California Environmental Protection Agency
AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING

PROPOSED AMENDMENTS TO THE REGULATION FOR IN-USE OFF-ROAD DIESEL-FUELED FLEETS AND THE OFF-ROAD LARGE SPARK-IGNITION FLEET REQUIREMENTS

Mobile Source Control Division
Emissions Reductions Incentives Branch

October 2010

State of California
AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS

Public Hearing to Consider

PROPOSED AMENDMENTS TO THE REGULATION FOR IN-USE OFF-ROAD DIESEL-FUELED FLEETS AND THE OFF-ROAD LARGE SPARK-IGNITION FLEET REQUIREMENTS

To be considered by the Air Resources Board at a meeting of the Board that will commence on December 16, 2010, may continue to December 17, 2010, at

California Environmental Protection Agency
Air Resources Board
Byron Sher Auditorium
1001 I Street
Sacramento, California 95814

State of California
AIR RESOURCES BOARD

PROPOSED AMENDMENTS TO THE REGULATION FOR IN-USE OFF-ROAD DIESEL-FUELED FLEETS AND THE OFF-ROAD LARGE SPARK-IGNITION FLEET REQUIREMENTS

This report has been prepared by the Mobile Source Control Division staff of the Air Resources Board with the assistance and support from the following divisions: Planning and Technical Support and Research. In addition, we would like to acknowledge the assistance and cooperation that we have received from many individuals and organizations.

TABLE OF CONTENTS

I. EXECUTIVE SUMMARY 1

II. INTRODUCTION 7

A. Background 7
B. Regulatory Authority 8
C. Rationale for the Proposed Amendments 9
D. Stakeholder Participation 11

III. NEED FOR EMISSION REDUCTIONS 13

A. Emissions from Off-Road Vehicles 13
B. National Ambient Air Quality Standards 17
C. PM Emissions and Mortality 20
D. Localized Risk 21

IV. PROPOSED AMENDMENTS TO THE OFF-ROAD REGULATION 22

A. Existing Regulation 22
B. Proposed Amendments to the Off-Road Regulation 23
C. Impact of Proposed Changes on Funding Opportunities 30
D. New and Existing Incentives for Early Actions 31

V. PROPOSED AMENDMENTS TO THE LSI FLEET REGULATION 34

A. Existing Regulation 34
B. Proposed Amendments to the LSI Fleet Regulation 34

VI. ENVIRONMENTAL IMPACTS 37

A. Legal Requirements 37
B. Air Quality Impacts of Proposed Off-Road Regulation Amendments 37
C. Air Quality Impacts of Proposed LSI Fleet Regulation Amendments 42
D. Impact on SIP Target 43
E. Impact on PM Mortality 44
F. Impact on Localized Risk 44
G. Impact on Climate Change 44
H. Environmental Justice and Neighborhood Impacts 45
I. Other Environmental Impacts 45
J. Conclusion 45

VII. ECONOMIC IMPACTS 46

A. Legal Requirements 46
B. Off-Road Regulation Amendments 46
C. LSI Fleet Regulation Amendments 51

D. Impacts on California Economy 53
E. Potential Impacts on Small Businesses 54
F. Potential Impacts on Public Agencies 54
VIII. ALTERNATIVES CONSIDERED 55
A. Major Off-Road Regulation Amendments 55
B. LSI Fleet Regulation Amendments 61
IX. REFERENCES 64

APPENDICES

APPENDIX A: OFF-ROAD PROPOSED REGULATORY ORDER

APPENDIX B: LSI FLEET REQUIREMENTS REGULATION

APPENDIX C: SUMMARY OF SURVEY RESULTS

APPENDIX D: OSM AND SUMMARY OF OFF-ROAD EMISSIONS INVENTORY UPDATES

APPENDIX E: PROPOSED MINOR AMENDMENTS TO THE OFF-ROAD AND LSI FLEET REGULATIONS

APPENDIX F: COST METHODOLOGY

APPENDIX G: HEALTH BENEFITS AND METHODOLOGY

APPENDIX H: LIST OF ACRONYMS

LIST OF TABLES

Table 1: Emission Margin for Truck and Bus and Off-Road Regulations: 2014 4

Table 2: Ten Guiding Principles 10

Table 3: Public Workshops 11

Table 4: Annual NOx and PM Emissions from Off-Road Diesel Vehicles in California without the Regulation (tpd) 14

Table 5: Comparison of 2007 Off-Road Regulation and Current Emissions Estimates 17

Table 6: 2009 Estimated Fuel Use (Million Gallons of Diesel Fuel): ARB vs. Industry 17

Table 7: Emissions are Less Than the 2014 SIP Target – Existing Truck and Bus and Off-Road Regulations, Including Recession 20

Table 8: Existing and Proposed VDECS Double Credit Deadlines 25

Table 9: Compliance Option for Fleets Under 500 Horsepower 26

Table 10: Current and Proposed: Final Fleet Average Targets by Horsepower (Hp) Bin 26

Table 11: Early Credit and Incentive Period Deadlines for Receiving Credit by Fleet Size 32

Table 12: Baseline Emissions and Regulation Impact on Statewide NOx and PM Emissions 38

Table 13: Benefits of the Current Regulation Compared to the Proposed Amendments (tpd) 40

Table 14: Cost Effectiveness Comparison of the Regulation 42

Table 15: Annual HC+NOx Emissions from Off-Road LSI Equipment in California (tpd) 42

Table 16: Emissions and Costs of Various Off-road Major Amendment Alternatives Considered 58

LIST OF FIGURES

Figure 1: Off-Road Contribution to 2010 Statewide Mobile Source Emissions (Particulate Matter and NOx without Regulations) 3

Figure 2: Off-Road Contribution to 2020 Statewide Mobile Source Emissions (Particulate Matter and NOx without Regulations) 3

Figure 3 : Cost of Proposed Off-Road Regulation Down Substantially 6

Figure 4: Off-Road Contribution to 2010 Statewide Mobile Source Emissions (Particulate Matter and NOx without Regulations) 13

Figure 5: Off-Road Contribution to 2020 Statewide Mobile Source Emissions (Particulate Matter and NOx without Regulations) 14

Figure 6: California Nonattainment Areas for PM2.5 18

Figure 7: California Nonattainment Areas for Ozone 19

Figure 8: Annual Retrofit Requirements under the Current Regulation and Proposed Amendments 29

Figure 9: Annual Turnover Requirements under the Current Regulation and Proposed Amendments 30

Figure 10: Statewide NOx Emissions from Off-road Diesel Vehicles 39

Figure 11: Statewide PM Emissions from Off-road Diesel Vehicles 39

Figure 12: Year-by-Year Comparison of Truck and Bus and Off-Road PM Emissions after Regulation is Applied: Current Rule without Recession vs. Amended Rule with Recession 41

Figure 13: Year-by-Year Comparison of Truck and Bus and Off-Road NOx Emissions after Regulation is Applied: Current Rule without Recession vs. Amended Rule with Recession 41

Figure 14: Cost of Proposed Off-Road Regulation Down Substantially 47

Figure 15: Current vs. Proposed Off-road Regulation Yearly Compliance Costs 48

Figure 16: Sample Fleet Costs for Current vs. Proposed Regulation 49

Figure 17: Comparison of Fleet Average Targets 61

I. EXECUTIVE SUMMARY

Emissions associated with off-road vehicles (such as those used in construction, manufacturing, the rental industry, road maintenance, airport ground support and landscaping) are a significant contributor to many of the air quality challenges facing California, whether they be meeting federal air quality standards, reducing premature mortality, addressing localized risk, or reducing greenhouse gas emissions. To meet its air quality goals, the Air Resources Board (ARB or Board) has put into place a series of comprehensive regulations and programs to meet these challenges.

Important among these is the in-use off-road diesel vehicle regulation (off-road regulation), approved in 2007, which is intended to significantly reduce emissions of diesel particulate matter (PM) and oxides of nitrogen (NOx) from the over 150,000 in-use off-road diesel vehicles that operate in California by requiring their owners to modernize their fleets and install exhaust retrofits. The regulations are especially rigorous in the near-term, in part to meet federally-mandated clean air standards by 2014.

Complementing this regulation is the large spark ignition (LSI) fleet regulation, approved in 2006. The LSI fleet regulation is intended to reduce hydrocarbon and oxides of nitrogen (HC+NOx) emissions from the nearly 90,000 LSI vehicles operating in California by accelerating the introduction of new clean vehicles and the retrofit or retirement of uncontrolled in-use vehicles.

Since the adoption of the off-road and LSI fleet regulations, a number of events have occurred which have presented an opportunity for ARB to reevaluate these regulations. First, a global recession has substantially reduced the activity (and emissions) of many off-road fleets. At the same time, the recession has substantially reduced the near-term ability of fleets to invest in the clean vehicles and equipment needed to comply with the regulations. These first two factors are especially true for California's construction industry. Lastly, ARB staff has undertaken a thorough review and update to our estimates of the emissions from off-road diesel vehicles, and staff has determined that emissions are substantially lower than previously estimated.

Despite a significant reduction in emissions, the off-road and LSI fleet regulations are still critically important to ensuring that California meets both its short-term and long-term air quality obligations and health based goals. This includes achieving sufficient PM emissions reductions to meet federal air quality standards for fine particulate (PM2.5) by 2014, and to make continued progress to maximize reductions of ozone forming emissions by 2023. The overall reduction in emissions from off-road vehicles resulting from the current economic climate presents an opportunity, especially in the near-term, to reduce the economic impact on impacted fleets while still achieving needed emission reductions.

Considering this, in April 2010, the Board directed staff to update the emissions inventories from heavy-duty on-road trucks and buses and off-road vehicles to reflect

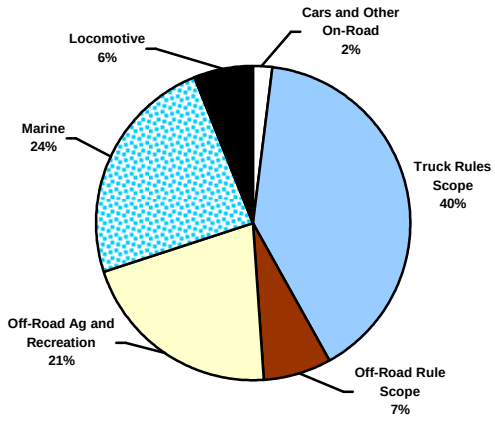
the impact of the recession. The Board further directed staff to develop amendments to the In-use On-Road Diesel Vehicle (Truck and Bus) and off-road regulations together that would reduce the cost to fleets while continuing to meet the Board's air quality goals and obligations. The Board's direction included the following principles for staff to consider in proposing amendments:

- Continue progress toward cleaner air
- Maintain public health benefits
- Meet California's State Implementation Plan (SIP) commitments
- Provide incentives to achieve greenhouse gas reductions
- Improve cost effectiveness
- Lower peak year costs
- Consider cumulative impact of both regulations
- Provide most economic relief to fleets hardest hit by recession
- Ensure emission reductions as economy recovers
- Support clean technologies

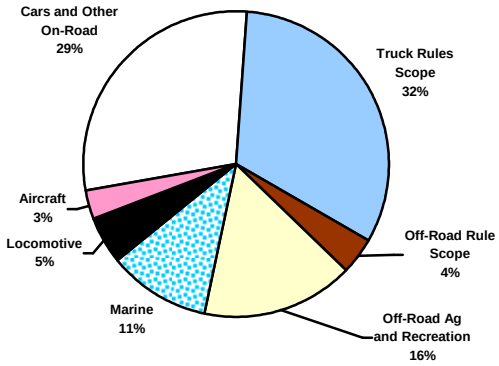
To support development of the proposed amendments, staff conducted a comprehensive review of the off-road emissions inventory that focused on two areas. First, staff undertook a thorough review of its inventory methodology, and updated many key factors used in estimating emissions from off-road vehicles. This included new population and activity data reported to ARB, as well as new published studies and other data that evaluated emissions from off-road vehicles. Staff also evaluated new data that showed that the previous inventory overestimated how much and how hard off-road vehicles work. Staff also took into account the severe impact the recession has had on the construction industry in California, where construction activity has decreased by more than 50 percent since 2005, and new vehicle sales have declined more than 90 percent (CA DOF, 2010; EDA, 2010). The net result of the recession and methodology changes was an almost 80 percent reduction in emissions from what had previously been estimated, with about half of this reduction the result of the recession, and about half to changes in inventory methods.

Despite the changes and reduced emissions from off-road vehicles without the off-road regulation, the categories of vehicles that it covers remain an important contributor to emissions in California, both in 2010 and 2020, as shown in Figure 1 and Figure 2. In addition, reducing emissions is necessary to reduce premature deaths associated with exposure to fine PM (PM2.5) and near-source exposure to diesel PM.

Figure 1: Off-Road Contribution to 2010 Statewide Mobile Source Emissions (Particulate Matter and NOx without Regulations)

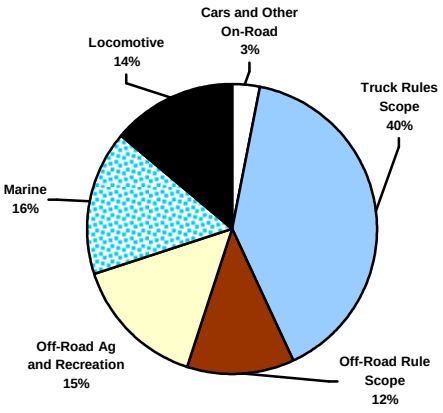


PM Emissions

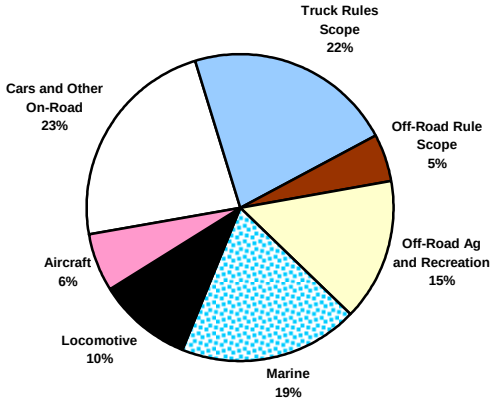


NOx Emissions

Figure 2: Off-Road Contribution to 2020 Statewide Mobile Source Emissions (Particulate Matter and NOx without Regulations)



PM Emissions



NOx Emissions

In directing staff to propose changes to the Truck and Bus and off-road regulations together, the Board further instructed staff to also consider the impact of the recession and inventory changes on affected fleets. This was intended to ensure emissions reductions could be targeted most cost effectively, and the combined emissions benefits achieved by the two rules would continue to meet State Implementation Plan (SIP) requirements. The SIP is California's roadmap towards achieving federal clean air standards by the applicable deadlines. To assess progress towards meeting the emission reduction obligations in the SIP, staff evaluated whether the lower emissions from the revised inventory and the recession provided greater emission reductions than were expected. Any excess emission reductions achieved are referred to as an emission margin. The margin defines how much relief can be provided under the regulations while still meeting the legal emission reduction requirements of the SIP. To allow for a comparison of different pollutants (PM and NOx), the margin is calculated, by

air basin, in NOx equivalent emissions. Table 1 shows the emission margin for the South Coast and San Joaquin Valley air basin for 2014, which is the attainment date for these two air basins to meet federal PM2.5 standards. Based on this analysis, staff believes it is feasible to significantly reduce the economic impact on affected fleets while meeting all SIP obligations.

Table 1: Emission Margin for Truck and Bus and Off-Road Regulations: 2014

Air Basin	Equivalent NOx Tons per Day Below Combined SIP Target
South Coast	62
San Joaquin Valley	40

The U.S. EPA has recently concluded, based on the published and peer reviewed scientific literature, that long-term exposure to PM2.5 is causally associated with premature mortality. A causal relationship means it has the highest scientific level of certainty. The U.S. EPA also found that premature deaths caused by PM2.5 occur at levels well below the Federal air quality standard for PM2.5. The U.S. EPA estimates that about 63,000 to 80,000 premature deaths each year in the U.S. are related to PM2.5. ARB staff used the EPA methodology to estimate that long-term exposure to PM2.5 from all sources in California results in 9,200 premature deaths annually and that reducing emissions to meet the Federal standard would reduce premature deaths by 2,700 annually. Reducing PM emissions below the Federal standard would reduce the number of premature deaths even further.

After holding 19 workshops in 2010 throughout the state and considering the principles laid out by the Board, staff has developed a comprehensive set of amendments to the Truck and Bus[1] and off-road regulations that will:

- Substantially reduce compliance costs;
- Achieve the emissions reductions needed to meet California's SIP commitments to attain federal air quality standards;
- Continue to reduce localized risk; and
- Continue to reduce the premature mortality impacts of diesel emissions.

Included in these proposed amendments to the off-road regulation are recommendations developed in conjunction with representatives from the Associated General Contractors of America (AGC) (ARB, 2010a), including:

- Delay start of requirements until January 1, 2014
- Increase the number of "low-use" equipment exempted
- Provide simpler compliance options for the smallest fleets
- Extend benefits for businesses that comply before their deadline
- Lower annual requirements to clean up engines

[1] A summary of amendments to the Truck and Bus regulation is set forth in the Truck and Bus Staff Report: Initial Statement of Reasons.

The current performance requirements of the off-road regulation require large fleets (those with over 5,000 horsepower (hp)) to begin turning over 8 percent and retrofitting 20 percent of their hp per year, beginning in 2010. Medium fleets (those between 2,501, and 5,000 horsepower) are required to begin meeting the same requirements in 2013. Small fleets, those with 2,500 hp or less, are required to install retrofits on 20 percent of their horsepower beginning in 2015, but are not required to turn over any vehicles. Large and medium fleets may complete their turnover requirements by replacing, retiring, or repowering them with a newer engine, operating the vehicle less than 100 hours per year, or moving to electric or alternative fuel engines. For fleets of all sizes, the fleet may avoid the need to take any compliance action under the off-road regulation if the fleet is relatively new and clean and meets a 'fleet average target,' meaning the average emissions per vehicle are low (which is the case with newer vehicles). The regulation also requires fleets to report their off-road diesel vehicles to ARB and label the vehicles with an ARB assigned identifier in 2009, and currently requires fleets to limit idling to no more than five minutes and provide a disclosure notice whenever they sell an off-road vehicle in California.

The proposed amendments to the off-road regulation delay the initial compliance date for all fleets by four years, provide a path to compliance without any required retrofits, simplify the regulation, and lower the costs of the regulation significantly while still maintaining progress toward clean air. More specifically, these amendments would:

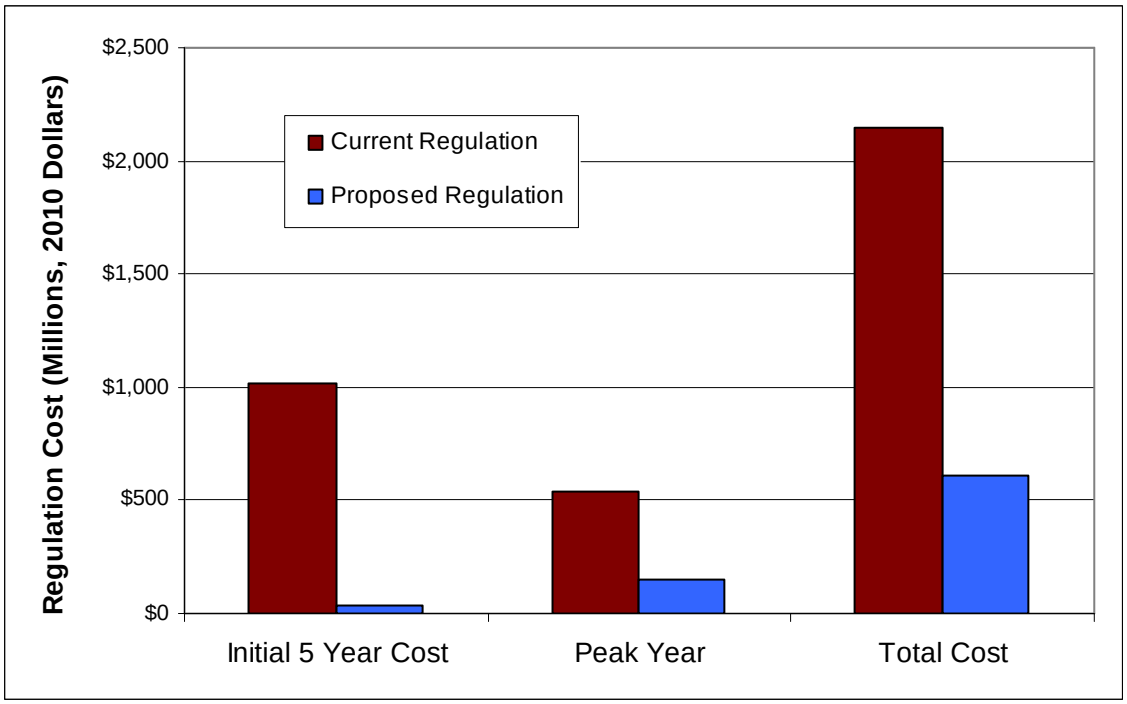
- Delay first compliance date until no earlier than January 1, 2014, for all fleets. The initial compliance dates for medium and small fleets would be delayed until January 1, 2017, and January 1, 2019, respectively;
- Combine PM and NOx requirements to dramatically simplify the regulation and reduce the number of annual requirements;
- Allow turnover in lieu of retrofitting;
- Lower annual requirements to clean up engines to no more than 5 to 10 percent of a fleet's horsepower (down from 28 to 30 percent);
- Provide significant credit for early retrofits to incentivize early actions;
- Increase low use threshold from 100 to 200 hours annually, allowing more vehicles to be defined as low-use (and therefore exempt from control requirements);
- Provide simpler compliance option for the smallest fleets, those with less than 500 horsepower; and
- Achieve more NOx reductions in later years by requiring more turnover to the newest, cleanest engines starting in 2017.

