 2023 requirements applicable for the following regulatory programs and provisions as well:

- §86.010-38: Fuel requirements
- §86.1370 (Cal) B.7.: New in-use idling compliance test should not apply
- Diesel Test Procedures Subpart T: Manufacturer-run In-Use Testing
- §13 CCR 2140: Heavy-Duty In-Use Compliance Testing

EMA cannot guarantee that the list above covers all additional applicable references to MY 2023 requirements. CARB should add these and any other relevant exceptions following a thorough review. A more straightforward approach would be to apply a regulatory structure such as that used in §1956.8(a)(2)(C)2. related to engines >525HP to these flexibility provisions.

Additionally, the HD OBD exemptions for legacy engines set forth at §1956.8(a)(2)(C)3.a.iv. also should be documented in 13 CCR §1971.1 and §1971.5. Any exceptions to the OBD provisions should be clearly stated, or, at minimum, referenced, in the OBD regulation. This will ensure that all of the applicable HD OBD certification and enforcement requirements are considered and applied appropriately to legacy engine families. (EMA)

Agency Response to Comments (m)i.12 and (m)i.13: CARB staff did not make any changes to the Proposed Amendments based on these comments.

In terms of HDIUT requirements, 13 CCR 1956.8 (a)(2)(C)3.a.ii the regulatory language clearly states that “[T]he engine family must comply with the requirements for a 2023 MY engine family...”. Therefore, the new in-use idling compliance and other 3B-MAW requirements would not apply to legacy engines.

For the other requirements such as: §86.xxx-30.B carry-over provisions, §86.010-38 fuel requirements, §1065.518.B pre-conditioning, §1065.680.B IRAF calculations, §1065.935.B range and drift provisions, Title 13 warranty reporting and corrective actions manufacturers are expected to comply with all 2024 MY applicable requirements.

In terms of OBD requirements, the provisions for a 2023 MY engine family in 13 CCR 1971.1 and 1971.5 would be applicable to legacy engines.

- (m)i.14. Comment: §86.xxx-15.B.(3)(i)(1)(G) specifies the FEL cap for PM as 0.010 g/bhp-hr for MY 2024 and later engines. However, the PM standard for legacy engines is the 2023 standard of 0.01 g/bhp-hr, with two digits after the decimal point instead of three. CARB should revise (G) to specify a PM FEL cap of 0.01 g/bhp-hr for MY 2024 and 2025 legacy engines, to be consistent with the applicable PM standard for legacy engines. (Cummins)
- (m)i.15. Comment: In a related manner, the legacy engines are subject to 2023 model year requirements (save for GHG requirements). Yet, the FELs as expressed in the introductory text, are specified to three significant digits. As stated earlier, CARB should eliminate these lower-level limits. If CARB nonetheless decides to retain them, or changes them, EMA recommends that CARB specify the NO<sub>x</sub> FELs to two significant digits, consistent with the MY 2023 standards and FEL provisions. (EMA)
- (m)i.16. Comment: 86.xxx-15.B.3.i.1.G. establishes a maximum allowable PM FEL (“FEL cap”) of 0.010 g/bhp-hr for MY 2024 and later engine families. The PM FEL cap for legacy engines, however, should be specified to the same number of significant digits as the PM standard applicable to MY 2023 engines. EMA recommends that CARB apply the same approach they are proposing for the NO<sub>x</sub> FEL caps under 86.xxx-15.B.3.i.1.B and C. Accordingly, EMA recommends the PM FEL cap be written as follows:

(G) For 2024 through 2025 model years, the maximum FTP particulate matter FEL value is 0.01 g/bhp-hr for engines certified under title 13, CCR, section 1956.8(a)(2)(C)3. For all other 2024 through 2025 model year engines, the maximum FTP particulate matter FEL value is 0.010 g/bhp-hr.

(H) For 2026 and subsequent model years, the maximum FTP particulate matter FEL value is 0.010 g/bhp-hr. (EMA)

Agency Response to Comments (m)i.14 through (m)i.16: CARB staff did not make any changes to the Proposed Amendments based on these comments.

