California Environmental Protection Agency

AIR RESOURCES BOARD

TECHNICAL SUPPORT DOCUMENT:

PROPOSED REGULATION FOR IN-USE ON-ROAD DIESEL VEHICLES

Mobile Source Control Division
Heavy-Duty Diesel In-Use Strategies Branch

October 2008

State of California
AIR RESOURCES BOARD

TECHNICAL SUPPORT DOCUMENT: REGULATION FOR IN-USE ON-ROAD DIESEL VEHICLES

Public Hearing to Consider

ADOPTION OF THE PROPOSED REGULATION FOR
IN-USE ON-ROAD DIESEL VEHICLES

To be considered by the Air Resources Board at a two-day meeting of the Board that will commence December 11, 2008, and may continue to December 12, 2008, at

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State of California
AIR RESOURCES BOARD

PROPOSED REGULATION FOR IN-USE ON-ROAD VEHICLES

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Acknowledgements

This report was prepared with the assistance and support from the other divisions and offices of the Air Resources Board. In addition, we would like to acknowledge the assistance and cooperation that we have received from many individuals and organizations.

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A. Introduction

The California Air Resources Board's (ARB or Board) mission is to protect public health, welfare, and ecological resources through the effective and efficient reduction of air pollutants, while recognizing and considering the effects on the economy of the State (ARB, 2002). ARB's vision is that all individuals in California, especially children and the elderly, can live, work, and play in a healthful environment – free from harmful exposure to air pollution. To achieve this, ARB has adopted numerous regulations to control emissions from many different sources, including diesel engines. Reducing health risk from diesel particulate emissions is one of the Board's highest priorities. Diesel engine exhaust is a health concern because it is a source of unhealthful air pollutants including gaseous and particulate-phase toxic air contaminants (TAC), particulate matter (PM), oxides of nitrogen (NOx), carbon monoxide, and hydrocarbons. Reducing health risk from diesel particulate emissions is one of the Board's highest priorities.

Staff is proposing a regulation to reduce emissions from in-use on-road diesel vehicles. Such vehicles include various types and sizes of trucks that haul products throughout the state, vehicles used in agricultural operations, and drayage trucks used at California's ports and intermodal rail facilities.

Staff is also proposing a number of changes to existing in-use diesel vehicle and engine regulations to reduce overlapping requirements for the same vehicles, to clarify a number of issues with the existing regulations, to provide additional compliance flexibility, and to generally improve enforceability of the existing regulations.

This technical support document is an addendum to the Initial Statement of Reasons and includes the following chapters:

- Background information, the purpose of the regulation (Chapter I)
- ARB's legal authority to adopt the regulation (Chapter II);
- Summary of outreach to inform the public and solicit public participation in the development of the proposed regulation (Chapter III);
- Discussion of the need for control of diesel PM and NOx from in-use on-road diesel vehicles (Chapter IV);
- Discussion of the various types of vehicles subject to the proposed regulation and their manufacturers (Chapter V);
- Describes the emissions inventory that was developed for the proposed regulation (Chapter VI);
- Discussion of retrofit strategies available for reducing diesel emissions from in-use on-road vehicles (Chapter VII);
- Discussion current and future engine technologies that will be available to meet the NOx and PM performance standards (Chapter VIII);

- Summaries of the requirements of ARB's regulations that reduce the emissions and risk from new and existing on-road and off-road diesel engines as well as portable engines and equipment (Chapter IX);
- Summary and discussion of the proposed regulation (Chapter X);
- Discussion of modifications proposed for a number of existing ARB diesel regulations (Chapter XI);
- Environmental impact of the proposed regulation (Chapter XII);
- Discussion of the statewide cost of the proposed regulation and on affected business sectors (Chapter XIII);
- Discussion of the economic impact of the proposed regulation on the economy of the state and on certain affected business sector (Chapter XIV);
- Discussion of availability of incentive funding (Chapter XV);
- Discussion of the rationale for proposing special provisions, such as the requirements for small fleets and the less stringent requirements for low mileage thresholds (Chapter XVI);
- Discussion of preliminary plans for enforcement (Chapter XVII);
- Alternatives considered and the reasons they were not chosen over the proposed regulation (Chapter XVIII); and
- Proposed text of the regulation and other supplementary information (Appendices).

B. Overview

Staff of the Air Resources Board (ARB or Board) is proposing a regulation that would reduce emissions of diesel particulate matter (PM) and oxides of nitrogen (NOx) from over 400,000 diesel vehicles registered in the State, and another half a million out-of-state vehicles that visit California each year. The regulation would achieve these emission reductions by requiring fleet owners to modernize their fleets and install exhaust retrofits. The regulation is projected to achieve significant emission reductions, but at a significant cost to affected fleets.

The scope of the proposed regulation is broad. It would affect about 170,000 California businesses (including over 150,000 small businesses) in most sectors of the State's economy, and almost a million vehicles. Some common industry sectors that operate trucks and buses subject to the regulation include: for-hire transportation, construction, manufacturing, retail and wholesale trade, vehicle leasing and rental, bus lines, and agriculture. Within each of these broad sector categories, there is a wide variety of vehicle types. The potential impact of this regulation on various business sectors depends on the number, type and age of the affected vehicles operated by each sector. A copy of the regulation is provided in Appendix A, and a simplified summary is provided in Appendix A1.

The proposed new regulation would apply to any person, business, or federal government agency that owns or operates affected vehicles in California. Affected vehicles include heavy-duty diesel-fueled vehicles with a gross vehicle weight rating (GVWR) greater than 14,000 pounds, yard trucks with off-road certified engines and certain diesel-fueled shuttle vehicles regardless of weight. The proposed regulation would be applicable regardless of where the vehicle is registered. However, the proposed regulation would not apply to military tactical support vehicles, authorized emergency vehicles, or private motor homes not used for commercial purposes.

In general, the regulation would require owners to reduce PM and NOx emissions from their fleets by upgrading the vehicles to meet specific performance standards for these pollutants (defined as best available control technology, or BACT). The BACT standard for PM is generally an engine equipped with a diesel particulate filter, and the BACT standard for NOx is an engine newly manufactured in 2010 or later. A fleet may meet these performance requirements by retrofitting a vehicle with a verified diesel emission control strategy (DECS)[1] that will achieve PM or NOx reductions or both as required, replacing an engine with a newer cleaner one, or replacing a vehicle with one having a cleaner engine. This replacement vehicle can be either new or used.

The proposed regulation begins in 2010, and requires the installation of verified PM DECS on certain vehicles depending on their model year. Then, beginning in 2012, fleets would need to begin replacing their vehicles with newer used or new vehicles that meet the most stringent 2010 model year engine emission standards. Through this, by the beginning of 2014, nearly all on-road diesel engines operating in California will either have a verified DECS installed, or will be engines that came with a diesel particulate filter (DPF) from the engine manufacturer. Then, between 2012 and 2022, the remaining older vehicles would be need be replaced such that by 2023, all on-road diesel vehicles operating in California would have the cleanest engines available - that is, they would meet the 2010 model year emission standards.