The reporting, labeling, and idling restrictions would remain in place. In addition to these amendments above, staff is also proposing additional minor modifications to clarify or simplify regulatory provisions.

For the LSI fleet regulation, staff is proposing to broaden the definition of low-use vehicles to match that in the off-road regulation, broaden compliance extension flexibility, and make other minor clarifications.

The proposed amendments to the off-road regulation will provide substantial economic relief to all affected fleets, especially in the short term. Estimated costs of the off-road regulation over the next 5 years would be reduced by 97 percent, from $1 billion to $33 million. Total costs over the life of the off-road regulation would be reduced by over 72 percent, and peak year costs would be reduced by 73 percent. This would represent a cost savings of $1.5 billion and $396 million, respectively. These cost savings are shown in Figure 3. The proposed LSI fleet regulation changes are expected to provide $8.4 to $59.5 million in savings to affected fleets by increasing flexibility options.

Figure 3 : Cost of Proposed Off-Road Regulation Down Substantially



Overall, the regulations will continue to provide significant emissions reductions that are necessary to meet California's air quality obligations and goals. The proposed amendments will reduce the emissions margin to zero in the San Joaquin Valley and to 5 tons/day in the South Coast. Because the combined margin for trucks/buses and off-road equipment is minimized, maximum relief is provided while still meeting SIP legal obligations.

In addition, the off-road regulation will continue to provide significant health benefits by reducing premature mortality from PM2.5 exposure and localized risk from diesel PM. Staff estimates that 470 premature deaths (360 to 570, 95% confidence interval) would be avoided by implementation of the amended off-road regulation from 2010 to 2029. This estimate is based on United States Environmental Protection Agency's (U.S. EPA) new risk assessment methodology (U.S. EPA, 2010), and includes the most recent air quality data available (2006 to 2008) and the latest emissions inventory estimates. Staff also expects localized risk to be reduced commensurate with the expected diesel PM emission reductions.

II. INTRODUCTION

The purpose of this report is to describe proposed amendments to the following regulations:

- Regulation for In-Use Off-Road Diesel-Fueled Vehicle Fleets (the off-road regulation), California Code of Regulations (CCR), Title 13, sections 2449 through 2449.3, and
- The Large Spark Ignition Engine Fleet Requirements (LSI fleet regulation), CCR, title 13, sections 2775 through 2775.2.

Staff of the Air Resources Board (ARB or Board) is proposing amendments to provide economic relief to fleets affected by the recent recession and to address the finding that off-road diesel emissions are lower than previously expected. At the same time, staff is proposing minor amendments, simplifications, and clarifications to both regulations.

A. Background

1. History of off-road regulation and previous amendments

The off-road regulation was originally approved by the Board on July 26, 2007, and became effective on June 15, 2008. The Board approved additional amendments on December 11, 2008, which aligned requirements with the newly adopted Truck and Bus regulation, and January 26, 2009, which extended credits for exhaust retrofits. These became effective on January 8, 2010, and January 1, 2010, respectively. On February 20, 2009, the Governor signed Assembly Bill 8 2X (AB 8 2X) in which the Legislature added Section 43018.2 to the Health and Safety Code, directing ARB to amend the off-road regulation. The Board approved the AB 8 2X amendments, and additional minor amendments to the off-road regulation on July 23, 2009. The AB 8 2X Amendments became effective on December 3, 2009, and the additional amendments approved by the Board in July 2009, became effective on August 15, 2010.

The off-road regulation is intended to significantly reduce emissions of diesel particulate matter (PM) and oxides of nitrogen (NOx) from over 150,000 in-use off-road diesel vehicles that operate in California. The off-road regulation is structured to achieve these reductions by requiring fleet owners of off-road in-use diesel vehicles to modernize their fleets by accelerating the use of cleaner engines and applying exhaust retrofits to their vehicles (ARB, 2007a). The off-road regulation was designed to support the Diesel Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles, which was adopted by the Board on September 30, 2000, as well as the 2007 State Implementation Plans (SIPs) for the South Coast and San Joaquin Valley air basins (ARB, 2000; ARB, 2007c).

2. History of LSI fleet regulation and previous amendments

The Off-Road LSI Engine Regulation (LSI regulation), which established new engine standards and test procedures for manufacturers of LSI engines, was approved by the Board on October 22, 1998, and became effective on November 8, 1999. On May 12, 2006, the ARB amended the existing LSI Regulation and additionally adopted

fleet requirements for operators of in-use LSI fleets (the LSI fleet regulation) and verification procedures for manufacturers of LSI retrofit emission control systems (retrofit kits). The amendments became effective on May 12, 2007.

The 2006 rulemaking requires operators of in-use fleets to achieve specific hydrocarbon and oxides of nitrogen (HC+NOx) fleet average emission level (FAEL) standards that become more stringent with fleet size and time. The standards are also more stringent for forklifts than they are for non-forklift LSI equipment. The stringency of the standards reflects the differences in availability of retrofit devices for the four categories of in-use LSI equipment as well as the greater ability of large fleets to incorporate zero- and near zero-emission equipment into their operations.

The intent of the LSI new engine standards and fleet requirements was to reduce HC+NOx emissions from the approximately 90,000 pieces of LSI equipment operating in the State of California by accelerating the introduction of new zero- and near zero-emissions equipment and the retrofit or retirement of in-use uncontrolled equipment. The LSI fleet regulation was designed to support the 2003 SIP (ARB, 2003a).

The LSI fleet regulation applies to operators of forklifts, sweepers/scrubbers, tugs, and ground support equipment (GSE), the four largest categories of LSI engine equipment. These vehicles are found in thousands of fleets in California, in industries as diverse as manufacturing, wholesale, transportation and utilities, retail, services, and construction, as well as public agencies. The LSI fleet regulation affects approximately 2,000 LSI fleets in California.

B. Regulatory Authority

ARB has authority under California law to adopt the proposed amendments to the off-road and LSI fleet regulations. California Health and Safety Code (Health & Saf. Code) sections 43000, 43000.5, 43013(b) and 43018 provide broad authority for ARB to adopt emission standards and other regulations to reduce emissions from new and in-use vehicular and other mobile sources. Under Health & Saf. Code sections 43013(b) and 43018, ARB is directly authorized to adopt emission standards for off-road vehicular sources, as expeditiously as possible, to meet state ambient air quality standards.

ARB is further mandated by California law under Health & Saf. Code section 39667 to adopt Airborne Toxic Control Measures (ATCMs) for new and in-use vehicular sources, including off-road diesel vehicles, for identified toxic air contaminants (TACs), such as diesel PM.

Under federal and California law, ARB is the primary agency in California responsible for ensuring that all regions of the State attain and maintain the National Ambient Air Quality Standards (NAAQS). To achieve this, California must adopt all feasible measures to obtain the necessary emission reductions, including measures from mobile sources. The Federal Clean Air Act (CAA) preempts states, including California, from adopting requirements for new off-road engines less than 175 hp used in farm or

construction equipment. California may adopt emission standards for in-use off-road engines pursuant to CAA section 209(e)(2), but must receive authorization from U.S. EPA before it may enforce the adopted standards.

C. Rationale for the Proposed Amendments

Both the off-road and LSI fleet regulations are needed to protect public health and to achieve the emission reductions necessary to attain federal clean air standards. However, staff is proposing major amendments to both regulations, especially to the near-term requirements, for several reasons.

First, the global recession has caused a loss in employment and revenue in the construction sector and other industries that are affected by the regulations (U.S. BLS, 2010; U.S. BEA, 2009). This has resulted in a reduction in business activity and has strained the financial ability of industry to comply with the regulations. At the same time, the recession has also resulted in reduced vehicle activity and emissions there from.

In February 2009, ARB was directed to grant short term economic relief from the off-road regulation for fleets adversely affected by the economy through AB 8 2X (ARB, 2009b; AB 8 2X, 2009), including providing credits towards the PM and NOx requirements of the regulation if a fleet could show:

1) A reduction in total fleet horsepower from March 1, 2006, to March 1, 2010, or
2) A reduction in fleet activity between July 1, 2007, and March 1, 2010.

As of April 2010 (the annual reporting deadline for large fleets), approximately 55 percent of large fleets have received reduced activity and/or reduced horsepower credit under the off-road regulation. On average, these fleets have accrued enough credits to delay initial compliance with the existing regulation for two to four years (ARB, 2010b). Although these credits will help many fleets comply with the first several years of regulatory requirements, there are still many fleets in California that have not been able to obtain credits, and therefore would be subject to full regulatory compliance.

In addition, since the beginning of 2010, ARB staff has undertaken a comprehensive review and update of the methodology and data inputs used in staff's initial estimates of off-road diesel vehicle emissions. As part of that work, staff considered the current economic recession and corresponding decrease in off-road vehicle activity. Based on the new data available, staff now believes that past and future emissions from off-road vehicles are significantly lower than previously estimated. Staff has determined that it is feasible to utilize the lower than expected emissions to provide economic relief to fleets, while still achieving the emission reductions necessary to attain federal clean air standards (Further detail on the emission inventory changes is provided in Chapter III.A.1.)

In April 2010, the Board directed staff to update the emissions inventories from trucks and buses and off-road equipment to reflect the impact of the recession on emissions. The Board further directed staff to develop amendments to the In-Use On-Road Diesel Vehicle Regulation (Truck and Bus) and off-road regulations together that would provide

economic relief to fleets while continuing to meet the Board's air quality goals and obligations. The Board's direction included the following ten guiding principles for staff to consider in proposing amendments (shown below).

Table 2: Ten Guiding Principles

1. Continue progress toward cleaner air
2. Maintain public health benefits
3. Meet SIP commitments
4. Incentivize greenhouse gas reductions
5. Improve cost effectiveness
6. Lower peak year costs
7. Consider cumulative impact of both regulations
8. Provide most relief to fleets hardest hit by recession
9. Ensure emission reductions as economy recovers
10. Support clean technologies

While the substantially lower off-road diesel vehicle emissions and the severe recession have created an opportunity for the ARB to go back and modify the off-road regulation to reduce its economic impacts, off-road diesel vehicles remain a significant source of pollution. Therefore, the proposed amendments to the regulation are structured to reduce the economic impact from this regulation while maintaining the emissions and public health benefits expected from the original regulation.

Along with providing economic relief to fleets, staff believes that the off-road regulation should be amended to provide fleets greater flexibility in how they choose to lower their emissions. When the Board approved the off-road regulation in July 2007, staff believed off-road exhaust retrofits would be a widely available and cost effective solution for compliance for nearly all fleets. Hence, the current off-road regulation includes mandatory requirements for installing retrofits for all fleets that do not meet the PM fleet average targets; such fleets are required to install retrofits on a fifth of their horsepower annually. However, as implementation of the off-road regulation began, it became clear that for many fleets and applications, retrofits presented a significant challenge, and accelerated turnover to newer vehicles was a more attractive compliance option. For example, actively regenerated retrofits may not a viable option for large equipment rental fleets that would have to train their customers on how to operate, regenerate, and maintain them. Although exhaust retrofits remain a viable option for many fleets, staff believes it is necessary to restructure the off-road regulation to remove mandatory retrofitting and instead allow fleets to choose between turnover and retrofitting as a compliance strategy.

Staff is also proposing several minor amendments to the off-road and LSI fleet regulations, which are not expected to significantly alter the emissions reductions or total costs expected from the regulations. These minor amendments are modifications or clarifications that are designed to make each regulation more clear, easier to

implement, or fix inconsistencies discovered during the beginning stages or regulatory implementation.

D. Stakeholder Participation

Since January 2010, staff held 19 public workshops statewide to discuss proposed amendments to the regulations and changes to the emission inventories. For the workshops held in Central Valley, live video feed was also provided to locations in Modesto and Bakersfield. The August 31 to September 8 workshop series also provided stakeholders an opportunity to discuss the revised report, "Estimate of premature deaths associated with fine particle pollution (PM2.5) in California using a U.S. Environmental Protection Agency Methodology," which was released by ARB on August 31, 2010 (ARB, 2010c). Table 3 shows the dates, locations, and the primary discussion topics of the workshops.

Table 3: Public Workshops

Workshop Dates	Locations	Truck and Bus	Drayage Truck	Off-Road	Emissions Inventory	Tractor Trailer GHG
January 20, 2010	El Monte	X				
January 25, 2010	Sacramento (webcast)	X				
January 26, 2010	Central Valley	X				
May 6, 2010	Sacramento (webcast)	X		X	X	
May 12, 2010	El Monte	X		X	X	
May 18, 2010	Central Valley	X		X	X	
June 23, 2010	Central Valley	X		X		X
June 28, 2010	Sacramento (webcast)	X		X		X
July 1, 2010	El Monte	X		X		X
July 6, 2010	San Diego	X		X		X
August 31, 2010*	El Monte				X*	
September 1, 2010*	San Diego				X*	
September 3, 2010*	Central Valley				X*	
September 7, 2010*	Sacramento (webcast)				X*	
September 8, 2010*	Oakland				X*	
September 30, 2010	Sacramento (webcast)	X	X	X**		X
October 4, 2010	El Monte	X	X	X**		X
October 5, 2010	San Diego	X	X	X**		X
October 12, 2010	Central Valley	X	X	X**		X

* PM2.5 Mortality Report was discussed
** LSI Fleet Regulation was also discussed

During the May workshops, staff distributed a survey regarding potential changes to the off-road regulation, with responses requested back to staff by June 1, 2010. The survey

sought feedback on different approaches, such as options in delaying the regulation, various levels of increasing the number of hours for the definition of low use, rolling back turnover/retrofit requirements and any other comments fleets may have on amending the regulation. The questions asked as well as a summary of responses to each question can be found in Appendix C.

In addition to the workshops, staff held numerous meetings with individual fleets, industry associations, and environmental groups. Also, on March 29, 2010, staff solicited input on the proposed off-road amendments from the Off-road Implementation Advisory Group (ORIAG). ORIAG is an informal committee whose goal is to help ARB staff fine tune outreach, training, and implementation materials and help make ARB staff more aware of the needs and opinions of affected stakeholders.

Staff considered all comments and recommendations received from various stakeholders and crafted the final proposed amendments to address the concerns that were expressed.

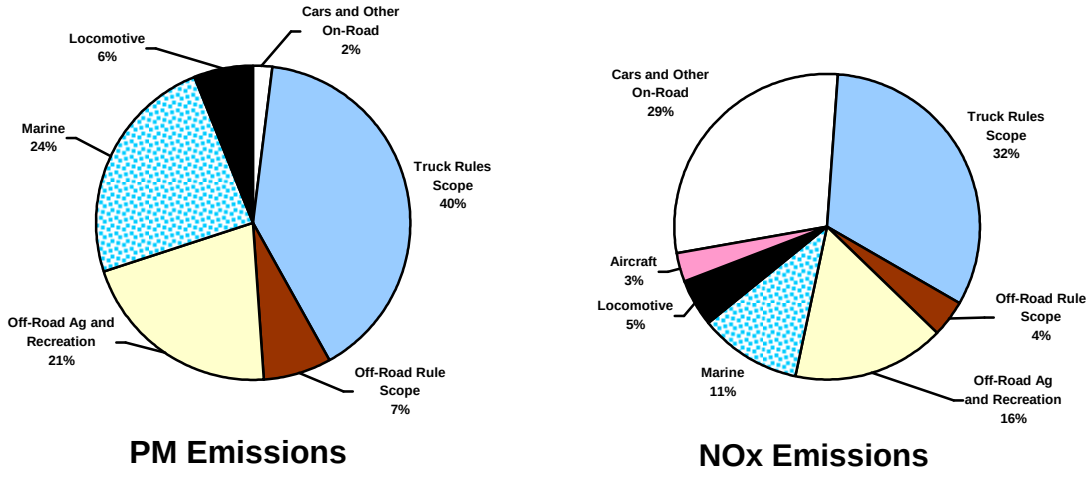
III. NEED FOR EMISSION REDUCTIONS

The emission reductions anticipated from the regulations are needed from a public health standpoint and to allow the state to meet its near and mid-term SIP commitments required by the CAA. They reduce public exposure to directly-emitted toxic PM and reduce atmospheric PM2.5 and ozone.

A. Emissions from Off-Road Vehicles

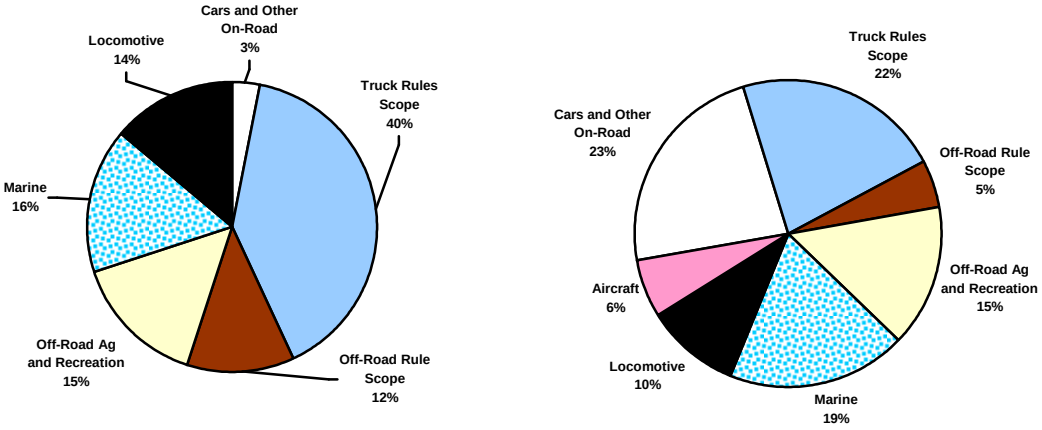
As shown in the Figures 4 and 5 below, the vehicles covered by the off-road regulation are a significant source of diesel PM and NOx emissions that lead to ozone and ambient PM; off-road vehicles covered by the LSI fleet regulation are also a significant source of NOx emissions. Despite the major economic recession and revisions to the off-road regulation inventory, the in-use off-road diesel vehicle category remains an important source of emissions. In 2010, staff estimates the off-road vehicles subject to the off-road regulation are the 4th largest source of diesel PM in California (7 percent of total) and the 6th largest source of NOx from all sources (4 percent of total).

Figure 4: Off-Road Contribution to 2010 Statewide Mobile Source Emissions (Particulate Matter and NOx without Regulations)



As shown in Figure 5 below without the off-road and LSI fleet regulations, in 2020 the emission impact of off-road vehicles within the scope of the off-road and LSI fleet regulations would remain significant.

Figure 5: Off-Road Contribution to 2020 Statewide Mobile Source Emissions (Particulate Matter and NOx without Regulations)



Diesel PM also contributes to ambient concentrations of fine particulate matter (PM2.5), which is associated with premature mortality, aggravation of respiratory and cardiovascular disease, asthma exacerbation, chronic and acute bronchitis and reductions in lung function.