The range of applicable FTP NO<sub>x</sub> and PM FELs for legacy engines are identified in 13 CCR 1956.8(a)(2)(C)3.a as “...0.100 < FTP NO<sub>x</sub> FEL ≤ 0.20 g/bhp-hr, and 0.005 < FTP PM FEL ≤ 0.01 g/bhp-hr....” These FEL cap values are consistent with the comment by the stakeholders and therefore no changes were made.

For the issue regarding the lower bound FEL values, please see Agency Response to Comment C.(m)i.20.

- (m)i.17. Comment: In §1956.8(a)(2)(C)3.b.v. and §86.xxx-11.B.5.3.5.2.(e), CARB proposes that NO<sub>x</sub> and PM deficits generated by legacy engines are subject to the provisions of §86.004-15.A.(b)(5), which says ABT compliance will be determined at the end of the model year, and engine families without adequate credits will violate the conditions of the certificate of conformity. The proposed language conflicts with language elsewhere in the legacy engine provisions which proposes that legacy engine deficits may be carried over until the end of MY 2026 under certain conditions. CARB should revise the proposed language of §1956.8(a)(2)(C)3.b.v. and §86.xxx-11.B.5.3.5.2.(e) to clarify that an exception to §86.004-15.A.(b)(5) is allowed for the carry-over of legacy engine deficits through the end of MY 2026. (Cummins)
- (m)i.18. Comment: Another issue related to the new flexibility provisions concerns the limitations imposed by §1956.8(a)(2)(C)3.b.v., which reads, “NO<sub>x</sub> and PM deficits generated by legacy engines are subject to the provisions of §86.004-15.A.(b)(5) of the “California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles,” as incorporated by reference in title 13, CCR, section 1956.8(b).” §86.004-15.A.(b)(5) is in conflict with §1956.8(a)(2)(C)3.b.iii.2, which permits credit deficits (under the circumstances described) to be carried into the 2026 model year: “If credits from the same averaging set are not available, the manufacturer may carryover the NO<sub>x</sub> or PM deficit balance generated by legacy engines until the end of the 2026 model year.” Similarly, carrying any legacy engine credit deficits from MY 2024 into MY 2025 appears to be in conflict with §1956.8(a)(2)(C)3.b.v. (EMA)

Agency Response to Comments (m)i.17 and (m)i.18: CARB staff did not make any changes to the Proposed Amendments based on these comments.

For legacy engine families, manufacturers have the option to offset the deficits either:

- At the end of the applicable MY. These engine families would be subject to the provisions of §86.004-15.A.(b)(5).
- At the end of the 2026 and 2031 MYs. These engine families would be subject to the 1.25 deficit multiplier and would require:
  - The submittal and approval of a mitigation plan by the end of the 2026 MY, and
  - Successful completion of the mitigation plan by the end of the 2031 MY.

Failure to meet either of the above requirements would be subject to the provisions of 13 CCR 1956.8(a)(2)(C)3.b.v.

- (m)i.19. Comment: The cascading chain of emissions recovery methods proposed in the 15-Day draft are fraught with uncertainty. First, there is no guarantee that the ZEV products offered to the California market in the timeframe leading up to the certification of legacy engines, or during the 2024-2026 timeframe when ZEV credits “come due” according to the Omnibus regulatory provisions, will actually find buyers. This risk is even more concerning to any loose engine manufacturers not obligated under the ACT Rule. Moreover, the Omnibus Rule is so challenging, with so many compliance hurdles, that it is impossible to predict how critical a role ZEV-generated credits may play in diesel engine manufacturers’ long-term compliance plans, making the future market availability of ZEV-based credits highly uncertain. It is also impossible to forecast what market price ZEV credits might bear, or whether they will be offered for sale at all. Regarding the next alternative in the chain of allowable legacy emissions-recovery methods, HDDE generated credits, it is well-known that, despite the US10 emissions standards having been in place for more than a decade now, no manufacturer has certified a HDDE below the 0.20 g/bhp-hr NO<sub>x</sub> standard to generate NO<sub>x</sub> credits. Despite manufacturers’ awareness that stringent standards were being promulgated by CARB, and federally-mandated emissions reductions were looming – conditions which normally motivate manufacturers to build a bank of credits to enable a more streamlined compliance pathway under those future standards – not a single manufacturer has taken that risk. Accordingly, it is highly unlikely that manufacturers will be able to identify a technical pathway to work with current, verified hardware configurations to build a bank of credits starting in 2023, with essentially no lead time. (EMA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment.