Each year, the proposed regulation provides three options for complying with the performance requirements. First, a fleet could retrofit and replace vehicles in its fleet, according to a prescriptive schedule, based on each vehicle's engine model year. Second, a fleet could meet a limit that sets an annual cap on the number of retrofits to be installed and the minimum number of engines replaced required to meet the 2010 engine requirements each year. Third, a fleet could meet a fleet average option, with targets that decline over time. Each fleet has the flexibility to meet any one of these options each year, and is not required to meet the same option for both pollutants. That is, a fleet could met the BACT schedule for PM, but meet the fleet average for NOx, and be fully compliant with the proposed regulation.

The proposed regulation also contains special provisions to address the unique issues facing small fleets. Under staff's proposal, small fleets, those with one to three vehicles, are exempt from any clean up requirements until 2012. Then, in 2013, small fleets would need to show they cleaned up one vehicle to a lesser requirement. That vehicle

[1] A retrofit device that has been verified under ARB's Verification Procedure, which ensures the effectiveness and durability of diesel engine retrofits.

would then not need to meet the 2010 engine requirement until 2018. In fleets of two or three, additional time is then provided for the second or third vehicle to meet the PM and NOx performance requirements.

Because of the wide variety of fleets and vehicles subject to the proposed regulation, certain special provisions have been included. First, the proposed regulation would exempt certain lower use vehicles from some or all of the clean up requirements. The proposed regulation would establish requirements to clean up diesel PM emissions from school buses, although it would not require the replacement of any school buses newer than 1977. Also, special provisions would be provided for unique vehicles and certain types of agricultural vehicles. The regulation would provide credits for actions which reduce emissions from these vehicles earlier than required, as well as for the early adoption of hybrid vehicle technology and for the use of alternative fuels. Staff is also proposing to address a number of regulatory issues with two-engine cranes and two-engine street sweepers which are subject to a number of different ARB regulations.

To aid in its enforcement, the proposed regulation would impose certain reporting and recordkeeping requirements. The proposed regulation would also establish requirements for any in-state or out-of-state motor carrier, California based broker, or any California resident who hires or dispatches vehicles subject to the regulation. Also, California sellers of vehicles are subject to the proposed regulation and would have to disclose the regulation's potential applicability to buyers of the vehicles.

The proposed regulation would provide significant diesel PM and NOx emissions reductions that would have a substantial positive air quality impact throughout California. By reducing emissions of pollutants that contribute to elevated ambient levels of particulate matter and ozone, the regulation would help achieve attainment of the federal and state clean air standards for PM and ozone. In 2020, the regulation is expected to reduce diesel PM2.5 emissions by 5.2 tons per day and NOx emissions by about 79 tons per day statewide, which represents a 43 percent reduction in diesel PM and a 23 percent reduction in NOx from emission levels that would be anticipated in the absence of the regulation. In addition, the proposed regulation would provide a slightly positive change in emissions of greenhouse gases, and would reduce emissions of black carbon – a component of diesel PM and a likely contributor to global warming.

In addition, the proposed regulation is the critical piece in California's efforts to meet federal clean air standards. In 2007, the State approved its blueprint to attain the federal clean air standard for fine particulate (PM2.5) and ozone. This document, known as the State Implementation Plan or SIP, committed to significant emission reductions from vehicles operating throughout the state, in particular in the South Coast and San Joaquin Valley air basins. The proposed regulation would meet or exceed the combined NOx and PM2.5 SIP fleet rule targets in both the South Coast and San Joaquin Valley air basins for all years. In 2014, in the South Coast Air Basin, the SIP target would be met by achieving slightly more PM2.5 reductions and slightly less NOx than expected. The proposed regulation would also help achieve the SIP reduction goals in 2020 for attainment in regions downwind of the South Coast and the San Joaquin Valley air basins.

Also, significant additional health benefits would also be obtained with the reductions of ambient levels of diesel PM. The emission reductions from the regulation are expected to prevent approximately 9,400 premature deaths over the course of the regulation (2,800 to 17,000, 95 percent confidence interval), and would result in about 150,000 fewer asthma-related cases and 950,000 fewer lost work days. The economic valuation of these health benefits is estimated to range from $48 to $68 billion.

However, while the proposed regulation would not quite achieve the overall goal set forth in the 2000 Diesel Risk Reduction Plan (RRP) of reducing diesel PM by 85 percent, from 2000 baseline levels, staff projects that the proposed regulation would reduce in-use on-road vehicle diesel PM emissions from the 2000 baseline by 80 percent in 2020. These reductions represent the maximum achievable reductions of diesel PM emissions from in-use on-road diesel vehicles.

While the benefits of the proposed regulation are significant, so are the costs. Staff estimates that the total cost of the proposed regulation is about $5.5 billion, in 2008 expenditure equivalent dollars (2008 dollars). Of this, about $4.5 billion will be incurred by California based fleets, and $1 billion will be borne by out-of-state fleet operators. These costs will be spread out over 16 years, from 2010 through 2025, with costs varying between years; in its highest year, 2013, the capital costs of the proposed regulation are expected to be about $566 million. Overall, about 40 percent of the cost of the proposed regulation is expected to be incurred directly by the transportation and warehousing industry, more than 20 percent by the construction industry, and about 10 percent by the wholesale and retail trade industry. The remaining costs are spread among various other affected industries.

Costs to individual fleets would vary depending on the size of each fleet, vehicle types, vehicle ages, and its normal purchasing practices. Costs also would vary depending on the compliance strategy chosen by each fleet (retrofit, repower, buy new, and/or buy used). For newer fleets, the costs will be minimal, while for older fleets that need to upgrade a significant number of vehicles, the cost will be significantly more substantial. The same holds true for small fleets, where some would experience no increased costs while others would experience higher costs. The total estimated cost over the lifetime of the regulation for small fleets is approximately $1.7 billion (2008 dollars).

Staff expects many, if not most, affected businesses to pass through the proposed regulation’s costs to their customers. This could be achieved, for example, through higher shipping rates, or higher costs for manufactured goods, resulting in higher revenue (but not necessarily higher profits) for affected fleets. However, the ability to pass on costs will vary by business sector. While the overall impact on most business sectors covered by the proposed regulation is small, generally averaging less than one tenth of one percent of their overall gross domestic product, some companies may not be able to pass through these costs, and will have to absorb them out of their gross revenues. While the extent of the ability for fleets to absorb the costs of the proposed regulation is unclear, this may likely impact the profitability of companies that cannot pass through their compliance costs.

Despite affected fleets passing through these costs, consumers can expect to pay a negligible additional amount for common consumer goods such as food, produce, consumables and other commodities as a result of the proposed regulation.