NOx leads to formation in the atmosphere of ozone and PM2.5. Ozone is a powerful oxidant, and exposure to ozone can result in reduced lung function, increased respiratory symptoms, increased airway hyper-reactivity, and increased airway inflammation. Exposure to ozone is also associated with premature death, hospitalization for cardiopulmonary causes, and emergency room visits for asthma.

To put the air quality impacts discussed later in context, the uncontrolled annual statewide emissions from vehicles subject to the off-road regulation are shown below in Table 4. Note that these emission estimates are significantly lower than those presented in the Technical Support Document (TSD) for the original off-road rulemaking in 2007 or previous staff reports, due to the recession and updated emissions inventory data, as summarized in Chapter II and discussed in Appendix D (ARB, 2007b).

Table 4: Annual NOx and PM Emissions from Off-Road Diesel Vehicles in California without the Regulation (tpd)

Baseline Emissions[2]	2011	2014	2017	2023
NOx Emissions	73	76	77	52
PM Emissions	3.7	3.9	3.9	2.4

[2] Baseline emissions are the emissions that would occur without a regulation in place.

1. Updates to off-road emissions inventory

During the development of the off-road regulation in 2005-2007, staff used a wide range of industry reports and studies as well as ARB surveys to update the emissions inventory. The original emissions inventory used to support the off-road regulation relied on the standard technique used by both the U.S. EPA and ARB, which calculates emissions as the product of the number of equipment (population), the size of the equipment (horsepower), the age of the equipment (model year distribution), how often the equipment works (annual hours of use), how hard the equipment works (load factor), and emission rates per unit power (emission factors). Staff used ARB's off-road emissions inventory model, called OFFROAD, to estimate emissions.

Estimating emissions from off-road equipment is challenging. Historically there has been no registration program for off-road equipment and so population must be estimated. Data on annual hours of use and load factor by equipment type are sparse and based upon industry funded studies that were not designed for emissions inventory purposes. In updating the inventory for the off-road regulation, staff focused on developing refined data representing population, hours of use, and other factors for input to the model. Data sources included:

- MacKay and Company Construction Equipment Universe Study (2003)
- ARB Off-Road Equipment Surveys (2005 and 2006)
- TIAX Public Fleet Survey (2003)
- Power Systems Research (2000 and 1996)
- Other data sources provided by industry stakeholders

Through the regulatory development process inventory updates were presented in workshops to solicit industry input. Stakeholders provided their input and in some cases provided additional information. When the workshop process was completed, staff finalized the original emissions inventory. In July 2007, the Board approved the off-road regulation for adoption.

Since the original emissions inventory was completed in 2007, conditions in the construction industry have changed dramatically. The subsequent economic recession was the most severe since the Great Depression, and had a devastating impact on the construction industry in California. Staff estimates that between 2005 and 2010 construction emissions dropped by more than 50 percent because of reduced demand for construction services caused by the recession. The recession has also caused significant declines in emission from other emissions categories, such as industrial off-road equipment and aircraft ground support equipment over the same time period.

In 2009 industry stakeholders pointed out a study by Millstein and Harley (2009) that used a fuel-based method to assess construction equipment emissions and found that ARB's inventory was significantly overestimated. Industry also pointed out that a similar study, which focused on all off-road equipment nationally, was published in 2000 by Kean, Sawyer and Harley and found similar results. Both of these studies used a fuel-based approach to estimate emissions. The fuel-based approach estimates emissions based on fuel usage in a broad array of equipment, using fuel-based emission factors.

The approach is simpler and often favored by academic researchers but is not used to support regulatory development because the method cannot relate emissions or reductions to specific equipment types or to a population of equipment directly. Such information is necessary for the rulemaking process.

In the past staff has been concerned about the accuracy of the fuel-based approach. While total off-road (red-dye) diesel fuel sales information in California is known, the breakdown of fuels among the different sources such as locomotives, construction equipment, industrial equipment, stationary and portable equipment, marine vessels, commercial harbor craft, cargo handling equipment, and other categories is not measured. The federal Energy Information Administration publishes estimates of fuel usage in broad categories of off-road equipment through their Annual Energy Outlook; these estimates are based on confidential surveys. Staff believes fuel use estimates should inform, but not be the basis for category-specific emissions estimates.

The Board's request coupled with the Millstein and Harley study caused ARB staff to go back and conduct a comprehensive review of the inventory. Staff evaluated new sources of information that were not available when the off-road regulation was developed, and updated the emissions inventory to reflect these new data as well as the impact of the recession. Staff made several updates:

- Population: The regulation, as initially adopted, required reporting to ARB of all off-road equipment subject to the regulation. This allowed staff to use the actual population of equipment, rather than estimates in the inventory. The total population estimate in 2009 was 26 percent lower than anticipated in 2007, largely due to fleet downsizing during the recession.
- Hours of Use: AB 8 2X regulatory amendments allowed fleets to report 2007 and 2009 activity to obtain credits towards meeting regulatory obligations. About 10 percent of regulated vehicles reported this information. Staff originally thought 2007 was a relatively average year for construction, so staff expected data to be consistent with estimates from MacKay (2003) that were used in the 2007 inventory. Instead, new data by equipment type were in most cases at least 30 percent lower than staff expected, and in some cases more than 50 percent lower. For example, staff assumed backhoes worked on average 942 hours per year; new data suggested the average was 512 hours per year. Staff evaluated the new information against a recent, albeit limited study conducted by a consultant and the results were generally consistent, so staff used the AB 8 2X data. The 2009 activity was lower than 2007 due to the recession.
- Load Factor: Load factor is a measure of how hard an engine works, and is expressed as a percent of total horsepower of an engine. Previous estimates from Power Systems Research (1996; 2000) were in the 60 percent range for many equipment types. In 2008 and 2009 several academic studies focused on testing construction equipment in real-world applications were completed. Additionally in 2010 staff received some data from engine manufacturers. While data varied across equipment types, overall staff's analysis suggested load factors should be reduced by 33 percent; however, staff is continuing to pursue additional information in this area.

- Growth Forecasts: Staff's previous growth forecasts used historical employment as a surrogate, and forecasted growth from historical trends. In 2007 staff did not anticipate the recession. After looking at many different indicators, from construction Gross Domestic Product (GDP) and employment to estimated construction fuel use, staff determined that in 2009 construction activity had decreased by 50 percent relative to 2005. Staff then reviewed economic forecasts by the University of California at Los Angeles (UCLA), University of the Pacific (UOP), the Department of Finance (DOF), the United States Congressional Budget Office, and others. Because future emissions will be a function of the shape of the economic recovery and that shape is not known, staff developed a bounding-scenario of a fast recovery (return to trend in 2017) and a slow recovery (historically average growth from the recession trough) and averaged the two. Because of the recession, staff's future growth forecasts were substantially revised.

As a result of this work, the revised emissions are substantially lower than previously estimated. About half of this reduction can be attributed to the recession, and about half to updated assumptions independent of the recession. Table 5 compares the 2007 and current inventories. Table 6 compares estimated fuel use in the 2007 inventory to the current inventory and industry estimates.

Table 5: Comparison of 2007 Off-Road Regulation and Current Emissions Estimates

Calendar Year	2007 Inventory (tons/day)		Current Inventory (tons/day)	
	PM2.5	NOx	PM2.5	NOx
2009	18.5	358	3.7	79
2014	13.1	272	3.6	76
2023	5.1	136	2.2	52

Table 6: 2009 Estimated Fuel Use (Million Gallons of Diesel Fuel): ARB vs. Industry

2007 Inventory	Current Inventory	Industry Estimates
990	219	160 to 186

Staff has more confidence in the inventory estimates today than in 2007 because staff has access to new input data provided directly by California fleets that wasn't available at the time of the original rulemaking. Fuel consumption now agrees more closely to other fuel based estimates.

B. National Ambient Air Quality Standards

1. SIP commitments

The U.S. EPA has established health protective NAAQS for a number of criteria pollutants, including PM2.5 and ozone. States with areas that do not meet these

standards must develop SIPs and adopt regulations to meet the standards by certain deadlines. Figure 6 and Figure 7 below show the nonattainment areas in California for PM and Ozone, respectively. Two air basins in California in particular – the South Coast Air Basin and the San Joaquin Valley Air Basin – are in nonattainment for both PM2.5 and the 8-hour ozone standard.

Figure 6: California Nonattainment Areas for PM2.5

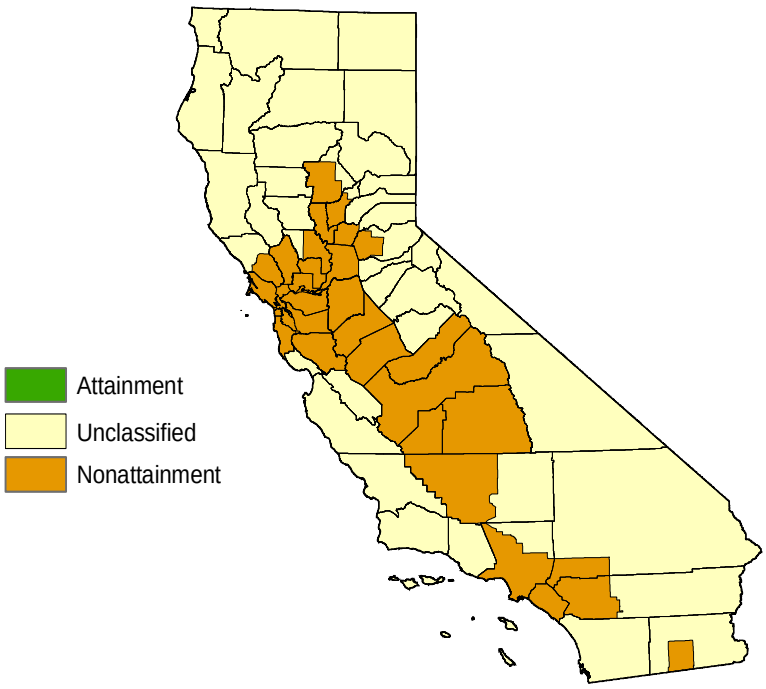
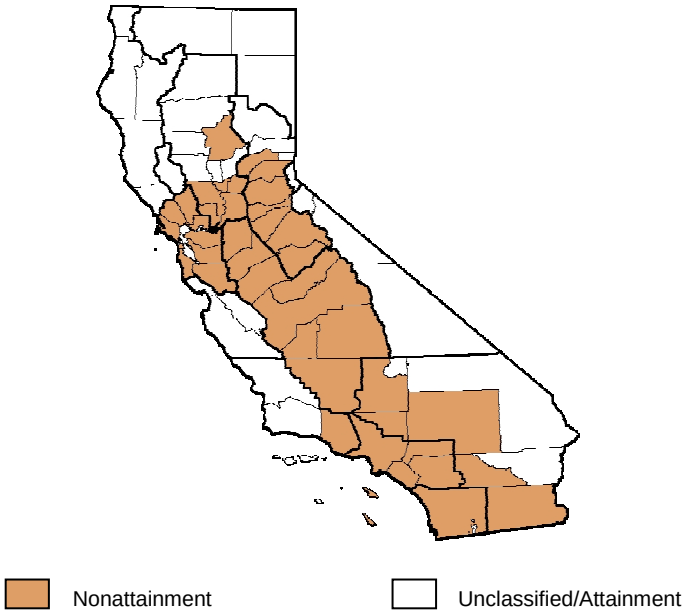


Figure 7: California Nonattainment Areas for Ozone



Overall, to meet the PM2.5 standard in the South Coast and the San Joaquin Valley Air Basins, NOx emissions must be reduced by approximately 50 percent. Even greater reductions of NOx, on the order of 75 to 88 percent, will be needed to achieve the 8-hour ozone standard in the by 2023. Despite the fact that emissions in future years are expected to be lower than originally anticipated when the regulations were adopted, substantial emissions reductions from trucks and buses are still needed by 2014 to meet the PM2.5 attainment deadline and by 2023 to meet the 8-hour ozone attainment deadline.

California's 2003 South Coast SIP contained two measures for off-road LSI equipment that represented a commitment of 2.8-6.0 tons per day in 2010 and 1.5-5.1 tons per day in 2020. The 2006 LSI rulemaking commits to reduce HC+NOx emissions from LSI equipment by 2.6 and 2.9 tons per day in the South Coast in 2010 and 2020, respectively (ARB, 2006a).

California's 2007 SIP included the off-road regulation as a control measure. ARB's legal commitment to achieve the emission reductions laid out in the SIP relies upon the emission reductions from the regulation by 2014 in the South Coast and the San Joaquin Valley (ARB, 2007c). If the off-road regulation falls short of achieving these reductions, the shortfall would need to be achieved by other control measures.

2. Meeting SIP Target

In directing staff to propose changes to the Truck and Bus and off-road regulations together, the Board directed staff to also consider the impact of the recession and

inventory changes on fleets affected by these regulations in deciding how to provide appropriate regulatory relief. This was intended to ensure emissions reductions could be targeted most cost effectively, and the combined emissions benefits achieved by the two rules would continue to meet SIP requirements.

To assess progress towards meeting the emission reduction obligations in the SIP, staff evaluated whether the lower emissions from the revised inventories for both trucks and off-road vehicles, combined with the effects of the recession, provided greater emission reductions than were expected. Any excess emission reductions achieved are referred to as an emission margin. The margin defines how much relief can be provided under the regulations while still meeting the legal emission reduction requirements of the SIP.

To allow for a comparison of different pollutants (PM and NOx), the margin is calculated, by air basin, in NOx equivalent emissions, since both pollutants contribute to ambient levels of PM2.5 levels in the atmosphere. Table 7 below shows the emission margin for the South Coast and San Joaquin Valley Air Basins for 2014, which is the attainment date for these two air basins to meet federal PM2.5 standards. As can be seen, based on this analysis, it is feasible to provide regulatory relief to affected fleets while still meeting all SIP obligations, so long as these emission margins are not exceeded.

Table 7: Emissions are Less Than the 2014 SIP Target – Existing Truck and Bus and Off-Road Regulations, Including Recession

Air Basin	Equivalent Tons of NOx Below Combined SIP Target
South Coast	62
San Joaquin Valley	40

C. PM Emissions and Mortality

The U.S. EPA recently published a review of the PM-related health science literature in the Integrated Science Assessment, which is the first part of the ongoing review of the national ambient air quality standards for PM (U.S. EPA, 2009). Based on the overall evidence from the more than one thousand peer-reviewed publications of PM2.5 exposure in humans, animals, and cells, the U.S. EPA concluded that long-term exposure to PM2.5 exposure is causally associated with premature mortality, and that premature deaths caused by PM2.5 occur at levels as low as 5.8 micrograms per cubic meter, which is considerably lower than the current national standard of 15 micrograms per cubic meter. A causal relationship means it has the highest scientific level of certainty in its ability to contribute to premature death. This report was peer reviewed through a public process by the Clean Air Scientific Advisory Committee Particulate Matter Review Panel, an independent body of 24 national scientists.

The U.S. EPA risk assessment methodology, the basis for ARB's calculation, was developed to estimate premature deaths associated with PM2.5 exposure across the nation. This report was also peer reviewed through a public process by the Clean Air

Scientific Advisory Committee Particulate Matter Review Panel. The relationship between premature death and PM2.5 relies on a new comprehensive study of about 500,000 participants in 116 U.S. cities (Krewski et al., 2009). Besides the large representative study population, the U.S. EPA concluded this study has significant advantages over other epidemiological studies of the relationship between PM2.5 and premature death. These include the use of more recent measured PM2.5 air quality data, more individual lifestyle information to allow for consideration of potential confounding (compared to other cohort studies), and rigorous statistical methods. Using this relationship, the U.S. EPA conducted a national-scale analysis and a more limited risk assessment, which was focused on 15 urban study areas, including Fresno and Los Angeles (U.S. EPA, 2010).

Based on this work, the U.S. EPA estimates that about 63,000 to 80,000 premature deaths each year in the United States are related to PM2.5. Using the same methodology, ARB staff estimated that 9,200 (7,300-11,000, 95 percent confidence interval) of these deaths occur annually in California, and that reducing emissions to meet the Federal standard would result in 2,700 fewer premature deaths annually. Reducing PM emissions further would provide an additional reduction in the number of premature deaths.

D. Localized Risk

Diesel PM as a component of ambient PM2.5 is a significant public health concern throughout the state. Additionally, in August 1998, the ARB identified PM emissions from diesel-fueled engines as toxic air contaminants. It is, by far, the largest contributor of known ambient air toxics cancer risk in California (ARB, 2009b).

Following the identification process, the ARB developed the Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles (Diesel Risk Reduction Plan) in September 2000, paving the way for the development of control measures designed to reduce toxic diesel PM emissions. Through this plan staff identified strategies, including air toxics control measures and other regulations, to reduce diesel emissions by 75 percent by 2010, and by 85 percent by 2020. The goal of each regulation is to make diesel engines as clean as possible to reduce emissions and their associated cancer risk. The off-road regulation is a critical piece of the Diesel Risk Reduction Plan, as is evidenced by the significant emissions of diesel PM from the vehicles subject to this regulation. Failure to obtain substantial reductions in diesel PM from off-road diesel vehicles will likely mean the overall goals of the Diesel Risk Reduction Plan will not be met.

IV. PROPOSED AMENDMENTS TO THE OFF-ROAD REGULATION

This chapter describes the proposed changes to the off-road regulation. As described further in the sections below, amendments to the regulation are necessary and appropriate for the following reasons: (1) under current economic conditions, fleets subject to the regulation need economic relief from the cost of compliance, (2) emissions from off-road diesel vehicles are significantly lower than previously estimated due to the recession and new data and inventory methodology changes, and (3) based on feedback from affected fleets and ARB implementation staff, a number of other regulation provisions require clarification or streamlining.

A. Existing Regulation

1. Overview

The scope of the off-road regulation is far reaching; affecting vehicles of dozens of types used in thousands of fleets, in industries as diverse as construction, air travel, manufacturing, landscaping, and ski resorts, as well as public agencies. The off-road regulation affects, among others, the warehouse with one diesel forklift, the landscaper with a fleet of a dozen diesel mowers, the county that maintains rural roads, the landfill with a fleet of dozers, as well as the large construction firm or government fleet with hundreds of diesel loaders, graders, scrapers, and rollers. To punctuate the scope of the regulation, as of September 20, 2010, over 8,800 fleets had reported over 150,000 off-road vehicles to the Diesel Off-Road Online Reporting System (DOORS), the electronic reporting system for the regulation (DOORS, 2010).

The off-road regulation's requirements vary depending on the size of the fleet and on the vintage of its vehicles. Fleets are defined in the off-road regulation as small, medium, or large based on their total statewide horsepower (hp). The off-road regulation requires that the largest fleets, which have the most significant emissions, meet the most stringent requirements. The smallest fleets, and local municipal fleets located in low-population counties, are required to meet less stringent provisions.

2. Enforcement delay of off-road regulation

California may adopt and enforce emission standards and other requirements for off-road engines and equipment not expressly subject to federal preemption so long as California applies for and receives authorization from the Administrator of U.S. EPA. California's request for authorization was submitted on August 12, 2008. On October 27, 2008, and April 14, 2010, the U.S. EPA conducted hearings regarding California's request for authorization for the off-road regulation. However, the request for authorization is still pending.

In response to the continuing effects of the economy and because the U.S. EPA had not granted California's request for authorization, the ARB Executive Officer issued a regulatory advisory on February 11, 2010. The advisory notified stakeholders that ARB will not be enforcing the NOx and PM requirements of the regulation, pending further

notice (ARB 2009c). The reporting, labeling, idling and disclosure requirements remain in effect, however, because they do not require federal authorization.

B. Proposed Amendments to the Off-Road Regulation

As described in Chapter II, the recession and an updated inventory assessment provided both cause and means to lower the requirements and costs of the regulation. In selecting the provisions of the off-road regulation to modify, staff considered direction from the Board (see Chapter I), input from stakeholders and the ORIAG, and the results of emissions and cost modeling. Staff also worked with representatives from the Associated General Contractors of America (AGC), to develop several proposed amendments (ARB, 2010a), including:

- Delay start of requirements until January 1, 2014;
- Increase the number of "low-use" equipment exempted;
- Provide simpler compliance options for the smallest fleets;
- Extend benefits for businesses that comply before their deadline; and
- Lower annual requirements to clean up engines.