The reason CARB staff provided a three-step evaluation process to offset the emission deficits was to provide engine manufacturers more flexibility and to remove uncertainty within the framework of the Omnibus Regulation. CARB staff recognizes that some manufacturers would probably generate and therefore have more access to HD-ZEP credits than others. The three-step evaluation process would allow each individual manufacturer to customize and identify the most practical and cost-effective solution to offsetting the emission deficits from legacy engines.

CARB staff would also point out that optional low NO<sub>x</sub> HD engines have been certified and sold in the California market since 2016 MY. Manufacturers have the option of certifying these as FEL engine families and be eligible for accruing emission credits to be used later to offset legacy engine families.

- (m)i.20. Comment: Beyond the need for CARB to finalize a functional program as recommended above, EMA has some additional concerns regarding various details of the new flexibility provisions. For example, the introductory text at §1956.8(a)(2)(C)3 provides that a manufacturer may certify legacy engine families “[W]ith  $0.100 < \text{FTP NO}_x \text{ FEL} \leq 0.20 \text{ g/bhp-hr}$ , and  $0.005 < \text{FTP PM FEL} \leq 0.01 \text{ g/bhp-hr}$ ...” As written, a manufacturer is precluded from certifying a legacy engine at a PM level of 0.005 g/bhp hr, a level for which PM offset credits would not be necessary. Similarly, manufacturers are precluded from certifying a legacy engine to a NO<sub>x</sub> level less than 0.100 g/bhp-hr. The provisions are unnecessarily restrictive. EMA recommends that CARB remove the lower level limits to the allowable FELs for legacy engines. (EMA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment.

The legacy engine provisions were primarily created to avoid product availability issues for engine families rated below 525 bhp in 2024 and 2025 MYs. The intent was to allow manufacturers to continue selling a portion of their products certified at the 0.20 g/bhp-hr FTP NO<sub>x</sub> FEL and 0.01 g/bhp-hr FTP PM FEL.

If an engine manufacturer has plans to upgrade/update a portion of their product portfolio to FEL values below the range for legacy engine families, then the engine manufacturer should make the attempt to make the products fully compliant with the 2024-2026 MY requirements. The 2024-2026 MY requirements would ensure that the certified engine families would have on-road emission characteristics similar to what is observed at the laboratory on the certification test cycles.

- (m)i.21. Comment: §86.xxx-15.B.4.(b): EMA supports the availability of credit multipliers for engine families certified to future standards. In the 15-Day Notice, CARB proposes to limit the eligibility for credit multipliers to families certified at or below the standards of the future model year. CARB’s Omnibus Low NO<sub>x</sub> standards are extremely challenging, and include a number of new and progressively more demanding requirements at each of the three primary regulation stages, MYs 2024, 2027, and 2031. Credit multipliers serve as an important incentive to certify early to any of those regulation stages. The challenge is more than that of certifying to lower emissions standards; it also involves committing to more challenging in-use standards, and to longer Useful Life and Warranty periods, among other increasingly demanding requirements. Engine families should be eligible for credit multipliers whenever a manufacturer commits to the multi-faceted demands of future requirements, even if the family is certified at a level somewhat higher than the numeric standards of that future model year. For this reason, EMA recommends that CARB revise the eligibility for credit multipliers to include engine families certified up to the level of the maximum allowable NO<sub>x</sub> FEL (“FEL cap”) for the future model year. For example, a MY 2025

MHDDE family certified to meet all the requirements of MY 2027 MHDDEs at a NOx FEL up to 0.050 g/bhp-hr should be eligible for a NOx credit multiplier of 1.5 as provided for in the table of §86.xxx-15.B.4.(d). (EMA)

- (m)i.22. Comment: 86.xxx-15.B.3: Eligibility for credit multipliers for families certified to future model year requirements is proposed to be limited to those families certified at or below the future standard. For the reasons described above related to the Diesel Test Procedures provisions of §86.xxx-15.B.4.(b), EMA recommends that engine families be eligible for credit multipliers if certified up the level of the maximum NOx FEL level (“FEL cap”) of the future model year. (EMA)

Agency Response to Comments (m)i.21 and (m)i.22: CARB staff did not make any changes to the Proposed Amendments based on these comments.

