

UPDATED INFORMATIVE DIGEST

REGULATION TO PROVIDE CERTIFICATION FLEXIBILITY FOR INNOVATIVE HEAVY-DUTY ENGINES AND CALIFORNIA CERTIFICATION AND INSTALLATION PROCEDURES FOR MEDIUM- AND HEAVY-DUTY VEHICLE HYBRID CONVERSION SYSTEMS (INNOVATIVE TECHNOLOGY REGULATION)

Sections Affected: Adoption of California Code of Regulations, title 13, sections 2208, 2208.1, 2208.2, including the following document incorporated by reference therein: "California Certification and Installation Procedures for Medium- and Heavy-Duty Vehicle Hybrid Conversion Systems." Amendments to California Code of Regulations, title 13, section 1956.8, including amendments to the following documents incorporated by reference therein: "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Otto-Cycle Engines and Vehicles," as last amended [ITR Adoption Date], and the "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles," as last amended [ITR Adoption Date].

Background

California must transition to zero- and near zero-emission transportation and freight movement technologies to meet its air quality and climate goals. These goals include:

- Reducing greenhouse gas (GHG) emissions to 40 percent below 1990 levels by 2030;¹
- Reducing GHG emissions from the transportation sector to 80 percent below 1990 levels by 2050;²
- Deploying 1.5 million zero-emission vehicles (ZEV) by 2025, as directed in Executive Order B-16-2012; deploying one million ZEVs and near-ZEVs by January 1, 2023, as codified in Health and Safety Code Section 44258.4(b); deploying 100,000 freight vehicles and equipment capable of zero-emission operation by 2030, as set forth in the California Sustainable Freight Action Plan;³ and
- Meeting federal health-based eight-hour ozone standards, as required, by 2023 and 2031 in the South Coast Air Basin, which will require a reduction in oxides of nitrogen (NOx) emissions of approximately 70 percent by 2023 and 80 percent by 2031 from today's levels.⁴

While a diversity of new zero- and near-zero emission trucks and buses will be needed to meet these goals, the California Air Resources Board's (CARB) comprehensive heavy-duty engine and vehicle certification requirements may deter some manufacturers from developing promising new heavy-duty vehicle technologies, in part because of high initial certification costs and engineering challenges. One element of certification – on-board diagnostic (OBD) requirements – can be particularly resource-intensive, and can pose engineering challenges for some new technologies. OBD is a critical emissions control

1 Governor Brown's Executive Order B-30-2015: <http://gov.ca.gov/news.php?id=18938> .

2 Governor Brown's Executive Order B-16-2012: <http://gov.ca.gov/news.php?id=17472> .

3 CARB, *California Sustainable Freight Action Plan*, July 2016:

<http://www.casustainablefreight.org/theplan.html>.

4 CARB, *Mobile Source Strategy*, May 2016. <http://www.arb.ca.gov/planning/sip/2016sip/2016mobsrct.htm> .

program consisting mostly of added software to identify and address potential engine and aftertreatment failures that can lead to an increase in emissions. The initial challenge of OBD compliance could lead a manufacturer to choose not to develop, or to delay introduction of, innovative new truck or bus technologies that are uncertain to achieve market acceptance.

Summary of the Rulemaking Process

CARB staff developed these regulatory actions through an extensive public process. Staff made a considerable effort to inform, involve, and update the public and stakeholders on staff's progress developing the regulatory actions. CARB has held three public workshops, 15 topic-specific public work group meetings, and over 50 individual stakeholder meetings to inform development of the regulatory actions. The workshop and work group meeting notices were posted on the Innovative Technology Regulation webpage at <http://www.arb.ca.gov/msprog/itr/itr.htm>, and distributed to the ITR rulemaking list serve, which includes over 700 subscribers, as of June 1, 2016.