Staff developed the following package of proposed amendments to balance a number of considerations, including the wide range of industry, public health, and the legal requirements of the state to meet air quality standards. In developing the proposed amendments, staff considered numerous alternatives to this proposal, as discussed further in Chapter VIII.

A summary of the proposed amendments includes:

- The regulation would place annual requirements on fleets over the following timeline:
  - Large fleets: 2014 to 2024
  - Medium fleets: 2017 to 2027
  - Small fleets: 2019 to 2029
- In each compliance year, fleets (of all sizes) would be required to meet an adjusted fleet average target, or complete a single set of Best Available Control Technology (BACT) requirements;
- Annual BACT requirements would consist of turning over **or** retrofitting 8 to 10 percent of the fleet's horsepower (4.8 percent for large fleets in 2014);
- Extend double credit period for fleets choosing to retrofit;
- Vehicles under 200 hours of use annually would be defined as low-use and therefore largely be exempt from the regulation's requirements;
- Provide credit for reduced fleet horsepower from 2010 to 2011;
- Simplify compliance path for fleets under 500 horsepower; and
- Increase turn-over requirements in the later years of the regulation.

Background on each amendment is provided below, and each is described in further detail.

1. Major Amendments

Below is a summary of the proposed major amendments.

a) *Delay Implementation for Four Years*

Proposed Change: 2449.1(a)(1)(A)(1) and 2449.1(a)(2)(A)(1): Staff proposes to move the start date of the regulation back four years for all fleets.

- The first requirements for large fleets would be moved from 2010 to 2014, medium fleets from 2013 to 2017, and small fleets from 2015 to 2019.
- All requirements would be required by January 1 of the calendar (i.e. large fleets 2014 requirements would be required by January 1, 2014), instead of March 1.
- Credits that expire (i.e. reduced activity credits) would not be extended
- Reduced horsepower credits would be reduced by half, and fleets could not use such credits to meet the 2014 requirements.
- Fleets would maintain credit for repowers and retrofits until that credit is used to meet the BACT requirements.

b) *Combined PM and NOx Fleet Averages and BACT Requirements*

Proposed Change: 2449.1 and 2449.2: Staff proposes to combine the PM and NOx fleet averages and BACT requirements as described below:

- The combined BACT requirements would require actions on 8 to 10 percent of a fleet's horsepower in each year that a fleet does not meet the fleet average target (or 4.8 percent in 2014).
- A fleet would receive credit toward the BACT requirements for both retrofits and turnover.
- To determine whether it is required to comply with the BACT requirements, a fleet would compare its fleet average index to its fleet average target rate. The index would be based on a fleet's NOx fleet average, adjusted to reflect verified diesel emission control strategies (VDECS), including those that only reduce PM.

All fleets would have the following compliance options for meeting the proposed combined BACT requirements:

- Replace older vehicles with new or used vehicles;
- Replace diesel vehicles with electric or alternative fuel vehicles;
- Repower older engines with Tier 2 or higher engines;
- Retire vehicles from the fleet;
- Designate vehicles as permanent low-use; or
- Install VDECS.

c) *Extend Double Retrofit Credit Period*

Proposed Change: 2449.1(a)(2)(A)2.iii: Staff proposes to extend the period during which a fleet may receive double credit for the installation of a VDECS until 12 months

prior to the initial compliance deadline for all fleet sizes. Table 8 below lists the proposed deadlines for double credit for all fleet sizes, and for comparison the current deadlines for all fleet sizes.

Table 8: Existing and Proposed VDECS Double Credit Deadlines

Fleet Size	Current Double Credit Deadline	Proposed Double Credit Deadline
Large	January 1, 2010	January 1, 2013
Medium	March 1, 2012	January 1, 2016
Small	March 1, 2012	January 1, 2018

d) *Increase Low-Use Threshold*

Proposed Change: 2449.1(a)(2)(A)7: Staff proposes to increase the low-use threshold for both permanent low-use vehicles and year-to-year vehicles from 100 hours annually to 200 hours annually. This proposed change would impact both year-by-year low use vehicles and those designated as permanently low use (further discussion of low-use vehicles can be found in Appendix E)

e) *Provide Credit for Reduced Fleet Horsepower from 2010 to 2011*

Proposed Change: 2449.1(a)(2)(A)2.iv: Staff proposes to award credit toward the BACT requirements for fleets that reduce horsepower from March 1, 2010, to March 1, 2011, for retirements that comply with the order of turnover requirements. Fleets would receive credit toward the new combined BACT requirements in an amount equal to the total reduction of fleet horsepower from March 1, 2010, to March 1, 2011, or for the reduction in horsepower from Tier 0 and Tier 1 vehicles during that period, whichever is lower.

f) *Delay Requirements for Fleets That Complied in 2010*

Proposed Change: Staff proposes to remove the 2014 requirements for large fleets that came into compliance with the regulation's performance requirements by March 1, 2010. This provision would recognize the effort of fleets that met the 2010 fleet averages or accumulated enough credits to meet the March 1, 2010, BACT requirements. Such fleets would not be required to meet the 2014 fleet average or use their credits to comply with the BACT requirements in 2014 (therefore preserving their credits to be used in later years).

g) *Delay of Turnover for Tier 2 Vehicles*

Proposed Change: Staff proposes to exempt all Tier 2 vehicle or newer vehicles from the January 1, 2014 and January 1, 2015 compliance requirements for large fleets. That is, no fleet would be required to replace or retire a Tier 2 vehicle until the compliance year beginning January 1, 2015, and ending December 31, 2015, if it was necessary to meet the January 1, 2016 requirements. This provision would extend the similar principle the regulation current provides in delaying Tier 1 turnover until March 1,

2013, but would apply to Tier 2 or higher vehicles. By January 1, 2016, Tier 2 vehicles will be up to 15 years old (depending on horsepower category).

h) *Simpler Compliance Path for Fleets Under 500 Horsepower*

Proposed Change: 2449(e)(17): Staff proposes to allow fleets with under 500 horsepower to choose to comply with the regulation by phasing out their Tier 0 and Tier 1 vehicles. This phase-out would not be required, and these fleets could instead opt to meet the fleet average requirements or the BACT requirements. The phase-out schedule proposed is shown in Table 9.

Table 9: Compliance Option for Fleets Under 500 Horsepower

Compliance Date January 1 of Year	Percent of Fleet (by horsepower) Which Must Have a Tier 2 or Higher Engine
2019	25
2022	50
2026	75
2029	100

i) *More Stringent Fleet Average Targets Through 2023*

Proposed Change: 2449.1(a)(1)(A)(1): Staff proposes to increase the stringency of the fleet average targets, such that fleets are required to turn over to additional Tier 4i and/or Tier 4 vehicles from in 2022 and 2023. For vehicles over 175 horsepower and below 750 horsepower, the NOx fleet average currently end (in 2020) at levels slightly less stringent that the Tier 4i standard for off-road vehicles. These targets would be lowered to match the Tier 4i emissions standard by 2023. For vehicles between 75 and 175 horsepower, where vehicle life is generally lower and turnover is less costly, the final fleet average targets will be placed between Tier 4i and Tier 4 final emission standards.

Overall, this change would increase the amount of Tier 4i and Tier 4 vehicles required to comply with the regulation by 2023. The current and proposed final fleet averages are shown below in Table 10.

Table 10: Current and Proposed: Final Fleet Average Targets by Horsepower (Hp) Bin

Fleet Average Targets	25-49 Hp	50-74 Hp	75-99 Hp	100-174 Hp	175-299 Hp	300-599 Hp	600-750 Hp	Over 750 Hp
Current 2020 NOx Targets	3.5	3.2	2.4	2.2	1.9	1.9	1.9	3.4
Proposed 2023 Final Targets	3.3	3.0	1.4	1.3	1.5	1.5	1.5	3.4

Staff will continue to evaluate the fleet average targets for the middle years of the off-road regulation, and may make adjustments to further smooth out the compliance requirements.

2. Minor amendments

Staff is also proposing several minor modifications or clarifications to the regulations, which are not expected to significantly alter the emissions reductions or total costs expected from the regulation when initially adopted. These minor amendments are designed to make the off-road requirements clearer or to fix inconsistencies discovered during the beginning stages of regulatory implementation. The changes include the following:

Remove the Word "Should" - Remove all instances of the word "should" throughout the regulation, and replace the word with "shall".

Captive Attainment Area Fleet Definition - Modify the definition to designate these fleets as small fleets, regardless of their total horsepower.

Clarify Low Use Definition - Explicitly identify the two types of low-use within the regulation (year-by-year low use, and permanent low-use).

Modify Post-2007 Flexibility Engine Provisions - Modify the reporting requirements for Post-2007 flexibility engines. Although these engines will now be treated as if they were not "flexed", reporting is still required.

Alternative Fuel and Hybrid Provisions - Remove electric vehicle horsepower from the fleet's total horsepower calculation and from all BACT calculations; this change would incentivize the use of hybrid off-road vehicles by allowing fleets to use a lower emission factor(s) for hybrid equipment used in a fleet.

Remove Hours in Fleet Average Provision – Delete this provision since no fleets have taken advantage of it.

New Fleet Requirements - Clarify that upon a new fleet purchasing vehicles or bringing vehicles into the state for the first time, a fleet must meet the following requirements:

- *Large or Medium fleets:* Require a large or medium fleet to meet the fleet average target for the closest future *large fleet* compliance date upon initial formation or upon entrance into the state after the effective date of the proposed amendments.
- *Small fleet:* Require a new small fleet to meet the fleet average target for the closest future small fleet compliance date upon initial formation or upon entrance into the state after the effective date of the proposed amendments.

For any size fleet, the new fleet would have the choice of meeting either the fleet average target or the BACT requirements for subsequent compliance dates.

Adding Vehicle Requirements - Amend this provision to require that:

- A ban on adding vehicles with Tier 0 engines to any fleet would begin only after:

    - The proposed amendments to the off-road regulation are certified by the Secretary of State; and
    - The Administrator of the U.S. EPA grants authorization to enforce the off-road regulation.
- Beginning March 1, 2011, large and medium fleets would be allowed to add only vehicles with Tier 2 or higher engines, except as follows. A vehicle with a Tier 1 engine could still be added during this time, as long as all the following conditions are met:
    - The added vehicle with the Tier 1 engine must have been registered in DOORS before March 1, 2011;
    - The fleet adding the vehicle with the Tier 1 engine must be registered in DOORS; and
    - The fleet removing the vehicle with the Tier 1 engine must be registered in DOORS.
- Without exception, beginning January 1, 2013, large and medium fleets would be allowed to add only vehicles with Tier 2 or higher engines; beginning January 1, 2016, the restrictions would apply to small fleets; and
- Beginning January 1, 2018, large and medium fleets would be allowed to add only vehicles with Tier 3 or higher engines; beginning January 1, 2023, the restrictions would apply to small fleets.

These revised requirements would apply to all fleets (regardless of compliance path) and to all horsepower categories, providing additional clarity and simplification to the regulation.

Compliance after the Final Target Date - Clarify that the turnover and retrofit exemptions do not expire after the final compliance date.

Reporting Dates - Change the reporting dates to make them more consistent with the changes and delays to the compliance dates.

Labeling - Require equipment identification numbers (EINs) on both sides of a vehicle, instead of just on the right (starboard) side. Additionally, staff is proposing to require captive attainment area fleets to label their vehicles with EINs that are green with white letters (instead of red with white letters) if they choose to take advantage of the captive attainment area fleet provision. Staff is proposing to provide fleets with two years (until January 1, 2013) to make these labeling changes.

Compliance Certification Process – Clarify this provision by re-naming process "Responsible Official Affirmation of Reporting".

Order of Turnover - Simplify the order of turnover provisions by requiring fleets to turn over all Tier 0 and Tier 1 vehicles before counting other higher tiered vehicles in meeting the fleet's BACT requirements.

15 Percent Turnover Exemption – Extend this provision from March 1, 2011 to January 1, 2013, and clarify that if a fleet has more than 15 percent of its vehicles retrofitted before then, the fleet may choose any of those vehicles to be counted under this exemption, as long as the 15 percent cap is not exceeded; and clarify that a fleet must keep the VDECS on the vehicles with this exemption in order to maintain the exemption.

SOON targets - Adjust the SOON targets to reflect the delay in implementation and fleet average tightening in later years.

3. Impacts of Amendments on an Actual Fleet

Staff evaluated the impact of the proposed amendments on a variety of fleets of different sizes and ages. An example is shown below. This actual fleet has 490 vehicles with a combined 29,000 horsepower and an average vehicle age of 12 years.

The annual retrofit and turnover requirements under the existing regulation and the proposed amendments are shown below in Figure 8 and Figure 9, respectively.

Figure 8: Annual Retrofit Requirements under the Current Regulation and Proposed Amendments

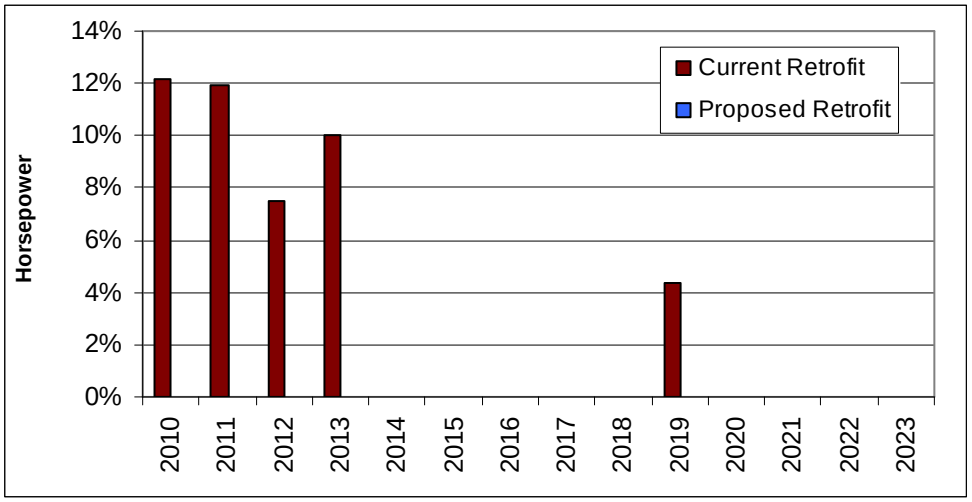
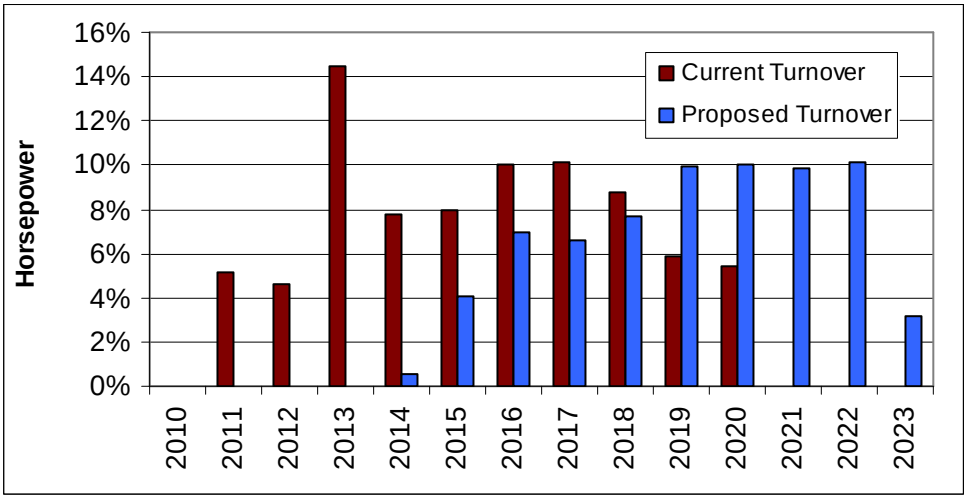


Figure 9: Annual Turnover Requirements under the Current Regulation and Proposed Amendments



The current regulation would require this actual fleet to turn over approximately 80 percent of its overall fleet horsepower from 2010 to 2020, and retrofit 30 percent of its horsepower, primarily between 2010 and 2013. After the proposed amendments, this fleet could comply by turning over 70 percent of its horsepower between 2014 to 2024, and not retrofitting any vehicles. As shown above, the proposed amendments allow for both a delay and reduction in compliance requirements, which will provide significant economic relief for those fleets subject to the regulation.

C. Impact of Proposed Changes on Funding Opportunities

Incentive funding programs play a complementary role to the state's regulatory emission reduction programs to help meet the state's SIP requirements and achieve California's air quality goals by funding projects that achieve early and extra (surplus) emission reductions. ARB oversees two incentive funding programs that allow off-road fleets to obtain funding to help meet future compliance requirements: the Carl Moyer Program and the off-road loan assistance program funded through the federal American Recovery and Reinvestment Act of 2009.

1. Program overview

Funding through the Carl Moyer Program is currently available for the replacement, retrofit, or repower of off-road vehicles to provide early and extra reductions to the regulatory requirements. These reductions are referred to as surplus. Eligibility depends on several factors, including fleet size, hours of usage, and the type of reduced emission technology. The regulation compliance deadlines affect eligibility by defining the end of the surplus emission reduction period. In general, the proposed regulatory changes will enable greater funding opportunities by allowing more time for applicants to apply for funding before compliance dates.

Staff is continuing to evaluate how the proposed amendments will affect available incentive funding opportunities, and will present a summary of potential incentive impacts when the Board considers the proposed regulatory changes in December, 2010. Staff will incorporate public comments and Board direction into planned revisions to the Carl Moyer Program that are currently scheduled to be considered by the Board in the spring of 2011. One change to the current Moyer program that staff has already identified would reduce the minimum project life for small fleets. The Carl Moyer Program currently requires a minimum three year project life which means that incentive funds cannot be used to pay for equipment that is less than three years from its compliance deadline. Staff intends to propose decreasing this requirement to two years for small off-road fleets, as has already been done for small on-road fleets.

The off-road loan assistance program, implemented in partnership with the California Air Pollution Control Financing Authority (CPCFA), is a component of the ARB's comprehensive Providing Loan Assistance to California Equipment (PLACE) program. The PLACE program is designed to assist small businesses in obtaining competitive-rate financing to purchase eligible vehicles and equipment to achieve early regulatory compliance. Through a one-time $5 million award from the U.S. EPA, the off-road loan assistance program utilizes the structure of CPCFA's highly successful loan guarantee California Capital Access Program to enable participating commercial lenders to provide affordable loans to borrowers that otherwise may not qualify for conventional financing. Borrowers then use the loan proceeds to upgrade their off-road equipment any time in advance of compliance deadlines. Unlike the Carl Moyer Program, eligible purchases need not occur two to three years prior to a compliance deadline.

2. Access to funding for equipment owners

Interested equipment owners can obtain more information on funding and compliance by using any of ARB's outreach tools including, the phone hotline at 866-6DIESEL (866-634-3735), or the email address at 8666diesel@arb.ca.gov

Other federal and state financial and incentive programs are administered by local agencies, so equipment owners should check with their local air quality management district for funding opportunities. Some equipment may have their own specially funded programs based on type and use.

D. New and Existing Incentives for Early Actions

Although the proposed amendments would delay the first large fleet compliance deadline until January 1, 2014, the proposal would introduce new incentives and maintain existing incentives for early actions including early retrofits, engine repowers, rebuilds, and vehicle replacement. Staff believes these incentives will help ensure continued progress toward cleaner off-road vehicles even in the years before the first compliance deadline. The new and existing incentives for early action are outlined in Table 11 and summarized below.

Table 11: Early Credit and Incentive Period Deadlines for Receiving Credit by Fleet Size

Early Credit or Incentive	Large Fleets	Medium Fleets	Small Fleets
Retrofit Double Credit (Period Ends On)	January 1, 2013	January 1, 2016	January 1, 2018
Exempt from Turnover if Retrofit	Up to January 1, 2013		
Early Credit for Repowers and Rebuilds to Higher Standard (Period Ends On)	January 1, 2013	January 1, 2016	January 1, 2018
Replacement or Retirement Over 8 Percent in a Year	January 1, 2013	January 1, 2016	January 1, 2018
Reduced Horsepower Full Credit	Between March 1, 2010 and March 1, 2011		
Reduced Horsepower Half Credit	Between March 1, 2006 and March 1, 2010		

1. Double Credit for Retrofits (Proposed Extension)

Staff's proposal would extend double credit for all retrofits installed up to 12 months prior to a fleet's first compliance deadline. Fleets would receive double BACT credit for all retrofits completed prior to the following dates:

- Large fleets: January 1, 2013;
- Medium fleets: January 1, 2016; and
- Small fleets: January 1, 2018.