In considering the ability of fleets to handle the compliance requirements associated with the proposed regulation and other ARB regulations, staff believes this issue is addressed in that ARB's various regulations have different compliance dates, regulatory requirements, and flexibility, which staggers the compliance dates and requirements for various regulations such that any overlap is typically minimal. Also, while many fleets subject to the proposed regulation are also subject to other ARB regulations, staff does not believe the cumulative cost impacts of these various regulations will impact affected fleets' ability to comply overall. For example, for construction fleets subject to the proposed regulation, the cumulative impact of the proposed regulation and the In-Use Off-Road Diesel Vehicle Regulation is an additional 6 percent over the anticipated costs of the off-road regulation.

While the cost of the proposed regulation is significant, there are also significant amounts of incentive money available for fleets to assist in cleaning up and modernizing their vehicles. In November 2006, California voters approved Proposition 1B, which included $1 billion to reduce emissions from the movement of goods throughout the state. ARB has earmarked over $300 million towards vehicles covered by the proposed regulation, and in particular vehicles operated by small fleets. California's Carl Moyer Program provides $140 million per year to help reduce emissions from existing diesel engines, and has historically funded a significant number of projects targeting on-road vehicles. Finally, with the approval of Assembly Bill (AB) 118, ARB has been allocated up to $50 million per year to achieve emission reductions from vehicles and equipment, as well as research for on the air quality impacts of alternative fuels and advanced technology vehicles. In fiscal year 2008/2009, $48 million has been allocated for the establishment of a heavy-duty vehicle air quality loan program. While these programs, and the dollars they provide, are significant, they are not enough to cover the anticipated costs of the regulation. However, for those that take advantage of them, the combined assistance these programs could provide will be significant. For example, a truck owner/operator could obtain a 2010 model year engine truck, which would comply with all of the requirements of the proposed regulation, for about $500 to $800 per month in loan payments.

Staff has made an enormous effort to notify affected fleets and interested parties about the proposed regulation, and to solicit their input on the regulation. Staff held 54 public workshops and workgroup meetings throughout the state, dozens of site visits and private meetings with fleet owners, vehicle dealers, and industry groups, and sent a mailing to nearly 300,000 owners of registered diesel vehicles in California notifying them of the proposed regulation, how to participate in an online survey, and how to obtain additional information about staff's proposal.

C. Recommendation

Staff recommends the Board adopt a new section 2025 in title 13, California Code of Regulations. In addition, staff recommends that the Board approve the proposed amendments to the existing regulations identified Chapter XI of this technical support document. The proposed regulation and the accompanying amendments to other existing regulations, are set forth in the proposed regulation order in Appendix A.

D. References

ARB, 2002. California Air Resources Board. California Air Resources Board Strategic Plan. January 2002. http://www.arb.ca.gov/planning/plan01/plan01.htm

II. REGULATORY AUTHORITY

ARB has been granted both general and specific authority under the Health and Safety Code (HSC) to adopt the proposed regulation. HSC sections 39600 (General Powers) and 39601 (Standards, Definitions, Rules and Measures) confer on ARB, the general authority and obligation to adopt rules and measures necessary to execute the Board's powers and duties imposed by State law. HSC sections 43013 and 43018(a) provide broad authority to achieve the maximum feasible and cost-effective emission reductions from all mobile source categories, including both on-road and off-road diesel engines. Regarding in-use motor vehicles, HSC sections 43600 and 43701(b) respectively grant ARB authority to adopt emission standards and emission control equipment requirements. ARB is proposing amendments to the Portable Equipment Registration Program (PERP) pursuant to authority granted in HSC sections 41750-41755.

Additionally, California's Air Toxics Program, established under California law by AB 1807 (stats. 1983, ch. 1047, the Tanner Act) and set forth in the HSC sections 39650 through 39675, mandates that ARB identify and control air toxics emissions in California. The identification phase of the Air Toxics Program requires ARB, with participation of other state agencies such as the Office of Environmental Health Hazard Assessment (OEHHA), to evaluate the health impacts of, and exposure to, substances and to identify those substances that pose the greatest health threat as toxic air contaminants (TACs). ARB's evaluation is then made available to the public and is formally reviewed by the Scientific Review Panel (SRP) established under HSC section 39670. Following the ARB's evaluation and the SRP's review, the Board may formally identify a TAC at a public hearing. Following the identification of a substance as a TAC, HSC section 39665 requires ARB, with the participation of the local air pollution control and air quality management districts (districts), and in consultation with affected sources and interested parties, to prepare a report on the need and appropriate degree of regulation for that substance. Based upon the findings of the report, ARB is vested with authority under sections 39666 and 39667 to adopt and enforce airborne toxic control measures (ATCM) that will respectively achieve emission reductions using best available control technology (BACT) for nonvehicular and vehicular sources, the latter of which includes in-use on-road heavy-duty vehicles.

1. Preemption under the Clean Air Act

The proposed regulatory actions would not be preempted by the federal Clean Air Act (CAA) section 209. Section 209(a) preempts states from adopting emission standards relating to the control of emissions from new motor vehicles or new motor vehicle engines. Section 209(b) provides that the Administrator of the United States Environmental Protection Agency (U.S. EPA) shall grant California a waiver of preemption, unless those challenging the waiver can show that certain specified criteria for denying the waiver have been met. Section 209(e)(1) preempts all states from adopting emission standards for new nonroad engines under 175 horsepower used in farm and construction equipment and vehicles and new locomotives and locomotive engines.[2] Section 209(e)(2) impliedly preempts all states other than California from adopting new and in-use emission standards and other requirements relating to the control of emissions of all nonroad not otherwise expressly preempted under section 209(e)(1). California can adopt and enforce regulations for these other nonroad engines upon receiving authorization from the Administrator of U.S. EPA. As with a section 209(b) waiver, the Administrator must grant authorization unless those challenging the authorization can demonstrate that certain specified criteria for denying the authorization have been satisfied.

The proposed in-use on-road diesel vehicle regulation would not be preempted under CAA section 209(a). The proposed regulation would not establish emission standards for new motor vehicles or engines; rather the proposed regulation would establish in-use performance requirements that must be met by in-use on-road vehicles. To the extent that fleets elect to meet those performance standards by replacing in-use vehicles and engines with new vehicles and engines, those emission standards have previously been adopted and granted waivers under section 209(b).

The proposed amendments to ARB's previously adopted heavy-duty vehicle idling requirements are also not preempted by section 209. The idling requirements are in-use operational control measures that are specifically permitted under section 209(d), which provides that states have the right "to control, regulate, or restrict the use, operation, or movement of registered or licensed motor vehicles." The right to adopt in-use operational controls has been extended to nonroad engines. See *Engine Manufacturers Association v. EPA*, (D.C. Cir. 1996) 88 F.3d 1075.