For this rulemaking, CARB staff issued a "Notice of Public Meeting to Consider Proposed Regulation to Provide Certification Flexibility for Innovative Heavy-Duty Engines and California Certification and Installation Procedures for Medium- and Heavy-Duty Vehicle Hybrid Conversion Systems (Innovative Technology Regulation)" on August 30, 2016. An Initial Statement of Reasons (Staff Report) and all required documents were also made available for public review and comment on August 30, 2016. The Staff Report contained a description of the rationale for the proposed regulatory action as Appendix B, and technical supporting information in Appendix A. The text of proposed California Code of Regulations, title 13, sections 2208, 2208.1, and 2208.2 was included as Appendix C; the proposed amendments to California Code of Regulations, title 13, Section 1956.8 and associated test procedures were included as Appendix D; and the proposed "California Certification and Installation Procedures for Medium- and Heavy-Duty Vehicle Hybrid Conversion Systems" was included as Appendix E to the Staff Report. The Staff Report and the appendices were posted on CARB's website at: <https://www.arb.ca.gov/regact/2016/itr2016/itr2016.htm>.

At its October 20, 2016, public hearing, the Board approved for adoption California Code of Regulations, title 13, sections 2208, 2208.1, and 2208.2, including the following document incorporated by reference therein: "California Certification and Installation Procedures for Medium- and Heavy-Duty Vehicle Hybrid Conversion Systems." At this hearing, the Board also approved amendments to California Code of Regulations, title 13, section 1956.8, as well as amendments to the following documents incorporated by reference therein: "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Otto-Cycle Engines and Vehicles," as last amended [ITR Adoption Date], and the "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles," as last amended [ITR Adoption Date].

Staff issued two 15-day notices with modifications for public comment. The following modifications were among those made available during the first 15-day comment period in a

“First Notice of Availability of Modified Text and Availability of Additional Documents,” released May 31, 2017:

- The requirements for evaluating the evaporative emissions of an aftermarket conversion system was changed from the three-day diurnal plus hot soak test to the two-day diurnal plus hot soak test. Staff presented this change to the Board at the October 20, 2016, public hearing.
- The test procedures for evaluating emissions of electric power take-off functionality were updated to mirror the requirements of the federal Heavy-Duty Phase 2 program.⁵ Staff presented this change to the Board at the October 20, 2016, public hearing.
- Addition of documents to the record.

Further modifications were made available for a second 15-day comment period in a “Second Notice of Availability of Modified Text and Availability of Additional Documents,” released August 16, 2017, and an errata to this Second Notice that was posted on August 18, 2017:

- Removal of unnecessary incorporations by reference of California law.
- Correction to the revision date of the incorporated document, Society of Automotive Engineers International J1979, “E/E Diagnostic Test Modes”. The revision date was incorrectly noted as August 2013 in the first 15-Day Notice and was changed to the correct revision date of August 2014, as noticed in the original 45-day Notice.
- Removal and addition of documents incorporated by reference to the record.
- The errata only corrected inaccurate strikeout and underline and incorrect use of text in the attachment to the “Second Notice of Availability of Modified Text and Availability of Additional Documents;” the attachment’s text was from a previous version that failed to include modifications made in the first 15-day changes. The corrections made in the errata did not materially affect the substance of the proposal, as they served to clarify the changes in the second 15-day period, which only removed the unnecessary incorporation by reference language and did not change the regulation.

Subsequent to the 15-day public comment periods, CARB staff made additional clarifying modifications along with non-substantial and grammatical changes to the regulations as authorized under Government Code section 11346.8(c) and section 40 of title 2 of the California Code of Regulations. These changes, along with a detailed summary of all 15-day modifications, are described in the Final Statement of Reasons

⁵ United States Environmental Protection Agency and National Highway Traffic Safety Administration; Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles – Phase 2 (Final Rule); August 16, 2016; <https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-greenhouse-gas-emissions-and-fuel-efficiency>.

Public comments regarding the regulation were received during the 45-day public comment period, at the Board hearing, and during the first 15-day public comment period (CARB received no comments during the second 15-day comment period), which are summarized in the Final Statement of Reasons, and for which CARB staff subsequently provided responses in the Final Statement of Reasons.