Fleets can utilize credits in lieu of taking future compliance actions.

2. Turnover Exemption for Retrofit Vehicles (Proposed Extension)

Under this provision, fleets that retrofit their vehicles prior to March 1, 2011, receive a permanent exemption from turnover requirements for that vehicle, for the life of the regulation, for up to 15 percent of their horsepower. Staff is proposing to extend this date until January 1, 2013.

3. Repowers and Rebuilds (Proposed Extension)

Staff also proposes to credit fleets that repower or rebuild their engines to a Tier 2 or higher emissions standard before their initial requirements. All fleets will maintain credit

for previous repowers (including those to Tier 1 or higher completed before March 1, 2009) and rebuilds to a higher emission standard. The proposal would provide several years to accumulate additional credits for early repowers and rebuilds completed prior to the following dates:

- Large fleets will receive an additional 2 years (January 1, 2013);
- Medium fleets will receive 5 years (January 1, 2016); and
- Small fleets will receive 7 years (January 1, 2018).

4. Early Turnover (Proposed)

Fleets that choose to retire or replace their vehicles may also begin accumulating credit. To ensure that credit is only granted for turnover that exceeds normal replacement of vehicles, staff propose to credit any fleet retiring or replacing vehicles at a rate over 8 percent of a fleet's total horsepower, in any year up to the fleets initial compliance year. For 2011, this period will extend from March 1, 2011, to December 31, 2011, to avoid overlapping with the credit for fleet reductions discussed below. For all other years, the annual period will extend from January 1 to December 31. This credit is available in the following years.

- Large fleets: 2011 and 2012 (i.e., for turnover prior to January 1, 2013);
- Medium fleets: 2011 through 2016 (i.e., for turnover prior to January 1, 2016);
- Small fleets: 2011 through 2018 (i.e., for turnover prior to January 1, 2018).

For example, if a medium fleet (first requirements would due between January 1, 2016 and December 31, 2016 for the compliance deadline of January 1, 2017) replaced 16 percent of their horsepower in 2012 and then replaced 18 percent of their horsepower in 2015, the fleet would accumulate 8 percent credit from 2012 and 10 percent credit from 2015. This would allow the fleet to start with 18 percent credit, or enough to comply with their first two year of requirements.

5. Reduced Horsepower from 2010 to 2011 (Proposed)

The impact of the economic recession caused many fleets to reduce their total horsepower by selling off or scrapping equipment. To recognize this impact, and provide relief from the regulation for those fleets most impacted by the recession, staff is proposing to credit all fleets if they reduced horsepower between March 1, 2010 and March 1, 2011.

6. Reduced Horsepower from 2006 to 2010 (Proposed Modification)

The regulation currently credits fleets for the total reduction in horsepower from March 1, 2006 to March 1, 2010. This credit was adopted to provide a delayed implementation for those fleets hardest hit by the recession. However, under staff's current proposal, all fleets would have delayed requirements for 4 years. Staff still believes there is value in retaining the credit, but that it is appropriate to discount the amount of credit accumulated by fleets under this credit by 50 percent.

V. PROPOSED AMENDMENTS TO THE LSI FLEET REGULATION

This chapter summarized the proposed changes to the LSI fleet regulation.

A. Existing Regulation

The original (1998) LSI rulemaking required LSI engine manufacturers to certify their new engines to a 3.0 gram per brake horsepower-hour (g/bhp-hr) combined HC+NOx standard. The emission control requirements were phased in, in increments of 25 percent per year, beginning with the 2001 model year. Thus, by the 2004 model year, 100 percent of the new engines were emission-controlled. To achieve this standard, manufacturers relied upon the same emission control technologies used in automotive engines – three way catalytic converters, electronic fuel/air controllers, and oxygen sensors. The 3.0 g/bhp-hr standard represented a 75 percent reduction in emissions versus LSI engines with no emission controls.

The subsequent (2006) rulemaking required manufacturers to certify their new LSI engines to a 2.0 g/bhp-hr HC+NOx standard effective January 1, 2007, and a 0.6 g/bhp-hr standard effective January 1, 2010. The latter standard represents a 95 percent emission reduction versus uncontrolled LSI engines.

The 2006 rulemaking also required operators of in-use fleets to achieve specific HC+NOx fleet average emission level (FAEL) standards that become more stringent with fleet size and time. The standards are also more stringent for forklifts than they are for non-forklift LSI equipment. The stringency of the standards reflects the differences in availability of retrofit devices for the four categories of in-use LSI equipment as well as the greater ability of large fleets to incorporate zero- and near zero-emission equipment into their operations.

The new engine emission standards and test procedures apply to LSI engines used in airport ground support equipment (GSE), forklifts, generator sets, mining equipment not otherwise primarily used in the construction industry, off-highway recreational vehicles, refrigeration units less than 50 horsepower, industrial (non-road) sweeper/scrubbers, industrial tow tractors (tugs), turf care equipment, and other industrial equipment. The standards affect approximately 30 engine and equipment manufacturers.

The LSI fleet regulation applies to operators of forklifts, sweepers/scrubbers, tugs, and GSE. These vehicles are found in approximately 2,000 LSI fleets in California in industries as diverse as manufacturing, wholesale, transportation and utilities, retail, services, and construction, as well as public agencies.

B. Proposed Amendments to the LSI Fleet Regulation

As with the off-road regulation, the recession and its impact on the emissions inventory provide an opportunity to reduce the compliance requirements and costs of the regulation while retaining its overall emission benefits. In considering the provisions of the regulation to modify, staff primarily considered the extent to which large operators

have already taken measures to comply with the 2011 and 2013 FAEL standards, and identified those emission reduction measures that were the least cost effective.

Staff compiled the following amendments to address the wide range of obligations towards industry, public health, and the legal requirements of the state of California to meet air quality standards. Staff also considered alternatives to this proposal, as discussed further in Chapter VIII.

Based on its assessment, staff is proposing the following major modifications to the LSI fleet regulation:

- Modify the limited hours of use provisions; and
- Broaden compliance extension flexibility.

A summary of the regulatory requirements if the proposed amendments are approved is as follows:

- The LSI fleet regulation would continue to require medium and large fleet operators to comply with the existing 2011 and 2013 FAEL standards requirements;
- Agricultural crop preparation services fleets would continue to comply with the retrofit or lesser FAEL standard requirements;
- Operators would achieve the FAEL standards requirements through either replacement with new or used zero- or near zero-emission equipment or retrofit of late model uncontrolled equipment; and
- Small fleets would continue to be exempt.

1. Major Amendments

Below is a summary of the proposed major amendments.

a) ***Modify the Limited Hours of Use Provisions***

Proposed Change: 2775.1(d)(1)(D): Staff proposes to modify the current limited hours of use (LHU) provisions to allow equipment operated no more than 200 hours per year subsequent to January 1, 2011, to be excluded from FAEL standard calculations. To ensure that the LHU provision is enforceable, the ARB intends to clarify that operators desiring to exclude equipment need to use non-resettable hour meters.

b) ***Broaden Compliance Extension Flexibility***

Proposed Change: 2775.2(e)(1)(A): Staff proposes to modify the current extension provision language to allow a two-year compliance extension with provisions for an additional two years in the event of continued non-availability of retrofit kits. Administratively, section 2775.2(e)(1)(A) provides an incomplete reference to "subsections (a), (c), and (d) without stating the section. Staff proposes to clarify that the subsections are part of section 2775.1.

2. Minor amendments

Staff is also proposing other minor modifications to the LSI fleet regulation, which are intended to clarify or simplify the provisions of the LSI fleet regulation. Below is a description of these minor amendments.

Agricultural Operations Definition – Add an Agricultural Operations definition.

Airport Ground Support Equipment Definition – clarify this definition to remove the "other" category of equipment and allow operators to include electric equipment in their FAEL standards calculations only as long as the equipment performs the work equivalent of an LSI engine-powered piece of equipment.

Baseline Inventory Definition – Clarify this definition to reflect that the baseline inventory should reflect all operated equipment subject to the FAEL standards.

Boneyard Definition - Add a "boneyard" definition and modify the FAEL definition to exclude boneyard fleets.

Fleet Average Emission Level Definition –Modify the definition to:

- exclude in-field, boneyard, experimental, and retired equipment from the FAEL standards calculations,
- allow electric equipment of less than 19 kW to be included in FAEL standards calculations as long as the equipment performs, with similar efficiency, the same function as an LSI engine-powered piece of equipment subject to the standards, and
- clarify that the default emission rate for uncontrolled LSI equipment is 12.0 g/bhp-hr HC+NOx.

In-Field Equipment Definition – Add a definition for in-field equipment.

Operator Definition – Modify this definition to allow dealers some de minimis level of use of their rental and used equipment fleet vehicles without triggering the FAEL standard requirements.

Retired Equipment Definition – Add a definition for retired equipment.

Record Keeping Requirements – Modify to remove the fuel quality record-keeping requirement, and clarify the ARB's intent that the record-keeping requirement apply to each piece of LSI equipment.

VI. ENVIRONMENTAL IMPACTS

This chapter describes how the proposed amendments continue to achieve the needed emission reductions, reduce localized risk from exposure to diesel PM, reduce impacts of diesel engine emissions on mortality and other health effects and meet SIP commitments to meet federal air quality standards.

A. Legal Requirements

The California Environmental Quality Act (CEQA) and ARB policy require an analysis to determine the potential environmental impacts of proposed regulations. The legal requirements applicable to the environmental impact analysis are the same as those presented in the original off-road TSD (ARB, 2007b). Please see Chapter IX of the off-road TSD for a description of these requirements.

The results of the environmental impact analysis for the proposed regulation amendments are discussed in the sections below. Alternatives to the proposed amendments, including a comparison of emissions benefits, are discussed in Chapter VIII.

B. Air Quality Impacts of Proposed Off-Road Regulation Amendments

Because of the recession and revisions to the emissions inventory, revised emissions estimates are significantly lower than estimated in 2007. However, despite these reduced emissions, further emission reductions are necessary to meet the federal clean air standards as well as provide important reductions in premature mortality and localized risk from diesel PM. The proposed amendments to the off-road regulation would continue to provide significant air quality benefits to meet these objectives. Staff anticipates, even with proposed amendments, that the regulation will achieve a 17 percent reduction in NOx emissions and a 21 percent reduction in PM2.5 emissions in 2023.

All emissions estimates were completed using the Off-Road Simulation Model (OSM), and the Off-Road Emissions Inventory Model, discussed further discussed further in Appendix D.

1. Methodology to Model Emissions Impacts

Staff modeled the proposed amendments using OSM to determine the actions all fleets in the state would be required to take to meet the regulatory requirements. Staff used OSM to analyze the benefits of various proposed amendments. This information was then used to estimate the emissions benefits of the amendments proposed by staff herein. Staff then compared these results with the expected benefits of the current regulation to determine the change in benefits due to staff's proposal. The difference in emissions benefits can be considered to be the change in emissions benefits due to the proposed amendments. Staff then considered the impact of the recession on emissions and compared the expected benefits of the proposed amendments against the expected benefits of the current regulation that considered emissions expected before the

recession began. Through this analysis, staff was able to determine if the amended regulation would provide the emission reductions necessary (when combined with the estimated benefits from the Truck and Bus regulation) to meet applicable SIP targets.

Provisions Modeled - The portions of the proposed amendments staff modeled using OSM were:

- the delay of implementation,
- the combined NOx and PM BACT fleet average and schedule,
- the adjustment to credits for all fleets,
- and delayed requirements for fleets that complied early, and
- the increase in turnover requirements from 2022 to 2023.

Staff did not model other provisions of the proposed amendments, as they are not expected to have a significant impact on the overall benefits of the regulation. However, staff will monitor the implementation of the minor amendments to determine if any change in the expected benefits of the regulation is occurring.

2. Emissions Benefits of the Proposed Amendments

The revised baseline off-road emissions inventory (assuming no off-road regulation) and the impact of the proposed amended regulation on emissions in years relevant to attainment of NAAQS are shown below in Table 12.

Table 12: Baseline Emissions and Regulation Impact on Statewide NOx and PM Emissions[3]

Year	NOx Emissions Baseline	With Proposed Regulation	NOx Emissions Benefits	PM Emissions Baseline	With Proposed Regulation	PM Emissions Benefits
2014	76.2	74.9	1.3	3.9	3.8	0.1
2017	76.8	71.2	5.6	3.9	3.6	0.3
2020	65.0	56.8	8.2	3.1	2.6	0.5
2023	52.3	43.6	8.8	2.4	1.9	0.5

Figure 10 and Figure 11 below show the baseline NOx and PM emissions, respectively, from off-road diesel vehicles and the impact of the regulation on emissions if the proposed amendments are adopted.

[3] Using the revised off-road emissions inventory.

Figure 10: Statewide NOx Emissions from Off-road Diesel Vehicles

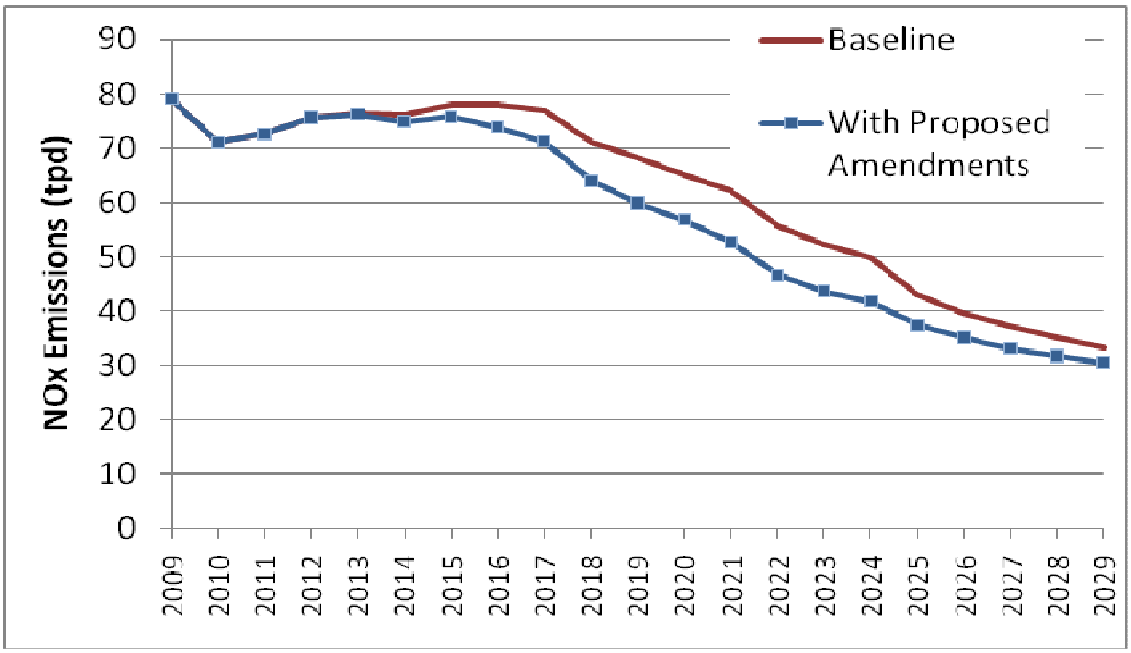
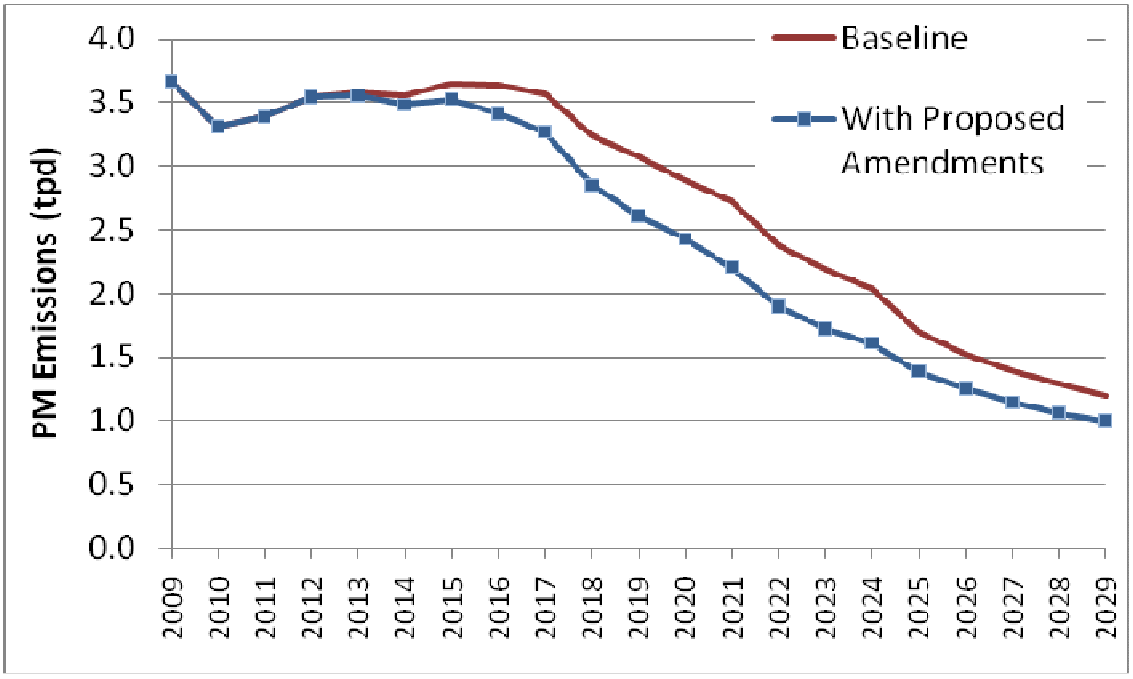


Figure 11: Statewide PM Emissions from Off-road Diesel Vehicles



3. Comparison of Emissions Benefits

The proposed amendments would delay the date for fleets to take initial action and generally require fleets to take fewer compliance actions in each year. Table 13 compares the benefits of the current regulation and the regulation as proposed to be amended.

Table 13: Benefits of the Current Regulation Compared to the Proposed Amendments (tpd)[4]

Year	NOx Benefits		PM Benefits	
	Current Regulation	With Proposed Amendments	Current Regulation	With Proposed Amendments
2014	8.7	1.3	1.3	0.1
2017	17.4	5.6	2.1	0.3
2020	18.5	8.2	2.0	0.5
2023	10.7	8.8	1.4	0.5

As can be seen, the NOx benefits of the proposed amendments would be less than if the current regulation were implemented, through 2020. By 2023, the requirement for fleets to increase turnover to Tier 4i and Tier 4 would increase the NOx benefits to approximately 80 percent of the benefits of the current regulation.

Due to the removal of the aggressive retrofit schedule, PM emission reductions from off-road diesel vehicles would be substantially less compared to implementation of the current regulation.

4. PM and NOx Emission Benefits are Preserved

The proposed regulatory amendments across both the Truck and Bus and off-road regulations are designed to provide the maximum amount of economic relief possible while still preserving as much of the originally envisioned benefits as possible. Staff's estimates suggest that statewide the combined impact of the recession with the proposed amendments to the Truck and Bus and off-road regulations will provide essentially the same cumulative remaining emissions levels between 2011 and 2023 as was expected with the existing regulations before the recession. These estimates are shown in Figure 12 and Figure 13 for PM2.5 and NOx respectively.

As can be seen in Figure 12, while the emissions that would occur in each year are not equivalent between the current regulation and the proposed amendments, cumulatively the amended regulation will result in essentially the same NOx and PM2.5 emissions levels compared to what was expected when the regulation was approved by the Board before the recession.

[4] Using the revised off-road emission inventory.