Early compliance credit multipliers are intended to reward engine manufacturers that make the necessary investments to design and produce products that meet all future regulatory requirements. Meeting some of the requirements while not complying with other future requirements is not a scenario that warrants the application of early compliance credit multipliers. As such, EMA’s request is not in alignment with the intent of early compliance credit multiplier applicability.

- (m)i.23. Comment: The Volvo Group strongly believes that limiting the (525 hp) higher horsepower exemption to manufacturers who have sold vehicles of that size in model year 2019 or 2020 unfairly picks winners and losers in the marketplace. Linking the availability of the exemption to past sales of this higher horsepower engine enables a limited, known number of manufacturers to continue serving this market while discriminating against companies that have been able to successfully meet the need of the heavy-haul applications with more efficient, smaller displacement engines under 525 hp. In order to provide a level playing field and prevent these exempt higher horsepower engines from being diverted to non-intended applications, further qualification which links utilization of these exempt engines in heavy-haul applications through use of new GHG Phase 2 GCVW classifications should be incorporated into the regulation. (Volvo)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment. This comment is beyond the scope of the 15-Day Notice Amendments.

Notwithstanding this response, in order to prevent excessive production of HD engines that are rated at or above 525 bhp (heavy-haul engines), the Proposed Amendments limit the future production volume of heavy-haul engines based on the 2018 or 2019 MY California productions for each certifying engine manufacturer. For example, if a manufacturer sold a total of 90 heavy-haul engines in 2018 MY, and 100 heavy-haul engines in 2019 MY in California, they

would be limited to selling no more than 110 heavy-haul engines in each of the 2024-2026 MYs in California. Although some of these heavy-haul engines are currently used in applications other than heavy-haul, CARB staff believes that, historically, the vast majority of heavy-haul engines sold in California are indeed used in heavy-haul applications and there is no information that would indicate a future shift in this practice.

In developing this exemption provision, CARB staff reached out to Volvo and other certifying engine manufacturers in California to collect information regarding historical sales of engines in California that are used in heavy-haul tractors. After examining the data, CARB staff believes the current proposal does create a level playing-field to all engine manufacturers.

- (m)i.24. Comment: Given that technologies are readily available for engines to meet MY 2024 standards, the decision by an OEM to take advantage of these proposed flexibilities is a business decision not to invest the capital to certify certain low volume engines for a limited period of two years. The 0.2 g engines sold will remain in the fleet for over 20 years. Furthermore, since legacy engines do not certify to the LLC, the calculation of credits will only be required to offset the difference between the certification standards of 0.2 g/bhp-hr and 0.05 g/bhp-hr. CARB could take into account these compounding factors when finalizing the calculation of credits needed to offset legacy engine NOx emissions in model years 2024 and 2025. (MECA)
- (m)i.25. Comment: To effectively offset the real-world emissions of legacy engines, CARB should require manufacturers to offset legacy emissions by at least a 2:1 margin to reflect the inadequate test procedures under which these legacy engines were certified. (CCA)

Agency Response to Comments (m)i.24 and (m)i.25: CARB staff did not make any changes to the Proposed Amendments based on these comments.

In order to assess the impacts of legacy engines on the statewide NOx emission inventory, CARB staff performed an analysis by assuming that the HD-ZEP percentage of sales would be the same as what is identified in the ACT regulation. For the 2022 and 2023 MYs, CARB staff assumed a four percent HD-ZEP penetration rate in the California market.