Description of the Regulatory Action

The ITR provides a more flexible short-term certification pathway, described below, for the following innovative truck and bus technologies:

- **New heavy-duty engine technologies:**
 - A heavy-duty spark-ignition engine (through the 2021 model year (MY)) or a heavy-duty compression-ignition engine (through the 2024 MY) meeting California's optional low-NOx emission standards;
 - A heavy-duty engine that will be installed in a hybrid heavy-duty vehicle (hybrid engine) through the 2021 MY, or 2024 MY, if the vehicle is capable of at least 35 miles all-electric range (AER);
 - A heavy-duty engine that meets the ITR's optional low-carbon dioxide (CO₂) emission standards, reflecting a 15-percent CO₂ reduction relative to a 2017 baseline engine, through the 2027 MY;

and

- **Hybrid conversion systems:** A hybrid conversion system installed on an CARB-certified vehicle between 6,001 and 14,000 pounds Gross Vehicle Weight Rating (GVWR) or on a CARB-certified engine installed in a vehicle over 8,500 pounds GVWR.

These technologies, described in further detail below, each play a role in helping California meet its air quality and climate goals, yet each could face certification challenges inherent in certifying a new technology for the first time.

Innovative New Heavy-Duty Engines

The ITR provides short-term, targeted certification flexibility, particularly OBD compliance flexibility, for new heavy-duty engines meeting California's optional low-NOx standards, hybrid heavy-duty engines, and high-efficiency heavy-duty engines. To be eligible, the engine would be required to be cleaner than required by, and not used to demonstrate compliance with, the applicable mandatory engine emission standards for NOx or CO₂ for the given MY in which the manufacturer seeks certification flexibility for the engine. The ITR structure and certification flexibility, summarized below, is tailored specifically to each proposed technology category in order to accelerate that technology's deployment, while still ensuring it achieves the anticipated in-use emission benefits.

Heavy-duty Engines Meeting California's Optional Low-NOx Standards. California needs significant deployment of heavy-duty engines meeting CARB's optional low-NOx engine standards to attain the National Ambient Air Quality Standard for ozone, particularly in the South Coast Air Basin, by 2023 and 2031. The ITR provides a heavy-duty spark-ignition

engine meeting California's optional 0.05 or 0.02 grams per brake-horsepower hour (g/bhp-hr) NOx standard, and a compression-ignition engine meeting the 0.10, 0.05, or 0.02 g/bhp-hr NOx standard, with up to three MYs of modest certification flexibility. This flexibility would be available to manufacturers through the 2021 MY for a spark-ignition engine, and through the 2024 MY for a compression-ignition engine. This structure recognizes the relative technology readiness of spark-ignition and compression-ignition low-NOx engines, and is intended to encourage certification of a diversity of low-NOx engine sizes and types before CARB may propose a mandatory low-NOx standard in the 2024 timeframe.

Heavy-duty Hybrid Engines. Hybrid trucks and buses, particularly plug-in hybrids with significant AER, can potentially reduce both criteria pollutant and GHG emissions in vocational applications, and help pave the way for zero-emission heavy-duty vehicle technology. The ITR provides an engine certified by CARB for use in a hybrid heavy-duty vehicle with up to four or six consecutive MYs of CARB certification flexibility, depending upon whether or not the engine is certified for use in a vehicle that achieves at least 35 miles AER.

A hybrid engine to be installed in a vehicle that does not achieve at least 35 miles AER (including non-plug-in hybrids) would be eligible for up to two MYs of more substantial "Tier 1" certification flexibility, followed by up to an additional two MYs of more modest "Tier 2" certification flexibility, through the 2021 MY. An engine to be installed in a hybrid vehicle that achieves at least 35 miles AER would be eligible for the same Tier 1 and Tier 2 certification flexibility provisions, but for up to four MYs of Tier 1 and two MYs of Tier 2 flexibility, through the 2024 MY.

The ITR also includes provisions that enable an engine originally certified for off-road or light- or medium-duty use to be certified as a range extender in a heavy-duty hybrid that achieves at least 35 miles AER, through the 2024 MY. The engine would have to operate at steady state to charge the vehicle batteries, would be prohibited from directly propelling the vehicle, and would be required to meet other emission and performance criteria. Should any of these hybrid configurations gain a market foothold, information gained during ITR-based certification would enable CARB staff to propose updated certification requirements.