Figure 12: Year-by-Year Comparison of Truck and Bus and Off-Road PM Emissions after Regulation is Applied: Current Rule without Recession vs. Amended Rule with Recession

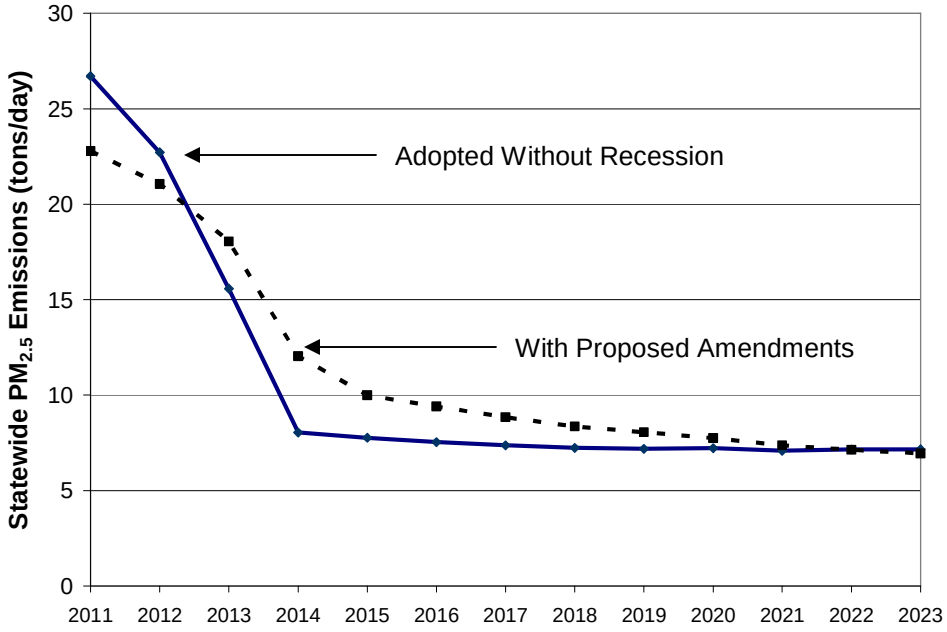
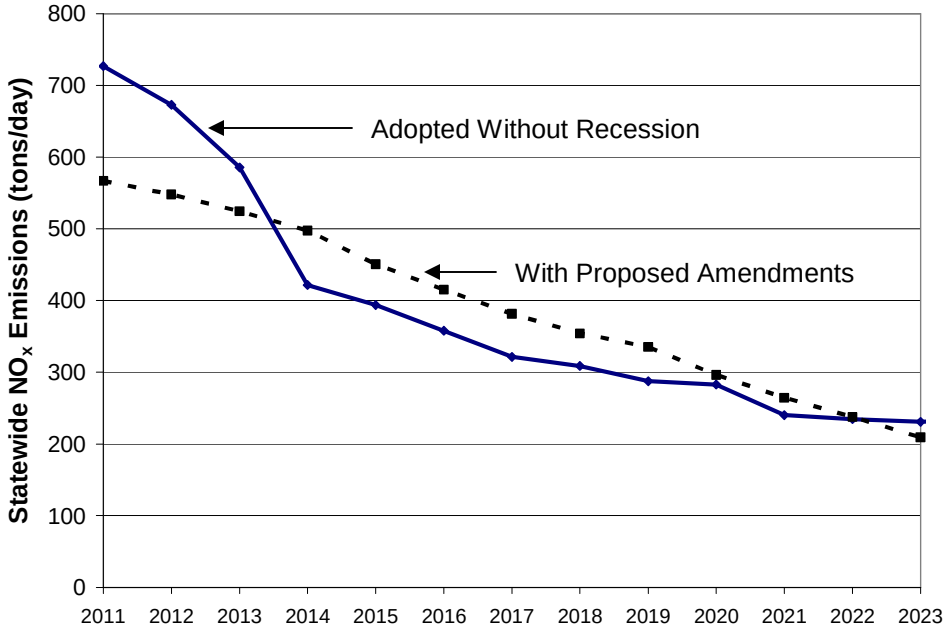


Figure 13: Year-by-Year Comparison of Truck and Bus and Off-Road NOx Emissions after Regulation is Applied: Current Rule without Recession vs. Amended Rule with Recession



5. Cost Effectiveness of the Emissions Reductions from the Off-road Amendments

The proposed amendments would improve the overall cost effectiveness of the regulation's PM reduction, but would not improve the cost effectiveness of NOx reductions, as shown below in Table 14. This is due to staff's efforts to provide the maximum economic relief (while maintaining SIP targets) and is discussed in Chapter VIII (alternatives chapter).

Table 14: Cost Effectiveness Comparison of the Regulation[5]

Emission Reductions	Proposed Amendments	Current Regulation
NOx ($/lb)	$4.31	$3.31
PM ($/lb)	$76.20	$93.80

The methodology used to calculate cost effectiveness is the same as described in the TSD for the original off-road rulemaking (ARB, 2007b).

C. Air Quality Impacts of Proposed LSI Fleet Regulation Amendments

1. Baseline HC+NOx Emissions from LSI Equipment and Current Regulatory Emissions Benefits

The ARB's OFFROAD emission inventory model was used in the development of the 1998 and 2006 LSI rulemakings. The projected annual average statewide emissions from off-road LSI engines are shown in Table 15 below. Based on the implementation of new engine standards that commenced in 2001, and the fleet requirements that commenced in 2009, HC+NOx emissions from off-road LSI equipment were expected to be about 30 tons per day in 2010 and 17 tons per day in 2020.

Table 15: Annual HC+NOx Emissions from Off-Road LSI Equipment in California (tpd)

Emissions	2004	2010	2020
HC+NOx Emissions	70.2	30.2	17.2

2. Air Quality Impact from Major Amendments

The proposed amendments are intended to provide economic relief for fleets, and would generally require fewer actions, particularly in the next year, and delay the requirement for fleets to take action on specialty equipment. As a result, the emissions benefits of the LSI fleet regulation will decrease, and statewide emissions may increase because of the proposed amendments. However, staff believes that reduced activity from LSI engines will offset this impact.

[5] Using the revised off-road emissions inventory, and the updated cost methodology (as described in Appendix F.

Most LSI equipment operators are expected to take advantage of the extended LHU provisions, but some are expected to retrofit, replace or retire the equipment anyway because of their commitment to cleaning up their fleet. However, it is uncertain how many fleets would take advantage of the broadened extension provisions for specialty equipment. Staff estimates that 20 percent and 5 percent of uncontrolled forklifts are LHU or specialty equipment, respectively. This represents about 2,400 pieces of equipment and a decreased HC+NOx emission benefit of about 1.1 ton per day.

Staff does not anticipate an appreciable impact on emissions from any of the minor amendments being proposed because they implement the original intent of the regulation. To the extent that some operators retrofit or replace pieces of equipment that could be excluded from the FAEL standards calculations because of the amendments, there may be air quality benefits.

D. Impact on SIP Target

Per the direction of the Board, staff considered the maximum economic relief that could be provided while ensuring that all applicable SIP targets were met. To do this, staff considered the impact of the recession and inventory changes on both truck and buses and off-road vehicles together in deciding how to provide appropriate economic relief. This approach allowed staff to better target emissions reductions across the two categories of vehicles while continuing to ensure that the combined emissions targets in the SIP were met.

As previously discussed, to determine how much economic relief could be provided and still meet applicable SIP remaining emissions targets, staff compared what emissions were expected to be remaining with the existing regulations and the pre-recession inventories to what emissions are expected to be under the proposed amendments and the updated inventories. The difference between these two is the emission margin. Since there are SIP targets for both NOx and PM2.5, staff expressed the margin as a weighted total of the two in NOx equivalent terms. The margin is 62 TPD of NOx equivalent emissions in the South Coast in 2014, and 40 TPD in the San Joaquin Valley.

Next, to evaluate whether the proposed amendments still met all applicable SIP targets, staff compared the remaining emissions from these vehicles, after applying the benefits of the proposed amendments and the revised emission inventories, to the 2014 SIP margins in the South Coast and San Joaquin Valley. In the San Joaquin Valley the proposed amendments reduce the margin to zero, meaning that the emission levels (after considering the amendments and the recession) will be at the same level that was expected with the existing regulation before the recession. In the South Coast, the margin will be reduced to about five tons per day NOx equivalent. Overall, this demonstrates that the proposed amendments continue to provide maximum economic relief while meeting all applicable SIP targets for trucks and buses and off-road vehicles.

E. Impact on PM Mortality

Even with the major amendments and economic relief proposed, the off-road regulation when implemented will provide significant health benefits by reducing premature mortality from PM2.5 exposure and localized risk from diesel PM. Staff estimates that 470 premature deaths (360 to 570, 95% confidence interval) would be avoided by implementation of the amended off-road regulation from 2010 to 2029. This estimate is based on U.S. EPA's new risk assessment methodology (U.S. EPA, 2010), and includes the most recent air quality data available (2006 to 2008) and the latest emissions inventory estimates.

F. Impact on Localized Risk

As discussed above, even with the proposed amendments, the off-road regulation is expected to reduce emissions signficantly. The regulation, coupled with normal turnover to newer, cleaner vehicles, will bring off-road vehicle emissions of toxic diesel PM down dramatically over time. As shown above in Figure 11, by 2020, staff expects that diesel PM emissions from off-road diesel vehicles will have dropped over 40 percent from 2010 levels, and by 2030, they will have dropped over 75 percent from 2010 levels. As off-road diesel vehicles on average become lower-emitting, staff expects a corresponding reduction in localized risk from sites where large numbers of off-road diesel vehicles are utilized, such as large construction projects.

G. Impact on Climate Change

Recent studies by scientists cited in the Intergovernmental Panel on Climate Change's (IPCC) report estimate that emissions of black carbon (BC) are the second largest contributor to global warming, after carbon dioxide emissions (Ramanathan, V. and Carmichael, G., 2008). Studies in the peer-reviewed literature also indicate that BC emissions cause warming primarily in the region where they are emitted. Therefore, it is important to understand that BC's warming impact requires close attention to the geography of emissions. A study published this year shows that the darkening of snow and ice by black carbon deposition is a major factor for the rapid disappearance of snow packs. The observed trend toward earlier melting of the snow packs in the Sierras is an important factor in water supply problems in California (Hadley, O. L. et al. 2010).

Reviewing all source categories of PM2.5 emissions, the BC content is greatest for diesel exhaust. Fifty percent of PM2.5 emissions from on-road diesel exhaust consists of BC, while 40 percent of PM2.5 emissions from off-road diesel exhaust consists of BC (Chow JC, Watson JG, Lowenthal DH, Chen LW, Motallebi N., 2010). By estimating the BC fraction of diesel PM and the global warming potential (GWP) of BC (using 500 $GWP_{100\text{-}yr}$ and 2000 $GWP_{20\text{-}yr}$)(Hansen, J.; Sato, M.; Kharecha, P.; Russell, G.; Lea, D. W.; Siddall, M., 2007), the approximate climate warming effect of the proposed off-road regulation for 2029 is about 1 and 4 million metric tons (MMT) carbon dioxide equivalents (CO_2-eq) for 100-year and 20-year time horizons, respectively. These estimates represent considerable reductions in global warming impacts from current BC emissions based on the baseline regulation. Finally, although use of a GWP may be a helpful tool to assess the importance of BC climate warming impact, the GWPs of

atmospheric short-lived compounds (e.g. non Kyoto compounds such as BC) are more uncertain and their climate forcing will strongly depend on the location and timing of the emission.

Additionally, staff is proposing to add a provision to incentivize hybrid electric off-road vehicles, which may lead to some additional green house gas (GHG) reductions. However, it is expected that overall impacts on GHG emissions from this provision will be negligible.

H. Environmental Justice and Neighborhood Impacts

The objectives of ARB's statewide regulatory programs are better air quality and reduced health risk for all residents throughout California. The Board has a policy that community health and environmental justice (EJ) concerns be addressed in all of ARB's regulatory programs

The proposed amendments to the off-road and LSI fleet regulations are consistent with the goals of the current regulations to reduce PM, NOx, and greenhouse gas emissions, as well as reduce the associated cancer risks and other health impacts over time statewide. This is consistent with the ARB's EJ policy of reducing exposure to air pollutants and reducing the adverse impacts from toxic air contaminants in all communities, including low-income and minority communities.

I. Other Environmental Impacts

Staff does not believe there will be any additional environmental impacts from the proposed amendments to both regulations.

The proposed amendments to the off-road regulation will reduce the number of exhaust retrofits installed. The diminished use of exhaust retrofits will lower the impacts on fuel economy and reduce hazardous waste generation. Hence, any negative environmental impacts due to hazardous waste generation are expected to be less than described in the TSD for the original off-road rulemaking (ARB, 2007b).

J. Conclusion

The proposed amendments would result in foregone emission reductions compared to the current regulation. However, ARB staff believes there are overriding economic and social considerations driving these proposed changes. The recession has significantly impacted the economic health of the regulated industry and, consequently, has greatly affected its ability to comply with the current regulation. Additionally, the recession has had significant social implications, causing a number of businesses to reduce their activities or go out of business, which has resulted in significant unemployment throughout the State. The recession has also caused emissions to be lower than anticipated when the regulations were initially approved. Hence, in addressing concerns with respect to the California Environmental Quality Act, staff is proposing that the Board find that overriding considerations exist.

VII. ECONOMIC IMPACTS

This chapter describes the potential economic impacts of staff's proposal.

A. Legal Requirements

Sections 11346.3 and 11346.5 of the Government Code require state agencies to assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. The assessment shall include a consideration of the impact of the proposed regulation or amendments on California jobs, business expansion, elimination, or creation, and the ability of California businesses to compete.

State agencies are also required to estimate the cost or savings to any state or local agency and school districts in accordance with instruction adopted by the Department of Finance. This estimate is to include any nondiscretionary costs or savings to local agencies and the costs or savings in federal funding to the state.

B. Off-Road Regulation Amendments

1. Cost Methodology

To estimate the economic impacts of these amendments, staff's overall methodology is similar to the one used when originally estimating the costs for the off-road regulation. The original economic impacts of the off-road regulation were based on the anticipated compliance paths of approximately 200 affected fleets. Using this data, the costs to the statewide fleet were calculated by predicting and evaluating the compliance paths for real individual fleets; these estimates were then scaled to statewide costs using the estimated horsepower in the statewide fleet (ARB, 2007a).

However, this economic analysis differs in that the impacts of the proposed amendments are based on the anticipated compliance paths of the approximately 8,800 real fleets that had been reported to DOORS as of September 20, 2010 (DOORS, 2010). This compliance plan modeling was done using OSM.[6]

For each fleet in DOORS, OSM calculated the costs the fleet would normally spend without the regulation in place. These costs are referred to as a fleet's baseline costs, and depended upon a fleet's average age and natural turnover rate. Once the baseline cost for a fleet was determined, a compliance cost was then calculated, based on a fleet's anticipated compliance path. The difference between a fleet's baseline cost, and a fleet's compliance cost is the cost attributed to the off-road regulation.

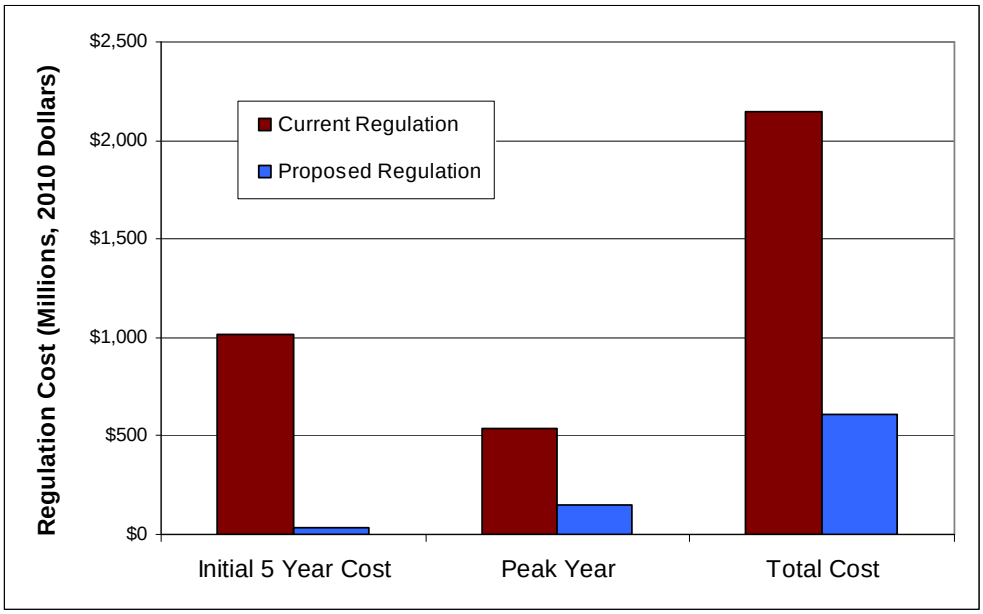
For more information on the vehicle and retrofit costs used to calculate a fleet's baseline cost and compliance costs, please see Appendix F.

[6] For more information on OSM and its compliance planning process, please refer to Appendix D.

2. Statewide Fleet Costs

The proposed amendments to the off-road regulation will provide substantial economic relief to all affected fleets, especially in the short term. As illustrated in Figure 14 below, estimated costs of the off-road regulation over the next five years would be reduced by about 97 percent, from over $1 billion[7] to approximately $33 million (2010 dollars). Total costs over the life of the off-road regulation would be reduced by 72 percent, which represents a cost savings of over $1.5 billion (2010 dollars). Peak year costs would be reduced by almost 73 percent (from $542 million to $146 million, 2010 dollars) and the peak year cost delayed from 2013 to 2019.

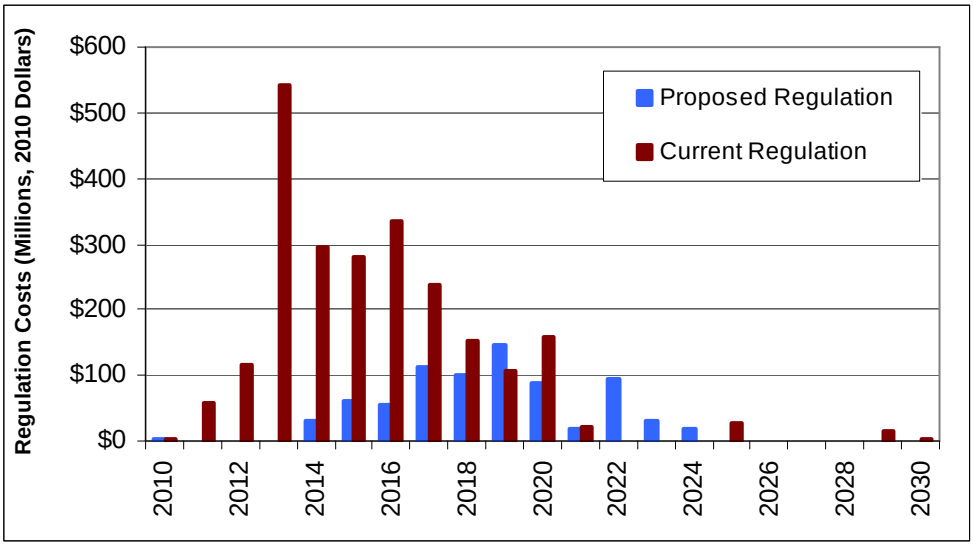
Figure 14: Cost of Proposed Off-Road Regulation Down Substantially



As shown in Figure 15 below, the costs of the proposed amended regulation would no longer be as front loaded as the current off-road regulation and are significantly less than the statewide year-by-year costs of the regulation. In the beginning years, the compliance costs for a fleet would be on average 97 percent less than originally estimated.

[7] The current regulation costs presented in this analysis have been updated and therefore differ from the costs presented in the original staff report for the off-road regulation. Please see Appendix F for additional information.