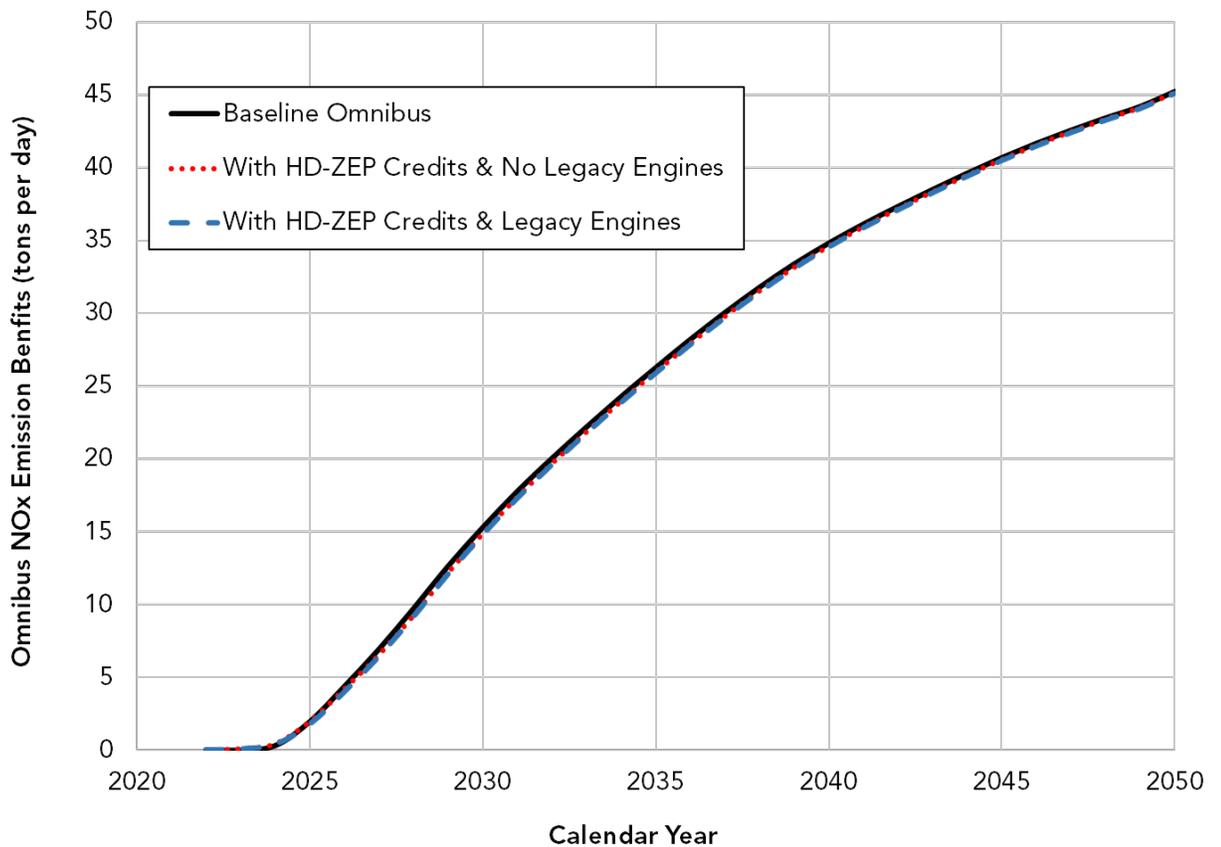
Using these assumptions, CARB staff considered two different scenarios:

- In the first scenario, all credits generated by HD-ZEPs were used in the 2024-2026 MY timeframe to certify HD diesel engines at the maximum FTP NOx FEL caps of 0.100 g/bhp-hr. This scenario would be considered as a “no legacy engine” scenario because it assumes that the legacy engine provisions do not exist.

- In the second scenario, CARB staff assumed that all credits generated by HD-ZEPs in 2024 and 2025 MYs are used to certify HD diesel engines at an FTP NOx FEL cap of 0.20 g/bhp-hr (legacy engines). For 2026 MY, all HD-ZEP credits were used to certify HD diesel engines at an FTP NOx FEL cap of 0.100 g/bhp-hr since legacy engine certification ends in 2025 MY.

The emission inventory results for both scenarios are shown in Figure IV.C.(m)i.24-25.1. As shown, the impact of legacy engines on the Omnibus Regulation NOx benefits is negligible. This is primarily due to the fact that for a given amount HD-ZEP credits, manufacturers can certify a larger number of “scenario 1” engines compared to the number of “scenario 2” engines. Therefore, CARB staff does not see any reasons for readjusting the amount of HD-ZEP credits needed for offsetting the deficits generated by legacy engines.

**Figure IV.C.(m)i.24-25.1 Impacts of HD-ZEP Credits & Legacy Engines on Omnibus Regulation NOx Benefits**



(m)i.26. Comment: CARB should remove combustion vehicles and non-ZEV offset projects as compliance pathways to avoid entrenching fossil fuel interests and help accelerate the transition to ZEVs. (CCA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment.