The proposed amendments to California's off-road regulations are not preempted under section 209(e)(1) in that they do not apply to new off-road engines under 175 hp used in farm and construction vehicles or to new locomotives and locomotive engines. To the extent that ARB is proposing amendments to its in-use off-road programs, ARB has pending authorization requests before U.S. EPA for its previously adopted off-road regulations. Upon adoption of the proposed amendments, ARB intends to file a request with U.S. EPA that it confirm that the amendments fall within the scope of the previously submitted authorization requests.

2. Interstate Commerce Clause

The Commerce Clause of the United States Constitution (U.S. Const., Art. I, §8, cl. 3) grants Congress the power "[t]o regulate Commerce with foreign Nations, and among the several States. . . ." In addition to granting Congress an affirmative grant of authority, courts have found that the clause creates an implied restraint on state authority to enact legislation that imposes significant burdens on interstate commerce. (See *United Haulers Ass'n, Inc. v. Oneida-Herkimer Solid Waste Management Authority* (2007) 127 S.Ct. 1786; *Healy v. The Beer Institute* (1989) 491 U.S. 324, 326, fn.1.) The proposed regulation of in-use on-road diesel vehicles would not be in violation of

[2] The federal term "nonroad" and California term "off-road" refer to the same types of engines and are used interchangeably.

this so-called Dormant Commerce Clause. The proposed regulation would not be *per se* unlawful in that it would not expressly discriminate against out-of-state heavy-duty vehicle fleets, have the practical effect or purpose of protecting California economic interests at the expense of out-of-state interests, or have an impermissible extraterritorial effect on other states.

When a state statute or regulation is neutral on its face, has only indirect or incidental effects on interstate commerce, and regulates evenhandedly, the courts have applied a balancing test that weighs the state's legitimate interests in adopting the regulation against the burden that the regulation may have on interstate commerce. (*Pike v. Bruce Church, Inc.* (1970) 397 U.S. 137.). Here, the proposed regulation, which achieves significant reductions in diesel PM, an identified TAC, and NOx, with concomitant reductions in health risks to the public (i.e., resulting in fewer fatalities, hospitalization, lost school and work days), would provide great health and welfare benefits to the public. The benefits of the regulation, which would be adopted under the police powers granted to the State, clearly outweigh any burdens that the regulation would impose on interstate commerce.

3. Regulatory Takings

Some stakeholders have commented during the course of this regulation's development that the proposed regulation would result in a regulatory taking. Specifically, they argue that the proposed regulation forces the replacement of older, dirtier vehicles, and would significantly devalue the resale market for these vehicles. ARB staff does not agree that the regulation would result in an unconstitutional taking. The "Takings Clause" of the Fifth Amendment to the United States Constitution provides that the federal government shall not take private property for public use, without just compensation.[3] The prohibition was extended to the states by the Fourteenth Amendment.[4]

Generally, in real property regulatory takings claims, courts have found a compensable taking if a regulation does not substantially advance legitimate state interests or has permanently deprived an owner of "all economically beneficial or productive use" of the land (*Lucas v. South Carolina Coastal Council (1992)* 505 U.S. 1003, 1015; *Tahoe-Sierra Preservation Council, Inc. v. Tahoe Regional Planning Agency* (2002) 535 U.S. 302). In determining whether a state may avoid compensation when it has used its police powers for public health and welfare purposes, and the action has resulted in

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[3] The Fifth Amendment provides in full:

> No person shall be held to answer for a capital, or otherwise infamous crime, unless on a presentment or indictment of a Grand Jury, except in cases arising in the land or naval forces, or in the Militia, when in actual service in time of War or public danger; nor shall any person be subject for the same offence to be twice put in jeopardy of life or limb; nor shall be compelled in any criminal case to be a witness against himself, nor be deprived of life, liberty, or property, without due process of law; nor shall private property be taken for public use, without just compensation.

[4] The Fourteenth Amendment provides in relevant part that "[no State shall] deprive any person of life, liberty, or property, without due process of law; nor deny to any person within its jurisdiction the equal protection of the laws."

depriving an owner of all beneficial or productive use of his land, the courts have looked to see if the proscriptions of the regulation were, in fact, covered by preexisting implied limitations on the property owner's title. (*Lucas v. South Carolina Coastal Council*, *supra,* 505 U.S. at 1027.) In *Lucas*, the Court acknowledged that where such implied limitations exist, "the property owner necessarily expects the uses of his property to be restricted, from time to time, by various measures newly enacted by the State in legitimate exercise of its police powers." (*Id.)*

Of significance to the instant proposed regulation, the Court went on to clarify that implied limitations on ownership rights almost always exist with regard to the commercial value of personal property. The Court stated:

> [I]n the case of personal property, by reason of the State's traditionally high degree of control over commercial dealings, [the personal property owner] ought to be aware of the possibility that new regulation might even render his property economically worthless. (*Id.*, at 1027-1028.)

In line with the Supreme Court's decisions with regulatory takings, the proposed regulation cannot be considered as unconstitutional. First, the regulation will not deprive the stakeholder of all beneficial value of the regulated engines and vehicles. Even those engines and vehicles that must be retired under the proposed regulation will continue to retain fair market value in domestic and international markets outside of California. Second, consistent with *Lucas,* even in the unlikely event the regulated engines and vehicles lost all of their beneficial value, ARB is exercising its vested police power authority to regulate in-use on-road fleets. Over the past 40 years, ARB has adopted a panoply of air quality regulations affecting nearly every vehicular source category. Given the extreme air quality problems confronting most areas of the state, owners of in-use on-road vehicles should be well aware that regulation of their fleets was likely to occur, especially given the high level of emissions associated with the operation of such vehicles.

III. PUBLIC OUTREACH AND ENVIRONMENTAL JUSTICE

ARB is committed to ensuring that all California communities have clean, healthful air by addressing not only the air quality issues confronting our cities by also the localized air quality impacts that are generated within our communities. ARB works to ensure that all individuals in California, especially the children and elderly, can live, work, and play in a healthful environment that is free from harmful exposure to air pollution. The proposed regulation's relationship to environmental justice is described in Section A below.

Staff conducted various outreach efforts to notify affected stakeholders of the proposed regulation and to give them opportunities to participate in the regulatory development process. These efforts are described further below in Section B.

A. Environmental Justice

As a matter of policy, ARB is committed to integrating environmental justice in all of its activities. On December 13, 2001, the Board approved Environmental Justice Policies and Actions, which formally established a framework for incorporating environmental justice into the ARB's programs, consistent with the directives of State law. Environmental justice is defined as the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies (ARB, 2001). These policies apply to all communities in California, but recognize that environmental justice issues have been raised more in the context of low-income and minority communities. As the proposed regulation would require cleaner fleets of in-use on-road diesel vehicles to be used throughout the state, it would reduce emissions in all communities in California, including those with environmental justice concerns. Staff are currently working to inform those in environmental justice communities of the proposed regulation and how final implementation would reduce exposure to diesel PM and protect public health in their communities.