Figure 15: Current vs. Proposed Off-road Regulation Yearly[8] Compliance Costs



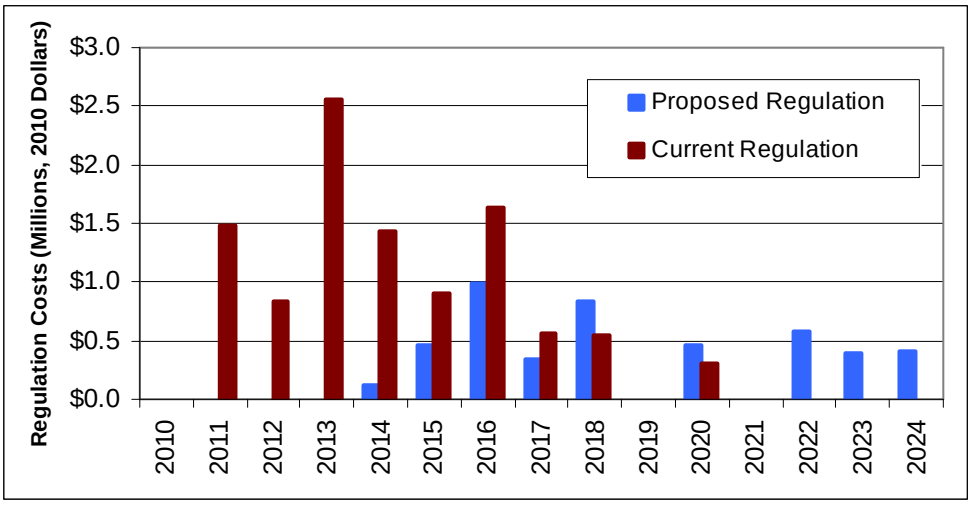
For a discussion on cost effectiveness, please see Chapter VI.

3. Cost Analysis for an Actual Fleet

To further analyze the savings expected from the proposed amendments, staff evaluated a real fleet of 30,000 horsepower (490 vehicles) reported to DOORS. Under the current regulation, this large fleet's compliance costs[9] would have totaled $7.9 million (2010 dollars) over the life of the regulation. However, it is now expected that the total compliance cost for this fleet would be reduced by over 84 percent, which represents a compliance cost savings of over $6.7 million (2010 dollars). Figure 16 below compares the sample fleet's yearly costs for the current regulation and the proposed amended regulation.

[8] Costs are shown for the compliance year the actions were taken to meet (i.e. if a fleet took actions to meet the Jan. 1, 2019 requirements, the costs are shown for 2019).
[9] Costs above normal operating costs.

Figure 16: Sample Fleet Costs for Current vs. Proposed Regulation



For this fleet, the proposed regulation would reduce peak year costs by 61 percent, reduce the compliance costs over the next five years by 98 percent, and reduce overall costs by 84 percent.

4. Impacts of the Major Amendments

Below is a description of the potential cost impacts of each of the proposed major amendments to the off-road regulation.

a) *Delay of implementation*

Delaying the initial implementation date by four years would provide fleets with more time to plan for compliance and allow them to benefit from more normal turnover to cleaner vehicles before the initial fleet average targets take effect. Also, this extra time to begin implementing the off-road regulation will give fleets more opportunity to recover from the current economic downturn before having to begin to incur compliance costs. This should result in an overall cost savings for affected fleets.

b) *Combine PM and NOx requirements and reduce BACT requirements*

The largest cost savings for fleets would be from combining the PM and NOx requirements, which would reduce BACT compliance requirements. In certain cases, fleets would have their compliance requirements reduced by more than 50 percent, resulting in large cost savings for affected fleets.

Additionally, for large fleets the 2013 increase in fleet requirements (also referred to as the “balloon payment”) was removed altogether, and not simply pushed back to a later compliance year. The removal of the increased 2013 requirements would result in a substantial cost savings for large fleets.

c) *Extend double retrofit credit*

The proposed amendment to extend double credit for all fleets that install highest level VDECS on their vehicles may also result in cost savings to fleets. The proposed amendment would give all fleets additional time to receive double credit for the installation of retrofits, thereby allowing such fleets to spread out their costs in later years. This should result in a cost savings to fleets that opt to take advantage of this credit.

d) *Increase low use threshold*

Staff's proposal to increase the low-use threshold from 100 hours per year to 200 hours per year would provide cost savings to fleets that have vehicles near this threshold. This would allow fleets to categorize additional vehicles as low use, and therefore avoid retrofitting or turning over those vehicles, reducing overall compliance costs for the fleet.

e) *Simpler compliance path for fleets under 500 horsepower*

This proposed amendment would provide a simpler compliance option for those smallest fleets in the state and may result cost savings for some of these fleets. For example, if an owner operator only has one Tier 2 vehicle in his fleet, under the current regulation, he would be required to install a VDECS on that vehicle at some point before 2025. However, if this same fleet owner chose to comply with this new simpler path, he would have no performance requirements (i.e., no turnover or retrofit requirements) at all, since this new path would only require the fleet's vehicles to have Tier 2 or higher engines.

f) *Increased turnover requirements*

Of all the major amendments, the increase in turnover requirements for 2022 and later is the only one that would not result in a cost savings. Because staff is proposing to increase the stringency of the fleet average targets in the later years of the regulation, fleets will need to incorporate slightly more Tier 4i and Tier 4 vehicles than were originally required. However, as shown earlier, when considering all of staff's proposed amendments together, fleets will experience a significant overall cost savings when compared to the current off-road regulation.

5. Impacts of the Minor Amendments

As described further below, staff expects the proposed captive attainment area fleet definition and alternative fuel provision changes to provide a cost savings for affected fleets, while the proposed changes to the adding vehicle and labeling requirements would result in a small additional cost for some fleets. All of the other proposed minor amendments are not expected to result in any additional costs or cost savings, and therefore are not mentioned below. However, as shown earlier, when considering all of staff's proposed amendments together, fleets would overall experience significant cost savings when compared to the existing off-road regulation.

a) *Captive attainment area fleet definition*

Currently in the off-road regulation, captive attainment area fleets are exempt from the NOx requirements of the regulation. However, they must still comply with the PM requirements per a timeline dictated by their fleet size. For example, under the current regulation, if a large fleet is a captive attainment area fleet, the fleet was not required to comply with the NOx turnover requirements. However, it would have been required to meet the PM requirements beginning in 2010, the first compliance date for large fleets. Under staff's proposal to reclassify all captive attainment area fleets as small fleets, medium and large captive attainment area fleets would be able to delay initial compliance requirements until the first small fleet compliance deadline in 2019, which will result in a cost savings for such fleets.

b) *Electric vehicle provisions*

Staff is proposing to remove electric vehicle horsepower from the total horsepower calculation, which will also result in removing this horsepower from all BACT calculations. For fleets with many electric vehicles (such as airport GSE fleets), this reduction in horsepower would potentially allow fleets to be reclassified to a smaller fleet size category. Additionally, if the BACT requirements are reduced (based on the decrease of the fleet's total horsepower), the cost of compliance for the fleet would further be reduced. Therefore, this amendment will result in some cost savings for fleets with electric vehicles.

c) *Labeling*

Staff is proposing a change to the labeling provision that would require a fleet to label both sides, rather than just the right hand side, of each vehicle with an EIN. Based on the 150,000 vehicles currently registered in DOORS, and assuming a cost of $10 per EIN label (Aaron, 2010; Glen, 2010; Snyder, 2010), this would equate to an additional $1.5 million (2010 dollars) in statewide costs.

Additionally, staff is proposing to require captive attainment area fleets to label their vehicles with EINs that are green with white letters, instead of red with white letters. There are currently approximately 5,000 vehicles registered as captive attainment area vehicles in DOORS; therefore, these fleets would incur an additional total cost of approximately $50,000 (2010 dollars) statewide if they choose to retain their captive attainment area status.

C. LSI Fleet Regulation Amendments

1. Methodology

Staff took information reported to them through the DOORS inventory reporting program and input it into the Off Road Model to estimate the economic impacts of the proposed changes to the off-road regulation. LSI staff had to use a different methodology to estimate the economic impacts of the LSI fleet regulation amendments for two reasons. First, only uncontrolled LHU and specialty equipment for which retrofit kits are not available are affected; the remainder of the LSI fleet must comply with the FAEL

standards and generally, already does. Second, the LSI fleet regulation does not require reporting so there is no readily available data on the operating hours of affected vehicles.

Staff estimates that there are approximately 46,000 pieces of LSI equipment subject to the LSI fleet requirements (ARB, 2006c). Based on routine turnover assumptions from the 2006 regulation, approximately 12,000 pieces would have to be retrofitted or replaced to achieve the FAEL standards. Twenty percent of these or about 2,400 pieces of LSI equipment are in small fleets and are exempt from the FAEL standards.

Of the remaining 9,600 units, manufacturer sales data indicates that approximately 5 percent of the units are specialty equipment. The broadening of the extension request provisions would be made available primarily to fleet operators with specialty equipment for which retrofit kits are not available. The two largest categories of equipment that fall into the specialty equipment category are pieces of equipment with an Underwriters Laboratories safety designation and equipment with engine displacements exceeding six liters. If retrofit kits were available for these units, they would cost around $3,500. To the extent that retrofit kits are not available, replacement cost for this equipment starts at about $50,000 per unit and can be significantly more.

Based on off-road regulation limited usage data reported through DOORS, staff estimates that an additional 20 percent of the 9,600 units are LHU. The extension of the LHU provisions would be available to any of the approximately 2,000 LSI fleets in California if they have LHU equipment. As LHU equipment may comply through either retrofit or replacement, and as LHU equipment typically is not specialty equipment, the compliance cost ranges from $3,500 for a retrofit kit to $30,000 for replacement.

2. Statewide Fleet Costs

The proposed amendments are expected to provide substantial near-term economic relief to most affected fleets. Overall, staff estimated that the proposed amendments will result in a cost savings of between $8.4 to $59.5 million (2010 dollars) over the life of the regulation.

For a more detailed breakdown of the proposed major and minor amendments, and a description of the cost methodology, please see the sections below.

3. Cost Analysis for an Actual Fleet

To further analyze the savings expected from the proposed amendments, staff looked at a real fleet of industrial sweeper/scrubbers. This fleet, depending upon whether it would retrofit or replace its LHU equipment to comply with the FAEL standards, would have incurred costs of $700,000 to $4.3 million (2010 dollars) over the next year to be in compliance with the regulation (LAUSD, 2010). The proposed amendments reduce the expected cost to this fleet by $500,000 to $3.1 million (2010 dollars).

In another example, a fleet has six high capacity Underwriters Laboratories (UL) safety certified forklifts for which retrofit kits are not available. Thus, the operator would have to replace these pieces of equipment to achieve compliance with the FAEL standards. The total cost to replace the six specialty forklifts would be about $1.0 – 1.5 million. The proposed amendments either reduce that cost by more than 90 percent if UL certified retrofit kits become available during the next four years, or give the fleet operator that additional time to plan for repower or replacement.

4. Impacts of the Major Amendments

Below is a description of the potential cost impacts of each of the proposed major amendments to the LSI fleet regulation.

a) *Extend limited hours of use provisions*

Staff's proposal to increase the LHU threshold from 0 hours per year to 200 hours per year beginning January 1, 2011, will provide some cost savings to fleets that have vehicles at or below this threshold. These fleets would be allowed to exclude LHU equipment from their FAEL standards calculations, thereby avoiding the costs of retrofitting or replacing those vehicles. As described above, this represents an average savings of about $16,750 (with a range of $3,500 to $30,000) per piece of equipment.

b) *Allow additional compliance extensions for specialty equipment*

Staff's proposal to allow additional compliance time for specialty equipment may provide significant cost savings to fleets that are able to retrofit in future years as lower emitting retrofit kits become available. Cost savings in this case are the difference between the typical retrofit cost of $3,500 and a replacement cost that can exceed $100,000. To the extent that some pieces of equipment are not retrofittable in the future, the amendments provide four additional years for compliance planning.

5. Impacts of the Minor Amendments

None of the proposed minor amendments are expected to result in any additional costs or savings, because they implement the original intent of the regulation.

D. Impacts on California Economy

The proposed amendments to both the off-road and LSI fleet regulations will not impose additional impacts on the economy, nor are they expected to adversely impact employment. The amendments are intended to provide economic relief from regulatory requirements over the next several years, and to reduce costs for all affected fleets. Staff believes this would lead to fewer fleets reducing employment as a result of either regulation, thereby benefiting overall California employment.

Although these proposed amendments are not expected to adversely impact the economy overall, these modifications could have a negative economic impact on retrofit manufacturers and installers and firms that provide repowers or equipment. Staff

anticipates that these businesses could receive fewer orders in the next few years. However, the proposed amendments to the off-road regulation provide extended and enhanced incentives that are intended to encourage early retrofitting, repowering, and replacement. Staff believes that these actions could help mitigate potential impacts on retrofit and repower jobs and businesses.

E. Potential Impacts on Small Businesses

The proposed amendments to the off-road regulation should provide an overall cost savings to small businesses by allowing fleets to delay the start of compliance and significantly lowering their compliance costs over the life of the off-road regulation. Also, the addition of the ultra small fleet provision, which requires only a phase out of a fleet's Tier 0 and 1 vehicles, would provide some very small fleets additional cost savings.

While staff believes most small businesses are small or medium fleets (under the off-road regulation), a few small businesses do meet the off-road regulation's definition of large fleet. However, because staff is proposing to delay and reduce the off-road regulation's requirements for all fleet sizes, small businesses should benefit significantly from the proposed changes, regardless of their fleet size designation.

The LSI fleet regulation does not affect small businesses, and therefore, the proposed amendments to the LSI fleet regulation are not expected to affect small businesses.

These proposed amendments could have negative impacts on retrofit manufacturers and installers and firms that provide repowers or equipment; many of these firms are small businesses. However, as stated above, staff believes that the extension and enhancement of early action incentives will help mitigate potential impacts on retrofit and repower businesses.

F. Potential Impacts on Public Agencies

The proposed amendments for both regulations would not impose any additional costs on public agencies. Because the amendments to both regulations are designed to provide economic relief from regulatory requirements, especially in the next few years, it is expected that public fleets will realize overall lower compliance costs.

VIII. ALTERNATIVES CONSIDERED

This chapter discusses the alternatives to the proposed amendments to both regulations that staff considered and why they were rejected in favor of the proposals.

A. Major Off-Road Regulation Amendments

Given the depth of the recession in the construction industry, staff considered a wide variety of options for amendment proposals. These alternatives ranged from a repeal of the regulation to proposing minimal changes. Staff also considered options such as rewriting the regulation without basing the requirements on the current regulatory language – starting 'from scratch', in effect, as well as other changes that are lesser variations of staff's proposal.

1. Repeal the Regulation

During the initial development of the off-road regulation, reducing emissions from off-road vehicles towards meeting the 2014 SIP, particularly for the South Coast Air Basin, was a driving factor for the structure of the regulation in the initial years. As the recession and inventory analysis demonstrated that meeting the 2014 SIP commitment no longer required the same level of retrofitting and early turnover currently required in the off-road regulation, industry stakeholders questioned whether the off-road regulation could be repealed, or alternatively, could be delayed for five or more years and reconsidered in the future.

While this alternative would provide the most economic relief to the construction industry and other industries using off-road diesel vehicles, staff rejected this alternative for many reasons, including:

- Based on the most current inventory information, reducing emissions from off-road vehicles is still needed to achieve PM2.5 SIP goals in the South Coast and San Joaquin Valley Air Basins in 2014, and will also be necessary to reduce ozone in both these regions in 2023. While the aggressive retrofit schedule and requirements for significant vehicle turnover from 2010 to 2014 are not as great as once needed, the 2014 SIP goals still require a (smaller) reduction in emissions from off-road vehicles by 2014.
- Repealing or delaying the regulation indefinitely would not achieve incremental progress towards cleaner air.
- Continued exposure to PM2.5 has been continually shown to have negative health impacts, and remains a mortality risk for those with long-term exposure.
- Reducing emissions from off-road vehicles is still cost effective.

Given these factors, pursuing emissions reductions from off-road vehicles, while considering the severe impact of the recession on construction and related industries, remains an important part of meeting state goals and protecting public health.

2. Make Minimal Changes

For this alternative staff considered minimal modifications to the off-road regulation that would still allow ARB to effectively enforce the regulation with consideration of the current enforcement delay. As previously discussed, ARB delayed enforcement of the regulation's first compliance date for large fleets (March 1, 2010) in part because ARB had not received authorization from U.S. EPA to fully enforce the regulation. Under this alternative, the proposed regulatory amendments would provide for some delay in the provisions of the off-road regulation and for a new compliance schedule for large fleets. This alternative included:

- Two year delay for large fleets only.
- Removing the heightened "balloon" requirements in 2013.

No other significant changes to the off-road regulation would have been proposed.

Staff rejected this alternative for the following reasons:

- The depth of the recession in the construction industry in particular demonstrates a need for greater consideration and economic relief than the minimal changes possible would provide, and would reduce emissions beyond what's needed to meet SIP commitments.
- This alternative would not improve the regulation's cost efficiency or respond to stakeholders suggestions to provide fleets with more compliance flexibility.
- This alternative would not simplify the regulation.
- Not as many off-road vehicles are candidates for successful retrofits as originally believed.

Given these factors, staff is proposing more than just the minimal changes to the regulation.

3. Make No Changes

For this alternative, staff considered making no changes to the regulation. Staff rejected this alternative for the following reasons:

- As stated above, ARB has delayed enforcement of the off-road regulation in part because of the lack of authorization from U.S. EPA to fully enforce the regulation.
- The depth of the recession, particularly as it has affected the construction industry, has reduced emissions beyond what's needed to meet state SIP commitments in the near-term and would not provide adequate economic relief to affected industries.
- This alternative would not improve the regulation's cost efficiency or respond to stakeholders suggestions to provide greater flexibility for fleets.
- This alternative would not simplify the complexity of the regulation.
- Not as many off-road vehicles are candidates for successful retrofits as originally believed.

4. Restructuring the Regulation ('from scratch')

Under this alternative, staff considered removing the current regulatory structure altogether and using the experience gained since the regulation took effect in 2008 to improve the regulation's structure and framework, aiming to improve simplicity and flexibility. Concepts considered included removing the current requirements and implementing a regulatory structure based primarily on vehicle age, or implementing a fee based on the age of vehicles, or different requirements that varied by region. Staff ultimately rejected this alternative for the following reasons:

- Any proposal staff considered would still have to account for the wide variety of vehicles and industries being regulated (as the current regulation does) and would require most or all of the same exemptions and provisions. For this reason, staff did not believe it was possible to further simplify the regulation beyond staff's final proposal.
- Regional requirements would cause confusion and result in inability of fleets to comply with the regulation, and would also be difficult to enforce because of the vehicle's ability to easily move throughout the state. Additionally, because diesel PM is a toxic air contaminant, staff did not believe it was appropriate to have a regulation limited to certain areas of the state.

5. Other Regulatory Alternatives Considered

Staff used the simulation model OSM, to evaluate other alternatives that would provide adequate economic relief to fleets given the recession. OSM allowed staff to review the impact of various proposals and different iterations of each proposal. Using this approach the following alternatives were considered.

Alternative A: The proposal staff presented at the June and July 2010 workshops (ARB, 2010d), in which staff proposed to:

- Delay the regulation two years for all fleet sizes.
- Remove the inflated 2013 requirements.
- Count turnover toward a fleet's PM BACT (or retrofit) requirements.
- Increase low use threshold.

This would have effectively lowered a fleet's retrofit requirements to 10 to 12 percent per year, down from 20 percent. This proposal would still have required a substantial number of retrofits to be installed.

- Actions would be required on up 20 percent of a fleet's horsepower annually, beginning 2012.

Alternative B: Staff also considered amending the regulation as follows:

- Delay the regulation two years for all fleet sizes.
- Remove the inflated 2013 requirements.
- Count turnover toward a fleet's PM BACT (or retrofit) requirements;
- Increase low use threshold.
- Lower PM BACT to 12 percent a year (a 40 percent reduction).
- Provide a new credit for fleets reducing horsepower from 2010 to 2011.

- Tighten the NOx requirements from 2017 to 2023 to achieve additional NOx benefits

This alternative would have effectively lowered the retrofit requirements for most fleets between two to four percent each year the fleet was required to do turnover.

- Actions would be required on, at maximum, 12 percent of a fleet's horsepower annually, beginning 2012.

Alternative C: This alternative would have reduced required retrofitting as follows:

- Delay the regulation two years for all fleet sizes.
- Remove NOx and PM requirements into a single fleet average and single BACT requirement.
- Lower combined BACT from 28 to 30 percent per year to 8 to 10 percent.

This proposal would have provided more flexibility to fleets while lowering the number of vehicles addressed in any one year to about a third of previous levels.

- Actions would be required on up to 10 percent of a fleet's horsepower annually, beginning 2012, with no separate PM requirements.

Comparison to proposed amendments: The principle difference between the final proposed amendments and Alternatives A and B was the removal of the separate PM fleet average and BACT requirements for all fleets. The major difference between the proposal and Alternative C was the four year delay for all fleets, instead of the two year delay proposed previously. Table 16 below shows the cost, cost effectiveness, and emission reductions achieved from the alternatives.