Recent studies have illustrated the potential for some hybrid heavy-duty vehicles to emit significantly more in-use NOx relative to their non-hybrid counterparts.⁶ In order to be eligible for the ITR's certification flexibility, a new heavy-duty hybrid vehicle would be required to achieve at least a ten percent CO₂ reduction without increasing in-use NOx, carbon monoxide (CO), hydrocarbon (HC), or particulate matter (PM) emissions. Compliance with these emission criteria would need to be demonstrated pursuant to the ITR's hybrid technology emission test procedures.

High-Efficiency Heavy-Duty Engines. The ITR also provides certification flexibility to significantly more-efficient 2017 through 2027 MY heavy-duty engines. In order to identify such engines, the amendments add optional low-CO₂ emission standards, which reflect a 15

⁶ National Renewable Energy Laboratory; *Data Collection, Testing, and Analysis of Hybrid Electric Trucks and Buses Operating in California Fleets - Final Report*, June 2015; www.nrel.gov/docs/fy15osti/62009.pdf.

percent CO₂ reduction relative to a 2017 baseline diesel engine, and a greater than ten percent CO₂ reduction relative to federal Heavy-Duty Phase 2 GHG Standards for the 2027 MY.⁷ The stringency of these optional low-CO₂ standards is based upon what CARB's *Technology and Fuels Assessment*⁸ and interested manufacturers indicate can be achieved by potentially transformational, new heavy-duty engine architectures (such as a camless or opposed piston engine), which could provide significant efficiency gains but face initial OBD and other certification challenges. However, the standards are performance-based, such that any heavy-duty engine meeting the standard would qualify. The ITR provides heavy-duty engines meeting these optional low-CO₂ emission standards with up to four MYs of Tier 1 certification flexibility, followed by an additional two MYs of Tier 2 flexibility, through the 2027 MY.

Truck and Bus Hybrid Conversion Systems

The ITR incorporates by reference "California Certification and Installation Procedures for Medium- and Heavy-Duty Vehicle Hybrid Conversion Systems." These procedures provide CARB certification criteria, including emission, diagnostic, warranty, reporting, and other requirements, for hybrid truck and bus conversion systems to be sold and installed on California-certified base engines or vehicles. The ITR allows a manufacturer to sell increasing California volumes of its hybrid conversion system by certifying to progressively more stringent Tier 1, Tier 2, and Tier 3/Final requirements.

For hybrid conversion systems that do not achieve at least 35 miles AER, the opportunity for conversion system manufacturers to apply for less stringent Tier 1 and 2 certification requirements would sunset on January 1, 2022. For conversions that do achieve at least 35 miles AER, the opportunity for manufacturers to apply for Tiers 1 and 2 hybrid conversion system certification would sunset on January 1, 2025. A hybrid conversion system first certifying after these sunset dates would be required to meet the more stringent Tier 3/Final certification requirements.

This structure is intended to encourage early development and market launch of a diversity of hybrid conversion systems, particularly from the smaller, independent manufacturers that make up today's market, by minimizing initial engineering challenges and certification compliance costs and scaling up certification requirements as the market develops. Staff anticipates that a flourishing market for hybrid conversion systems, particularly in the medium-duty sector, could achieve near-term CO₂ reductions, and encourage larger, original vehicle manufacturers to enter the market with robust, vertically integrated hybrid trucks and buses.

Objectives and Benefits of the Regulatory Action

The ITR and amendments are intended to encourage development and deployment of the

⁷ United States Environmental Protection Agency and National Highway Traffic Safety Administration; Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles – Phase 2 (Final Rule); August 16, 2016; <https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-greenhouse-gas-emissions-and-fuel-efficiency>.