B. Outreach Efforts

As part of the public process, staff conducted various outreach efforts to notify interested and affected stakeholders of the proposed regulation and to give them opportunities to participate in the regulatory development process. Staff held numerous public workshops at various locations throughout the state. Staff also met with individual stakeholders and contacted various industries, associations, individual businesses, and other organizations to inform them of the proposed regulation. A mailing to all owners of registered diesel vehicles in the State notifying them of staff's proposal was conducted. Fact sheets were developed in English, Spanish and Punjabi to inform affected stakeholders of the proposed regulation, health impacts, and contact information. Additional information can be found in Appendix C.

1. Public Workshops

Since April 2006, staff held 9 sets of workshops, for a total of 54 public workshops, to discuss development of the proposed regulation. In August 2007, workshops were held to specifically discuss updates to the emission inventory. In July 2008, workshops were specifically held to discuss methodologies for estimating costs and emissions attributed to the proposed regulation. The workshops were held in various locations throughout the State to allow stakeholders to participate in person. The workshops held in Sacramento were also webcast to provide even greater opportunity for stakeholder involvement. In many instances, staff held both day and evening workshops to allow stakeholders to attend at their convenience.

Table III-1 shows the dates and locations of the workshops. The dates, locations, and times of the workshops are listed in Appendix C.

Table III-1: Public Workshop Dates and Locations

Dates	Locations
April 2006	Sacramento, El Monte, Fresno
April 2007	Sacramento, El Monte
July 2007	Sacramento, El Monte
August 2007	Sacramento, El Monte, Fresno
October 2007	Redding, San Diego, Sacramento, Fresno, El Monte, Oakland
January - February 2008	Sacramento, Fresno, El Monte, Riverside, San Diego, El Centro, Redding, Berkeley
May – June 2008	El Monte, San Diego, El Centro, Riverside, San Jose, Redding, Sacramento, Fresno
July 2008	Fresno, El Monte, Sacramento
July – August 2008	San Diego, El Centro, El Monte, Redding, San Jose, Sacramento, Riverside, Fresno, Arvin

2. Other Outreach Efforts

Due to the wide variety of industries that use on-road diesel-fueled vehicles and would be impacted by the proposed regulation, staff performed outreach to many different industries and associations. Table III-2 lists companies, associations, and organizations that were contacted by staff, notifying them of the proposed regulation. In addition, staff sent a mailing to nearly 300,000 owners of registered diesel vehicles in California notifying them of the proposed regulation, how to participate in an online survey, and how to obtain additional information about staff's proposal (See Appendix C).

Table III-2: Companies, Associations, and other Organizations Contacted

Allied Weed Control American Car and Bus Rental Association American Rental Association American Bus Association American Trucking Association The Better World Group Blackmun Equipment and Vehicle Leasing Blagg Food Services Boyd Commodities British Petroleum Bud Line Trucking California Bus Association California Cotton Ginners and Growers Association California Dump Truck Owners Association California Farm Bureau California Forestry Association California Highway Patrol California Independent Oil Marketers Association California School Transportation Association California Trucking Association California Tow Truck Association Calstart Cattlemen's Association CCEEB Central Valley Air Quality Coalition Citrus Growers Association Coca Cola Construction Industry Air Quality Coalition Engine Manufacturers Association Environmental Defense Fund Federal Express Ganduglia Trucking Granite Construction Gibbs Truck Centers Holt	International Logistics and Warehousing Foundation Interstate Truck Center ITEC Jim Seal Consulting Services Kajai Trucking Lawson Drayage Local Air Pollution Control Districts Mid-Pacific Industries Mountain Valley Express National Association of Fleet Managers Nisei Farmers League Northern American Power Sweepers Association Northern Refrigerated Transportation Owner-Operator Independent Drivers Association PACCAR Pacific Coast Companies Pacific Gas and Electric Pape' Machinery Pat Cramer Insurance Agency Pepsi Port of Stockton Ritchie Brothers Auctioneers Roadrunner Manufacturing Save Mart SelectTrucks Sempra Sierra Research Storer Transportation Szeremi Sweeping Service Teamsters Union Union of Concerned Scientists United Motorcoach Association United Postal Service West Coast Collaborative Westar Transport Western Firefighters Association Western Propane Gas Association Western Trucking School Western United Dairymen Association Yellow Roadway Corporation

Staff also sent letters to diesel vehicle business owners in California (including truck stops and repair facilities throughout the Western United States) notifying them of the proposed regulation, and included a fact sheet so that they could notify their customers of the proposed regulation. Staff also provided ARB contact information (See Appendix C) so that additional information could be obtained. An existing toll free phone number, 866-6DIESEL, was expanded to assist affected stakeholders in obtaining information about the proposed regulation and the survey by enabling them to directly contact staff working on the proposed regulation.

Over the last two and a half years, staff held over 100 meetings with individual companies and organizations to discuss the proposed regulation. The meeting attendees ranged from just one company representative to over 100 attendees. This included over 50 meetings with individual companies to discuss how the proposed regulation will impact their businesses and to gather additional information about their business operations. The meetings also provided staff with additional information on how the proposed regulation will affect different types of companies that operate heavy-duty diesel vehicles. Staff met at various locations throughout the state and also traveled to locations in other states, such as Florida, Arizona, Michigan, and Texas, to discuss the proposed regulation to fleet owners that travel through California.

Staff also made presentations at several trucking, motorcoach, and heavy equipment shows. Listed in Appendix C are presentation appearances, the dates, names of companies or organizations, and locations where staff met with or made presentations about the proposed in-use on-road diesel vehicle regulation.

C. Future Efforts

If the proposed regulation is adopted, staff plans to continue and expand its outreach efforts to associations and other affected stakeholders. Staff would also look to expanding its existing toll free phone number, 866-6DIESEL, to assist stakeholders in obtaining information on how to comply with the regulation. During implementation, staff would work with affected stakeholders to educate them on complying with the requirements of the regulation in the least costly manner. This effort would include holding public workshops, seminars, and individual meetings throughout the State. Staff would also look to strengthen enforcement and compliance to ensure there is a level playing field in California. Also, staff plans to create a reporting system and tools to assist fleets in determining what compliance options are available and to develop their own compliance plans. Staff also plans to continue to work with industry representatives and associations on additional ways to educate different stakeholders.

Staff would also build on the efforts already made to educate affected stakeholders about the in-use off-road regulation and would look to coordinate those efforts to ensure that owners of off-road and on-road equipment receive the information they would need about both regulations at the same time. Staff also plans to track the implementation of the In-Use Off-Road Diesel Vehicle Regulation and use that effort as a model for this regulation. This includes conducting training sessions throughout the state and developing guidance material and fact sheets for affected fleets. Staff also will consider forming an advisory group representing fleets of all sizes and types, retrofit manufacturers and installers, consultants, engine manufacturers, and other affected industry groups. The overall mission of the advisory group would be to enhance outreach efforts, training and implementation materials for the regulation, and assist staff in being aware of needs of affected stakeholders and address specific issues.