The federal-ABT and CA-ABT programs both have mechanisms to offset deficits using credits from combustion engines. In fact, this mechanism has existed since the inception of the ABT program in 1991. Therefore, CARB staff does not believe that the removal of this option is warranted. However, engine manufacturers are only allowed to use this option after they have determined that HD-ZEP credits cannot be obtained through the marketplace within the price cap. The price cap is needed to provide engine manufacturers some assurance as to the maximum cost impact on the sale of legacy engines.

Furthermore, CARB staff believes that it is very important to include a pathway to offset deficits in disadvantaged communities. These projects would focus on reducing NOx emissions through various remediation mechanisms such as HD ZEV related projects or reductions through stationary source mitigation projects.

- (m)i.27. Comment: First, the CBA respectfully requests an extension of one year for the 2022 deadline for replacing 2006 engine model year motor coaches and a one-year extension for the 2023 deadline until 2024. (CBA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment.

This request is related to the Truck and Bus regulation and beyond the scope of this rulemaking.

- (m)i.28. Comment: Second, we respectfully request an extension of the 2024 Omnibus Low NOx Rule to 2027 as you have granted to the transit industry. (CBA)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment.

In order to remedy any product availability issues in 2024 and 2025 MYs, CARB staff has already introduced the legacy engine provisions in 13 CCR 1956.8 (a)(2)(C)3. These provisions are anticipated to mitigate the concerns raised by the CBA.

- (m)i.29. Comment: Specifically, ARB staff should include all those diesel engine applications > 525 horsepower where in lieu of the 0.05 gm NOx/brake horsepower-hour standard the existing 0.20 gm NOx/brake horsepower-hour standard is allowed to be carried over from 2024-2026 model years without requiring similar mitigation measures (as distributed at the August 27, 2020 Board hearing). There are plenty of traditional and non-traditional manufacturers attempting to electrify targeted applications to assist with

California's Advanced Clean Trucks rule. Under the Omnibus criteria rules, electrification of diesel engine applications > 525 horsepower deserves similar consideration and treatment as is being proposed in the most recent 15-day changes for diesel engine applications < 525 horsepower. (GM)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment.

During the August 27, 2020 hearing, the board directed CARB staff to implement the provisions for the  $\geq 525$  bhp (heavy-haul) engines. As such, any modification of these amendments would be beyond the scope of the proposed 15-Day Notice Amendments.

It should also be noted that product availability forecast for the two cases under consideration (at and above 525 horsepower, and below 525 horsepower) are very different. While CARB staff believes that compliant, < 525 bhp heavy-duty diesel engines would become available in California sometime in 2025 model year, the same situation does not apply to heavy-haul engines ( $\geq 525$  bhp). CARB staff does not believe that compliant heavy-haul engines would be available in California until 2027 model year. Given the differences between the two scenarios, a different certification pathway was developed for each scenario.

- (m)i.30. Comment: GM applauds efforts by ARB staff to recognize emission reduction projects in California's disadvantaged communities. In subsection 11.B.5.3.5.2(c)(3)(ii), a manufacturer may submit a plan to CARB Executive Officer which would offset the deficits within five years and additionally, primarily ensure such reductions would benefit disadvantaged communities. Once again, this is a thoughtful consideration by staff that we wish to see further emphasized in the final rule. Unfortunately, as currently proposed, mitigation projects in California's disadvantaged communities only come into play once all other targeted compliance avenues have been thoroughly exhausted.

GM offers two suggestions to further improve this approach. First, as the intent is to recognize and encourage electrification, we believe that the projects targeted in California's disadvantaged communities should exclusively recognize and benefit the broad electrification of transportation. For example, electrification projects in nearby port authorities, industrial zones, warehouse districts, airports, and rail yards can benefit surrounding communities. Second, electrification projects in California's disadvantaged communities should have at least equal and perhaps greater consideration as the on-road mitigation measures detailed within the most recent 15-day changes. (GM)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment.

CARB staff shares GM's enthusiasm for mitigation projects that encourage the development of even more electric vehicles and equipment in disadvantaged communities. However, part of the Executive Officers' consideration should be the maximum expected emission reduction of projects in disadvantaged communities that are suffering the most. That is why CARB staff did not put additional restriction on what projects to consider in order to maximize potential benefits to welfare of our most impacted communities.