⁸ CARB; Draft Technology Assessment; Engine/Powerplant and Drivetrain Optimization and Vehicle Efficiency; June 2015; http://www.arb.ca.gov/msprog/tech/techreport/epdo_ve_tech_report.pdf.

next generation of truck and bus technologies that California needs to meet its air quality and climate goals. Early deployment of these technologies achieves direct emission reductions sooner than would otherwise occur, and would support development of more robust technology-advancing rulemakings. For example, early technology deployment of low-NOx engines would enable manufacturers, fleets, CARB staff, and others to assess technology feasibility, consumer acceptance, benefits, and costs, and to prepare necessary infrastructure, supply lines, and workforce training. Likewise, these regulatory actions would encourage accelerated development of robust plug-in hybrid heavy-duty vehicle technology that would support implementation of CARB's potential Advanced Clean Transit Regulation and Advanced Clean Local Truck Regulation, if adopted. Early, accelerated technology deployment would help reduce per-unit technology cost as production volumes increase in advance of regulatory requirements. Finally, early deployment would provide an opportunity for manufacturers to anticipate and address potential technology failures before more widespread deployment could be required by regulation.

The regulatory actions are also geared to support implementation of California's portfolio of funding programs for demonstrating and deploying the next generation of clean vehicles and equipment. CARB's Air Quality Improvement Program (AQIP) and Greenhouse Gas Reduction Fund (GGRF) have invested over \$200 million over the past seven years to accelerate California's transition to zero- and near-zero emission vehicles and equipment. These programs' proposed Fiscal Year 2016-17 Funding Plan, approved by the Board in June 2016, would invest an additional \$34 million to demonstrate, and \$116 million to deploy, the next generation of truck and bus technologies.⁹ These include incentives to demonstrate zero- and near-zero-emission heavy-duty vehicles and equipment, and to deploy hybrid, zero-emission, and low-NOx trucks and buses. However, only two heavy-duty engines meeting optional low-NOx standards, and two hybrid heavy-duty engines (neither of which enable zero emission operation), were CARB-certified as of June 1, 2016. The regulatory actions, taken together, are intended to facilitate near-term certification of these technologies, enabling a greater diversity of promising heavy-duty engines and vehicles to be eligible for these investments and fulfilling the goal of these investment programs to foster needed technology development. The regulatory actions are particularly timely given California's financial commitment to these heavy-duty vehicle demonstration and deployment projects.

An Evaluation of Inconsistency or Incompatibility with Existing State Regulations (Gov. Code, § 11346.5, subd. (a)(3)(D)):

During the process of developing the regulatory actions, CARB staff has conducted a search for similar regulations on this topic and has concluded that these regulations are neither inconsistent nor incompatible with existing State regulations.

Comparable Federal Regulations

There are no comparable federal regulations to these regulatory actions, and it is consistent

⁹ CARB; Proposed Fiscal Year 2016-17 Funding Plan for Low Carbon Transportation and Fuels Investments and the Air Quality Improvement Program, Approved June 23, 2016; http://www.arb.ca.gov/msprog/aqip/fundplan/proposed_fy16-17_fundingplan_full.pdf.

and compatible with federal law. For example, U.S. EPA has indicated in its final Phase 2 program that it shall deem a low-NOx heavy-duty engine family receiving certification flexibility pursuant to the ITR as compliant with federal OBD requirements due to the relatively modest OBD compliance flexibility provided, and that it will consider new hybrids participating in ITR to be OBD compliant within the framework of Phase 2, facilitating sale of these engines nationally:

“As described in the proposed (Phase 2 standards), California CARB is in the process of developing similar provisions for a reduced compliance burden for qualifying highway vehicles toward the goal of incentivizing vehicles with hybrid powertrains and low-NOx engines. The incentives generally consist of allowing specific OBD variances of deficiencies (for low-NOx engines) or broadly waiving OBD requirements (for hybrid vehicles). To the extent that California CARB certifies vehicles based on approving OBD deficiencies, we would apply a similar discretion for 49-state certification of the same engine model to allow for nationwide sale of those products. If California CARB approves certification of hybrid systems in which the highway OBD requirements are mostly or entirely waived, we would expect to apply the provisions described in this section to allow vehicle manufacturers to produce up to 1000 such vehicles in a given year.”¹⁰

10 - Federal Register; Volume 81, Number 206, October 25, 2016; *Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles – Phase 2*; Preamble, Section XIII(A)(1).