Table 16: Emissions and Costs of Various Off-road Major Amendment Alternatives Considered

Scenario	Cost	Peak Year Cost/ Peak Year[10]	Initial 5 Year Cost	NOx Benefit (tons)	PM Benefit (tons)	$/lb NOx	$/lb PM
Current Reg.	$2.15B	$542M **2013**	$1.02B	68,740	9,020	$3.31	$93.80
Alternative A	$1.77B	$316M **2016**	$450M	49,430	7,050	$5.52	$87.10
Alternative B	$1.19B	$237M **2016**	$291M	53,010	6,250	$3.02	$69.70
Alternative C	$1.21B	$241M **2017**	$255M	74,080	5,830	$3.03	$65.10
Proposal	$607M	$146M **2019**	$33M	33,870	2,070	$4.31	$76.20

[10] The peak year shown means the year of compliance date for which costs were incurred (i.e., if fleets would have maximum cost between January 1 and December 31, 2018, to meet the January 1, 2019, requirements, the peak year is shown as 2019)

As shown in the table, Alternatives A, B and C significantly reduced overall costs, peak costs, and initial five-year costs to fleets. Alternative A reduced costs primarily by delaying the start of compliance, and reducing the 2013 'balloon payment'. Alternative B further decreased costs by reducing the annual retrofit requirements by up to 90 percent for fleets that turnover vehicles in that year, and Alternative C reduced costs by completely removing mandatory retrofitting and limiting fleet turnover to no more than 10 percent of their horsepower in any one year.

Ultimately, staff selected the proposed amendments over the alternatives considered because it:

- Had the lowest overall cost from 2010 to 2030 while still allowing the state to meet its 2014 SIP commitments, and providing additional reductions towards meeting the 2023 SIP ozone targets in the South Coast air basin.
- Had the lowest cost in the initial five years (from March 1, 2009, to March 1, 2014), while achieving incremental progress beginning in 2014.
- Had the lowest peak year cost.

In addition, the proposed amendments improved the regulatory structure over the alternatives due to a number of additional factors:

- The proposed amendments would greatly simplify the regulation as fleets would no longer be required to learn and analyze separate NOx and PM structures.
- Fleets never have to retrofit, but retain the option to do so where it would be more effective than turnover.
- Because the proposed amendments no longer contain separate NOx and PM targets, all fleets would have the choice of complying via turnover, retrofitting, or a combination of the two. This means that while fleets can choose to avoid retrofitting if they so desire, it remains a compliance option which ensures a continued market for retrofits to all fleets subject to the regulation.

6. Other Off-Road Amendment Provisions

The following section discusses the proposed changes to the delays for medium and small fleets, and credit or double credit for retrofits, and alternatives to those changes that were considered and rejected in favor of the final proposal.

a) *Lesser Delay for Medium and Small Fleets*

Staff had considered a proposal that would provide a lesser delay for medium and small fleets, which was rejected for the following reasons:

- Providing a four-year delay for medium and small fleets would allow additional time for smaller businesses or agencies to recover from the recession.
- Large and medium fleets' compliance dates were offset to provide additional time for medium fleets to plan compliance, but also to prevent multiple fleet categories from having to meet their first compliance deadline on the same date. To prevent the initial deadline for medium fleets coinciding with the large fleet deadline, staff proposed a four year delay for medium fleets, from 2013 to 2017. For similar

reasons, it will benefit small fleets to also delay the initial small fleet requirements from 2015 to 2019.

b) *Provide No Credit for Retrofits*

Staff had also considered a proposal that would maintain the NOx requirements of the regulation (section 2449.1) without providing credit toward either BACT or the fleet averages for PM retrofits, effectively removing PM VDECS as a means of complying with the regulation entirely. Staff rejected this proposal for the following reasons:

- Where PM VDECS can be applied safely and effectively, they remain a cost effective method of reducing the health risk from diesel engines and extending the life of a vehicle under the regulation. Particularly for relatively high horsepower applications (for example, high horsepower loaders), retrofitting with the highest level PM VDECS may cost approximately $50,000, while a vehicle replacement with a new model could cost upward of $1,000,000 in some cases. For such applications, retrofitting to extend the vehicle life under the regulation can be an economical and efficient solution.
- Numerous fleets, manufacturers, and installation facilities have invested in PM VDECS in anticipation of the current regulation and failing to credit or incentivize PM VDECS would negatively impact the retrofit industry and fleets that have installed VDECS.
- Fleets would never be required to install retrofits, hence VDECS would remain an option only when they are (compared to turnover) cost effective, consistent with the fleet's use and maintenance of vehicles, and preferred by the fleet to vehicle turnover.

c) *Not Extending Double Credit for Retrofits*

As another alternative, staff considered leaving the double credits periods unchanged (expired on January 1, 2010 for large fleets, and March 1, 2012 for medium and small fleets). Staff rejected this alternative for the following reasons:

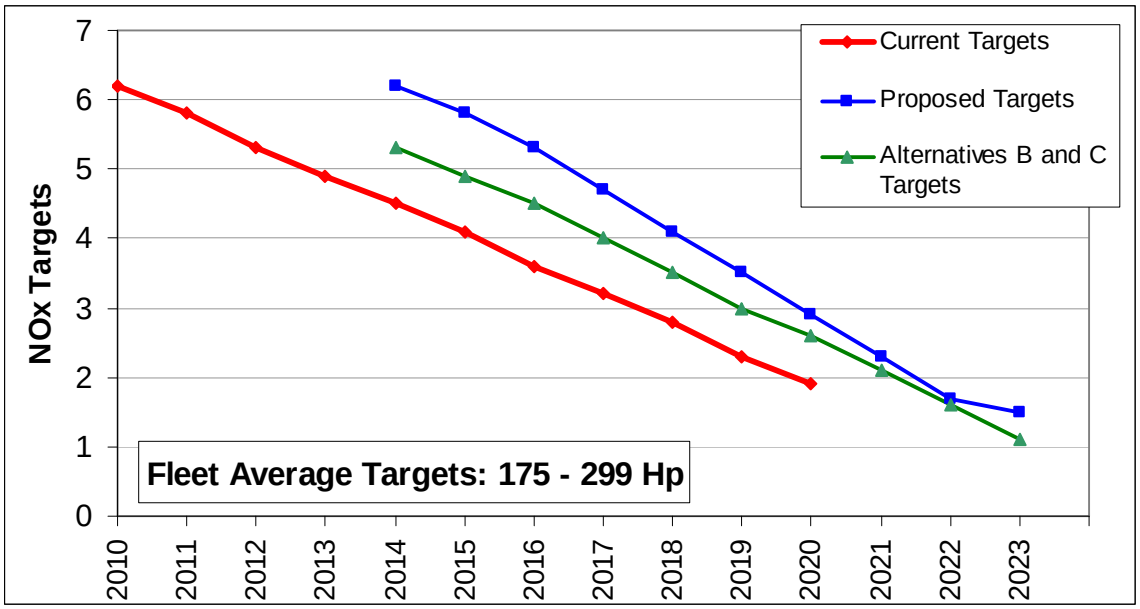
- Without double credit periods, fleets would have no incentive to invest early in retrofit technology or make incremental progress towards clean air.
- Without an extension of double credit, the fleets that invest in retrofits in the next two to three years would receive no reward or benefit over those that wait until the deadline.
- It is consistent with ARB's previous approach with initial deadlines to include double credit periods up to 12 months prior to the requirements, and in principle is the same as the approach fleets across the state were trained on and have become familiar with.

d) *Off-Road Regulation Fleet Average Target Stringency*

Staff considered alternatives that would have provided more NOx and PM benefits by 2023 through more stringent fleet average targets. Figure 17 shows the fleet average targets for the current regulation, those proposed by staff, and those considered as an

alternative to the proposed amendments (Alternatives B and C above included more stringent 2023 fleet average targets).

Figure 17: Comparison of Fleet Average Targets



As can be seen in Figure 17 staff evaluated lower final fleet average targets which are more aligned with attaining a fleet average that represents Final Tier 4, as opposed to staff's proposal which attains an Interim Tier 4 Level. Note that while only the fleet average targets for engines between 175 and 299 horsepower are shown, and that other horsepower groups would have targets that vary, this figure is representative of the trend for the various horsepower groups. As expected, staff found that more stringent final fleet averages achieved greater benefits, as expected and shown in Table 16. However, more stringent final fleet average targets resulted in higher overall regulatory costs, and did not provide the same level of cost savings to fleets as staff's proposed amendments. Because of this, staff ultimately rejected this proposal.

B. LSI Fleet Regulation Amendments

Staff considered several alternatives to the proposed amendments for the LSI fleet regulation. These alternatives included extending the compliance deadline for all LSI fleet operators, a lower limited hours of use provision, broadening the compliance extension provisions, and no change to the current regulation. These alternatives are detailed below.

1. Extend the Compliance Deadline for All Operators

Under this alternative, all LSI fleet operators would receive a two-year extension to their compliance dates. However, there were two concerns with this. First, the LSI fleet regulation has three progressively more stringent FAEL standards, with effective dates set two years apart. As of January 1, 2011, two of the three dates will have already

passed. As a result, operators have already had more than four years since adoption of the LSI fleet regulation to come into compliance with the standards. Many operators chose to procure equipment that brought their fleets not only into compliance with the near-term FAEL standard effective dates, but also the most stringent January 1, 2013 FAEL standard effective date. These operators are fully in compliance with the FAEL standards for the duration of the regulation. This brings about the second concern – that the compliance date extension would create an uneven playing field between those fleets that had not yet complied with the FAEL standards and others that already had.

Given the extent to which the LSI regulation has already been implemented, and the desire to avoid providing incentives to operators that were not yet in compliance with the LSI fleet regulation when their competitors have already made the economic commitment to comply, staff rejected this alternative.

2. Set the Limited Hours of Use Provision at 100 hours

The proposed 200-hr limited hours of use amendment would provide significant early and continued economic relief to LSI equipment operators in recognition of the recession while still achieving most of the emissions reductions necessary to protect public health.

As an alternative, staff considered proposing a 100-hour LHU provision. This is the threshold used by some ARB regulations for fully excluding equipment. This level would also result in a smaller impact on emissions benefits. However, the LSI fleet regulation and the off-road regulation have many operators in common and the off-road regulation, in consideration of the global recession and its impact on fleet operators, is proposing to establish a 200-hour LHU threshold. Staff believes consistency between the two regulations is important and improves the regulation's cost efficiency. Therefore, staff rejected the 100-hr LHU alternative and is recommending the 200-hour LHU threshold.

3. Allow Multiple One-Year Compliance Extension Periods

The LSI fleet regulation currently allows fleet operators to request to exclude equipment from the FAEL standards calculations for a period of one year if retrofit kits are not available. Staff considered proposing multiple one-year extensions in the event that retrofit kits continued to be unavailable. However, over the course of four years this proposal would double the administrative burden on both operators and ARB staff. Additionally, the one-year extension period does not accurately reflect the retrofit kit product development cycle, the longest component of which is accumulation of hours on a retrofitted device for verification purposes. Therefore, staff rejected this alternative and is proposing that operators be allowed to apply for a two-year extension, followed, in the event that a retrofit kit is still not available, by a subsequent two-year extension.

4. Make No Change

For this alternative, staff considered making no changes to the LSI fleet regulation. Staff rejected this alternative for the following reasons:

- Retrofit kits have not been available to the extent envisioned during the development of the 2006 LSI fleet regulation. For example, kit manufacturers are capable of producing kits with a UL component certification, but the market for these kits was not large enough to make development economically feasible. LSI equipment operators therefore would be required in some cases to spend as much as 10 to 50 times more than the cost of a retrofit kit to replace their equipment.
- Many pieces of low use equipment are operated too infrequently to make emission reductions cost effective, even when using retrofit kits.
- The severe recession currently hitting the industries subject to the LSI fleet regulation make compliance difficult, and some form of economic relief is needed. Staff believes taking no action would be detrimental to an already hard hit sector of the state's economy.

IX. REFERENCES

Aaron 2010. Aaron's Signs, October 21, 2010.
http://www.eindecals.com/

AB 8 2X, 2009. Assembly Bill 8 2X, Chapter 6. An act to amend Section 11011 of the Government Code, to add Section 43018.2 to the Health and Safety Code, which directs ARB to amend Sections 2449.1 and 2449.2 of Title 13 of the California Code of Regulations. Approved by the Governor on February 20, 2009.

ARB, 2000. California Air Resources Board. *Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles.* California Air Resources Board, October 2000. http://www.arb.ca.gov/diesel/documents/rrpFinal.pdf

ARB, 2003a. California Air Resources Board. *Proposed 2003 State and Federal Strategy for California State Implementation Plan, Section II Mobile Sources, Introduction and Chapter D.* California Air Resources Board, August 25, 2003.
http://www.arb.ca.gov/planning/sip/stfed03/stfed03.htm

ARB, 2005. The 2005 California Air Resources Board Off-Road Diesel Equipment Survey.

ARB, 2006a. California Air Resources Board. *Staff Report: New Emission Standards, Fleet Requirements, and Test Procedures for Forklifts and Other Industrial Equipment.* California Air Resources Board, March 2006.
http://www.arb.ca.gov/regact/lore2006/isor.pdf

ARB, 2006b. The 2006 California Air Resources Board Off-Road Diesel Equipment Mini-Survey.

ARB, 2006c, Form 399 Attachment, California Air Resources Board, March 25, 2006.

ARB, 2007a. California Air Resources Board. *Staff Report: Initial Statement of Reasons for Proposed Rulemaking; Regulation for In-Use Off-Road Diesel Vehicles*. California Air Resources Board, April 2007. http://www.arb.ca.gov/regact/2007/ordiesl07/isor.pdf

ARB, 2007b. California Air Resources Board. *Technical Support Document: Regulation for In-Use Off-Road Diesel Vehicles*. California Air Resources Board, April 2007.
http://www.arb.ca.gov/regact/2007/ordiesl07/TSD.pdf

ARB, 2007c. California Air Resources Board. *Air Resource's Board Proposed State Strategy for California's 2007 State Implementation Plan: Revised Draft*. California Air Resources Board, April 26, 2007.
http://arb.ca.gov/planning/sip/2007sip/apr07draft/covtoc.pdf
http://www.arb.ca.gov/planning/sip/2007sip/2007sip.htm#April26

ARB, 2009a. California Air Resources Board. *In-Use Off-Road Diesel Vehicle Regulation Frequently Asked Questions: Low-Use Provisions.* California Air Resources Board, April, 2009. http://www.arb.ca.gov/msprog/ordiesel/faq/faqlowuse.pdf

ARB. 2009b. The California Almanac of Emissions and Air Quality - 2009 Edition. http://www.arb.ca.gov/aqd/almanac/almanac09/almanac09.htm

ARB 2009c Advisory 10-414: Enforcement of the In-Use Off-road Diesel Vehicle Regulation, February 2010, http://www.arb.ca.gov/enf/advs/advs414.pdf

ARB 2010a, News Release #10-54: ARB, Contractors Agree On Proposed Changes to Rule Requiring Clean Up of Construction Equipment, October 7, 2010. http://www.arb.ca.gov/newsrel/newsrelease.php?id=159

ARB 2010b. California Air Resources Board. Workshop Presentation: Workshops Regarding the Off-Road and the Truck and Bus Inventories and Regulatory Amendments. Presented by California Air Resources Board Staff on May 6, May 12, and May 18, 2010: http://www.arb.ca.gov/msprog/ordiesel/documents/diesel2010mayfull.pdf

ARB, 2010c, Estimate of Premature Deaths Associated with Fine Particle Pollution (PM2.5) in California Using a U.S. Environmental Protection Agency Methodology, August 31, 2010 http://www.arb.ca.gov/research/health/pm-mort/pm-report_2010.pdf

ARB 2010d. Workshop on Amendments to the Off-Road Diesel Regulation. Presented by California Air Resources Board Staff on June and July 2010: http://www.arb.ca.gov/msprog/ordiesel/documents/offroadsummer2010full.pdf

California Department of Finance (CA DOF), 2010. Residential Unit and Valuation, 1975-2009 (annual), 1995-current (monthly). Last assessed February 2010. Available at: http://www.dof.ca.gov/html/fs_data/latestecondata/fs_construction.htm

Chow JC, Watson JG, Lowenthal DH, Chen LW, Motallebi N., (2010). Black and organic carbon emission inventories: review and application to California. J. Air Waite Manag Assoc. Apr;60(4):497-507.

DOORS, 2010. Diesel Off-road On-line Reporting System. https://secure.arb.ca.gov/ssldoors/doors_reporting/reporting.php

Equipment Data Associates (EDA), 2010. California Equipment Financed, 2005-current. Available at: www.EDAData.com

Glen 2010. Glen Sample Signs & Graphics, October 21, 2010. http://www.domestickers.com/calsticker.htm

Hadley, O.L. et al. 2010, Hadley, O. L., Corrigan, C. E., Kirchstetter, T. W., Cliff, S. S., and Ramanathan, V. (2010). Measured black carbon deposition on the Sierra Nevada snow pack and implication for snow pack retreat, Atmos. Chem. Phys., 10, 7505-7513, doi:10.5194/acp-10-7505.

Hansen, J.; Sato, M.; Kharecha, P.; Russell, G.; Lea, D. W.; Siddall, M. 2007. Climate change and trace gases. *Philos. Trans. R. Soc. London, Ser. A.*, *365* (1856), 1925–1954. Note: Hansen GWP estimates should be considered a conservative (i.e., lower bound) estimate for fossil fuel BC forcing, because he assumes a high OC/BC ratio for fossil fuel emissions.

Kean, A.J., Sawyer, R.F., Harley, R.A., 2000. A Fuel Based Assessment of Off-Road Diesel Emissions. Journal of the Air and Waste Management Association (50) 1929-1939.

Krewski et al., 2009, Krewski D, Jerrett M, Burnett RT, Ma R, Hughes E, Shi Y, Turner MC, Pope CA III, Thurston G, Calle EE, Thun MJ. 2009. Extended Follow-Up and Spatial Analysis of the American Cancer Society Study Linking Particulate Air Pollution and Mortality. HEI Research Report 140. Health Effects Institute, Boston, MA.

LAUSD, 2010. Letter from David Legg of the Los Angeles County Unified School District to Mark Williams, ARB. LAUSD compliance extension request for 237 forklifts and sweepers affected by the expiring limited hours of use provision. June 7, 2010.

MacKay, 2003. 2003 Construction Equipment Universe of Construction Equipment and Machinery. Prepared by MacKay and company for Construction Equipment Magazine, 2003. (See CARB Mailout#: MSC 99-32)

Millstein, D.E., Harley, R.A. 2009, Revised Estimates of Construction Activity and Emissions: Effects on Ozone and Elemental Carbon Concentrations in Southern California. Atmospheric Environment (43) 40: 6328-6335.

Power Systems Research, 1996; 2000. Partslink Database. (See CARB Mailout#: MSC 99-32). http://www.powersys.com

Ramanathan, V. and Carmichael, G. (2008). Global and regional climate changes due to black carbon. Nature Geoscience 156, 221-227

Snyder, 2010. Snyder Graphics, October 21, 2010. http://www.snydergraphics.com/

TIAX, 2003. California Public Fleet Heavy-Duty Vehicle and Equipment Inventory, Final Report. Report to the California Air Resources Board, march 17, 2003.

U.S. Bureau of Economic Analysis (BEA), 2009. Industry and State Level GDP, 1997-2008. Last updated: Tuesday, June 02, 2009.
Available at: http://bea.gov/regional/gsp/

U. S. Bureau of Labor Statistics (BLS), 2010. U.S. 1939-current, CA 1990-current. Statewide and National Employment (Variety Sectors). Last assessed June 2010. Available at: http://www.bls.gov/data/#employment

U.S. EIA, 2010, US Energy Information Administration, Annual Energy Outlook 2010. Available at: http://www.eia.doe.gov/oiaf/aeo/

U.S. EPA. 2009. Integrated Science Assessment for PM (Final Report). http://www.epa.gov/ttn/naaqs/standards/pm/s_pm_2007_isa.html

U.S. EPA. 2010. Quantitative Health Risk Assessment for Particulate Matter - Final Report. http://www.epa.gov/ttnnaaqs/standards/pm/s_pm_2007_risk.html