D. References

ARB, 2001. California Air Resources Board, Policies and Actions for Environmental Justice Staff Report. December 13, 2001.

IV. Need for Emission Reductions

California's mobile source emissions control programs have provided significant statewide reductions in emissions of carbon monoxide (CO), PM, sulfur oxides (SOx), and ozone precursors – NOx and volatile organic compounds (VOCs, also called reactive organic gases or ROG). However, even with the success of existing programs, over 90 percent of Californians still experience unhealthy levels of air pollution. Many areas in the State still exceed state and federal ambient air quality standards (AAQS); that is, they are non-attainment areas. Substantial new reductions in mobile source emissions are essential if the state is to attain and maintain the state and national AAQS. In addition, reducing diesel PM emissions from mobile sources is critical to reducing overall public exposure to ambient air toxic contaminants.

A. Ozone and its Precursors

Ground level ozone is the primary constituent of smog. Ozone is formed in the atmosphere as a result of reactions involving sunlight and two classes of precursors. One class of precursors includes nitric oxide and nitrogen dioxide, collectively referred to as NOx, and the other precursors or ROG. The highest levels of ozone are produced when both NOx and ROG emissions are present in significant quantities on clear summer days. Control measures that reduce the emissions of ozone precursors will also reduce the ambient concentration of ozone.

1. Ambient Air Quality Standards for Ozone

State and federal AAQS have been established for ozone, as shown in Table IV-1. Currently, there are two State standards for ozone: a one hour standard which has been in effect since 1987, and a new 8 hour standard that became effective May 17, 2006. This new 8 hour standard was based on the results of an evaluation of the adequacy of the 1987 standard, as required by the Children's Environmental Health Protection Act (Senate Bill 25, Escutia, 1999). Senate Bill 25 (SB 25) directed the ARB, in consultation with the Office of Environmental Health Hazard Assessment (OEHHA), to "review all existing health-based ambient air quality standards to determine whether these standards protect public health, including infants and children, with an adequate margin of safety.

In July 1997, U.S. EPA promulgated a new 8 hour ozone national standard (replacing the previous federal one hour standard) effective September 1997, and in 2004 issued new area designation maps for the new standard. The new standard was set at a lower level to address the cumulative impact of ozone exposure at lower levels for a longer period of time and is more protective of human health. The national one hour ozone standard was revoked effective June 15, 2005, for all areas except the 8 hour ozone non-attainment Early Action Compact areas that have deferred effective dates for their designations under the 8 hour ozone standard.

Table IV-1: State and National Ozone Ambient Air Quality Standards[5]

Averaging Time	California Standard	National Standard
1 hour	0.09 ppm (180 µg/m^3)	--[6]
8 hour	0.070 ppm (137 µg/m^3)	0.08 ppm (157 µg/m^3)

Because the new 8 hour State standard is more health protective than the one hour standard, it tends to determine the ozone area designations. As a result, a large number of areas that were formerly designated as attainment, unclassified, or transitional-attainment for ozone based on the one hour standard are now classified as nonattainment based on the 8 hour standard (ARB, 2006a).

In November 2006, the Board approved needed changes to the State area designations based on the new 8 hour ozone standard. As shown in Figure IV-1, most of California does not meet the State's AAQS for ozone. The Lake County Air Basin and in the North Coast Air Basin: Del Norte, Humboldt, Trinity, and Mendocino counties continue to be in attainment, but Sonoma County has changed from attainment to nonattainment.

Figure IV-1 also shows that many areas in the state violate the federal 8 hour ozone standard. U.S. EPA has designated 15 areas in California as nonattainment for the federal 8 hour ozone standard. These areas include San Joaquin Valley, South Coast Air Basin, Sacramento region, San Diego, Ventura, the San Francisco Bay Area, and a number of air districts downwind of urban areas. Federal law mandates development of SIPs documenting the actions the state will take to attain the standard.

Substantial new ozone precursor emission reductions are needed not only to achieve attainment for the 8 hour state and federal ozone standards, but also to meet progress requirements for the ozone standard required under California law. The greatest emissions reductions are needed in the South Coast and San Joaquin Valley Air Basins. Both the South Coast and San Joaquin Valley air districts have requested reclassification to "extreme" nonattainment for ozone, with an attainment date in 2024.

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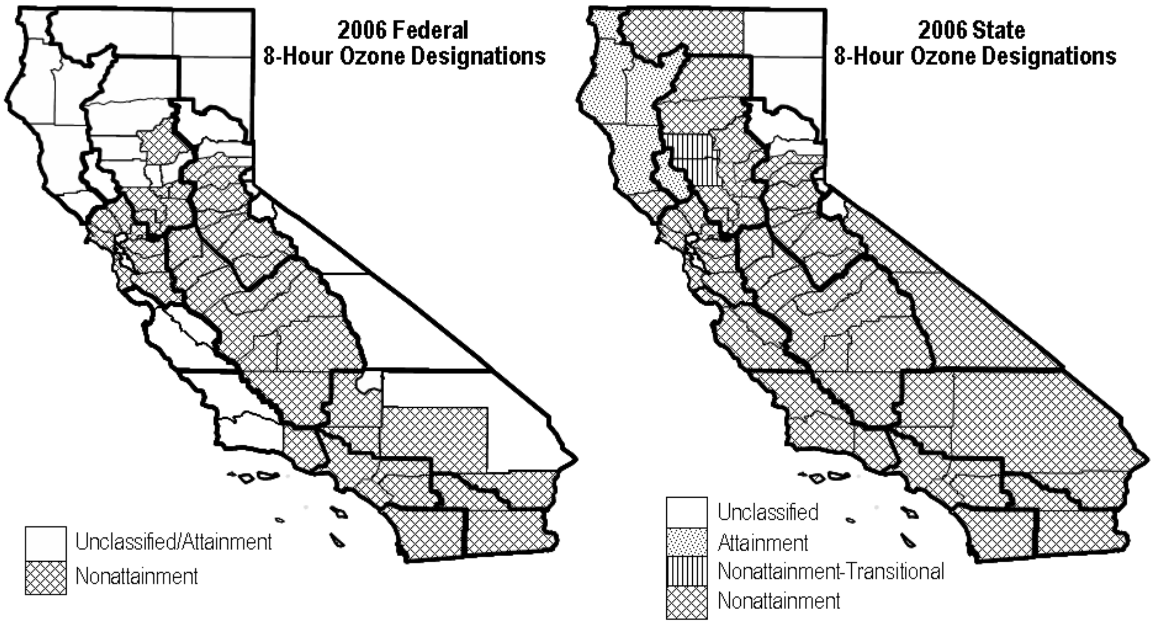
[5] ppm= parts per million, µg/m^3=micrograms per cubic meter

[6] The U.S. EPA revoked the national 1 hour ozone standard (0.120 ppm) effective June 15, 2005.