- (m)i.31. Comment: Due to these potential impacts, New Flyer / MCI requests that an exemption, similar to the one planned for transit bus engines, be offered for motor coach operators, at minimum, for model years 2022 and 2023. Although it is understood that the engine upcharge for 2022 CARB-standard transit bus engines will be higher than that for coach engines, the impact of COVID on coach operators compared to transit is arguably greater. (New Flyer/MCI)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment.

The commenters request is outside the scope of this proposed 15-Day Notice Amendments. CARB staff was directed by the Board at the August 27, 2020, Hearing to develop provisions to assist transit agencies that are also impacted by California's ICT regulations. No similar request was made for motor coach buses or other category of vehicles or vehicle operators. As discussed above in the Agency Response to Comments C.(m)i.1 through C.(m)i.3, CARB staff believes the legacy engine provisions included in the 15-Day Notice Amendments will address any engine availability problems about which New Flyer/MCI may be worried.

- (m)i.32. Comment: In response to the California Air Resources Board proposed amendments to the Heavy-duty Omnibus Regulations, Environmental Defense Fund respectfully requests the Board strengthen protections for people and communities harmed by climate and air pollution. Heavy-duty diesel vehicles and engines discharge extensive smog-forming nitrogen oxides, deadly respirable diesel particles, and climate-destabilizing pollution. The health burden from truck and bus pollution is substantial, causing adverse health impacts in utero, in infants and children, and in adults and the elderly – with those who live closest to our nation's roads and highways, ports, distribution centers, freight depots and other well-known sources of truck pollution facing the greatest harms. Further, new zero emitting vehicles are available for deployment and economically reasonable to own and operate (providing extensive fuel and maintenance cost savings). Adjustments to the Board's standards should strengthen protections for people and communities afflicted by this extensive and dangerous air pollution by urgently transitioning to zero emitting vehicles at scale. (EDF)

Agency Response: CARB staff did not make any changes to the Proposed Amendments based on this comment.

CARB staff appreciates the comments by EDF and firmly believes that the proposed 15-Day Notice Amendments do provide a balanced and effective approach for mitigation emissions from the HD sector, ensuring that product availability would not become an issue in California and encouraging the acceleration of introducing more ZEVs ahead of the ACT requirements. As shown in Figure IV.C.(m)i.24-25.1, CARB staff believes the 15-Day Notice Amendments will not result in any significant loss of emission benefits. Finally, with regards to EDF's concern for communities harmed by climate and air pollution, CARB staff shares that concern and indeed it was that concern CARB staff had in mind when crafting the provisions requiring offset of any excess emissions in such communities.

## II. Peer Review

H&SC section 57004 sets forth requirements for peer review of identified portions of rulemakings proposed by entities within the California Environmental Protection Agency, including CARB. Specifically, the scientific basis or scientific portion of a proposed rule may be subject to this peer review process. However, this rulemaking action is based on a technical and engineering basis, rather than a scientific basis, and is therefore not subject to the requirement of H&SC section 57004.

Specifically, this rulemaking primarily establishes exhaust emission standards for various categories of HD internal combustion engines and HD vehicles powered by such engines. The factors CARB considered in proposing and adopting such standards entirely relate to engineering issues. For instance, which technologies can be developed and implemented on affected engines within the proposed time frames, how effective those technologies are in reducing emissions of affected engines in relation to existing emission control systems and components, and estimating the relative sizes, weights, costs, and maintenance requirements associated with each anticipated compliance technology. Those factors did not involve the application of scientific findings or the development of scientific theories.

CARB's determination that this rulemaking action is exempted from H&SC 57004 is consistent with guidance provided by the California Environmental Protection Agency that expressly excludes work product regarding "[t]echnical performance related to new control standards or manufacturing technologies, such as emission standards for new motor vehicles .... It is not the intent of Health & Safety Code section 57004 to review engineering data to support the technical feasibility of these standards or technologies."<sup>255</sup>

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<sup>255</sup> California Environmental Protection Agency, Policy and Guiding Principles for External Scientific Peer Review (1998), page 7.