Figure IV-1: Federal and State Area Designations for Ozone



2. Ambient Air Quality Standards for Nitrogen Dioxide (NO_2)

The primary sources of nitrogen dioxide (NO_2) are internal combustion engines, both gasoline and diesel powered, and point sources such as power plants. NO_2 is also formed indirectly from emissions of nitric oxide (NO) that are converted photochemically to NO_2. Both NO and NO_2 are involved in a series of chemical reactions in the ambient air to produce additional pollutants such as ozone, nitric acid, nitrate aerosols, and other nitrogen containing compounds that are toxic. Of the nitrogen oxide compounds (NOx) in the atmosphere, NO_2 represents the greatest risk to human health (Frampton, 2000).

The U.S. EPA has established a national AAQS for NO_2 of 0.053 parts per million (ppm) averaged over one year. The ARB established a short term (one hour) standard for NO_2 of 0.25 ppm, averaged over one hour. As required by SB 25, staff of ARB and OEHHA reviewed the scientific basis for California's ambient standard for NO_2 to determine its adequacy to protect public health, including the health of infants and children. Staff found that health effects may occur at levels near the existing standard of 0.25 ppm, and recommended that the level of the California ambient air quality standard for NO_2 be lowered to 0.18 ppm, averaged over one hour. OEHHA staff also recommended the addition of an annual average standard of 0.03 ppm (ARB, OEHHA, 2007).

Though the state and federal NO_2 standards are not exceeded, NO_2 is still a concern because it is a precursor to both ozone and particulate matter. Secondary ammonium nitrate is formed from the oxidation NOx to nitric acid followed by the reaction of nitric acid with gaseous ammonia. The oxidation of NOx to nitric acid can occur during the daytime through reactions involving the hydroxyl (-OH) radical and during the nighttime through reactions with ozone and water. Secondary ammonium nitrate is a significant component of particulate emissions in the South Coast. Therefore, reducing ammonium nitrate through controls on NOx sources is a critical part of the State's PM strategy.

3. Health Effects of Ozone

Ozone is a powerful oxidant that can have substantial health impacts even at very low levels. Scientific studies show that exposure to ozone can result in reduced lung function, increased respiratory symptoms, increased airway hyperreactivity, and increased airway inflammation. Exposure to ozone is also associated with premature death, hospitalization for cardiopulmonary causes, emergency room visits for asthma, and restrictions in activity (ARB, 2005a).

Short term exposure to high ambient ozone concentrations have been linked to increased hospital admissions and emergency visits for respiratory problems (U.S. EPA, 2000). Repeated exposure to ozone can make people more susceptible to respiratory infection and lung inflammation and can aggravate pre-existing respiratory diseases, such as asthma. Prolonged (6 to 8 hours), repeated exposure to ozone can cause inflammation of the lung, impairment of lung defense mechanisms, and possibly irreversible changes in lung structure, which over time could lead to premature aging of the lungs and/or chronic respiratory illnesses such as emphysema and chronic bronchitis.

Those most susceptible to ozone health effects include individuals exercising outdoors, children and people with pre-existing lung disease such as asthma, and chronic pulmonary lung disease. Children are more at risk from ozone exposure because they typically are active outside during the summer when ozone levels are highest. Also, children are more at risk than adults because their respiratory systems are still developing. Adults who are outdoors and moderately active during the summer months, such as construction workers and other outdoor workers, also are among those most at risk. These individuals, as well as people with respiratory illnesses such as asthma, especially asthmatic children, can experience reduced lung function and increased respiratory symptoms, such as chest pain and cough, when exposed to relatively low ozone levels during prolonged periods of moderate exertion.

Reducing emissions of ozone precursors would reduce the prevalence of the types of respiratory problems associated with ozone exposure and would reduce hospital admissions and emergency visits for respiratory problems.

B. Particulate Matter

Ambient PM is a complex mixture of very small particles and liquid droplets in the air. Ambient PM is comprised of directly emitted PM such as dust and soot, known as primary PM, as well as secondary PM formed in the atmosphere from the reactions of precursor gases, such as NOx, SOx, VOCs, and ammonia (ARB, 2005b). NOx, SOx, and ammonia combine to form secondary ammonium nitrate and sulfate. Volatile organic compounds (VOCs) can form secondary organic aerosols as well as participate in the production of secondary ammonium nitrate. Particles with diameter less than or equal to 10 microns are referred to as PM10 and particles up to 2.5 microns in diameter are referred to as PM2.5. Those particles with diameter between 2.5 and 10 microns are referred to as coarse particles while PM2.5 are described as fine particles. PM2.5 is therefore a subset of PM10. In general, combustion processes form fine particles, while emissions from dust sources tend to be predominantly coarse particles.

The health and environmental effects of PM are related to the size of the particles. Fine particles can remain in the atmosphere for days to weeks and travel through the atmosphere for hundreds to thousands of kilometers, while coarse particles deposit to the earth within minutes to hours and within 10 kilometers from the emission source. Particles in the PM2.5 size range can penetrate into the deepest regions of the lungs.

1. Ambient Air Quality Standards for PM

ARB and the U.S. EPA have adopted health based ambient air quality standards for PM10 and PM2.5. In September 2006, the U.S. EPA lowered the short term ambient air quality standard for PM2.5 from 65 µg/m^{3}to 35 µg/m^3 and revoked the annual standard for PM10. The annual average state standard for PM10 was lowered in 2002 from 30 ug/m^3 to the current standard of 20 ug/m^3 after an evaluation by ARB and OEHHA staff of the literature on health effects associated with PM at or below 30 ug/m^3.

Table IV-2 shows the current federal and state standards. California's ambient air quality standards for PM are more stringent than the national standards and, like the ozone standards, are intended to provide protection for the most sensitive groups of citizens, including infants and children, the elderly, and persons with heart or lung disease.

Table IV-2: State and National PM Ambient Air Quality Standards (µg/m^3)

Standard		California	National
PM10	Annual Arithmetic Mean	20	--[7]
	24 Hour Average	50	150
PM2.5	Annual Arithmetic Mean	12	15
	24 Hour Average	--[8]	35

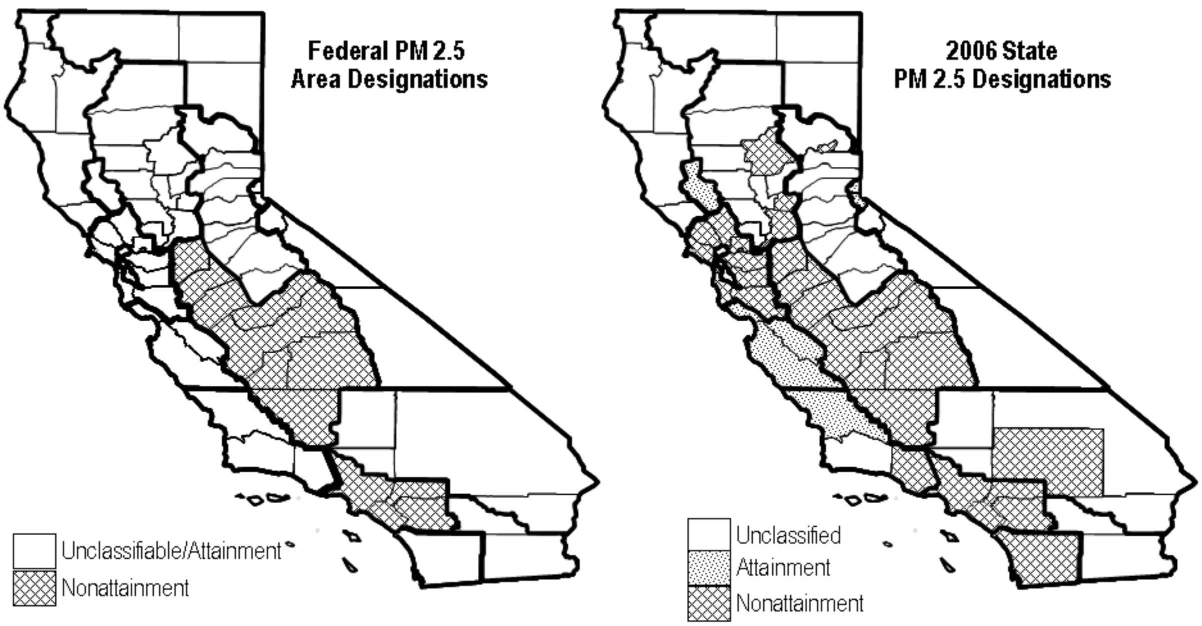
Most of California is designated as non-attainment for the State PM10 standard. Currently, the only areas that attain the State PM10 standard are the Lake County Air Basin and Siskiyou County in the Northeast Plateau Air Basin. The portion of Sonoma County in the North Coast Air Basin has been recommended for redesignation as attainment for PM10 (ARB, 2006a). With respect to the national 24 hour PM10 standard, the San Joaquin Valley, the South Coast and several desert air basins are in non-attainment. As shown in Figure IV-2, most urban areas and several isolated sub-

[7] The U.S. EPA recently rescinded the annual PM10 standard of 50 µg/m3.

[8] No separate State standard.

areas are in nonattainment for the State PM2.5 standard. However, the only federal nonattainment areas for the national annual average PM2.5 standard are the San Joaquin Valley and the South Coast.

Figure IV-2: Federal and State Area Designations for PM2.5



Because of the State's nonattainment status, PM emissions reduction remains one of California's highest public health priorities. The nonattainment areas with serious problems will require substantial reductions of directly emitted PM2.5 pollutants and PM2.5 precursors. Based on atmospheric modeling performed by ARB staff, control of the emissions of ozone precursors (and in particular NOx) may provide significant benefit due to the reduction in ambient concentrations of nitrate – an important component of ambient PM2.5.

2. Health Effects of Particulate Matter

There are strong and consistent associations between daily exposure to PM (measured as PM10, PM10-PM2.5, or PM2.5) and a range of adverse health outcomes. These include premature mortality, aggravation of respiratory and cardiovascular disease (as indicated by increased hospital admissions and emergency room visits, school absences, work loss days, and restricted activity days), asthma exacerbation, chronic and acute bronchitis, and reductions in lung function. The more severe outcomes are experienced primarily by the elderly and people with pre-existing chronic heart and lung disease. Children under age five may also experience serious adverse outcomes from exposure to PM10, including premature mortality and hospitalization for respiratory conditions (ARB, OEHHA 2002).

Almost all of diesel PM is in the PM2.5 fraction. Because of its significance also as a toxic air contaminant, diesel PM is discussed separately later in this chapter.

C. Toxic Air Contaminants

1. Components of Diesel Exhaust

Diesel engines emit a complex mixture of inorganic and organic compounds that exist in gaseous, liquid, and solid phases. The composition of this mixture will vary depending on engine type, engine age and horsepower, operating conditions, fuel, lubricating oil, and whether or not an emission control system is present. The primary gas or vapor phase components of diesel exhaust include typical combustion gases and vapors such as CO, carbon dioxide, sulfur dioxide, NOx, ROG, water, and excess air (nitrogen and oxygen).

Diesel exhaust contains over 40 substances (shown in Table IV-3) that have been listed as TACs by the state of California and as hazardous air pollutants by U.S. EPA. Fifteen of these substances are listed by the International Agency for Research on Cancer (IARC) as carcinogenic to humans, or as a probable or possible human carcinogen (ARB, 1998). U.S. EPA also classified diesel exhaust as likely to be carcinogenic to humans by inhalation at environmental exposures (U.S. EPA, 2002).

Table IV-3: Substances in Diesel Exhaust Listed by California as Toxic Air Contaminants

Acetaldehyde	Formaldehyde
Acrolein	Inorganic lead
Aniline	Manganese compounds
Antimony compounds	Mercury compounds
Arsenic	Methanol
Benzene	Methyl Ethyl Ketone
Beryllium compounds	Naphthalene
Biphenyl	Nickel
Bis[2-ethylhexyl]phthalate	4-Nitrobiphenyl
1,3-Butadiene	Phenol
Cadmium	Phosphorus
Chlorine	Polycyclic organic matter, including polycyclic aromatic hydrocarbons (PAHs) and their derivatives
Chlorobenzene	Propionaldehyde
Chromium compounds	Selenium compounds
Cobalt compounds	Styrene
Creosol isomers	Toluene
Cyanide compounds	Xylene isomers and mixtures
Dibutylphthalate	o-Xylenes
Dioxins and dibenzofurans	m-Xylenes
Ethyl benzene	p-Xylenes

2. Diesel Particulate Matter

Diesel PM is either directly emitted from diesel powered engines (primary particulate matter) or is formed from the gaseous compounds emitted by a diesel engine (secondary particulate matter). Diesel PM consists of both solid and liquid material and can be divided into three primary constituents: the elemental carbon fraction (ECF); the soluble organic fraction (SOF), and the sulfate fraction.

Many of the diesel particles exist in the atmosphere as a carbon core with a coating of organic carbon compounds, or as sulfuric acid and ash, sulfuric acid aerosols, or sulfate particles associated with organic carbon (Kittelson et al., 1999). Diesel PM can be distinguished from noncombustion sources of PM2.5 by the high content of elemental carbon and the high number of ultrafine particles (organic carbon and sulfate).

The SOF consists of unburned organic compounds which condense into liquid droplets or are adsorbed onto the surfaces of the elemental carbon particles. Several components of the SOF have been identified as individual TACs. The organic fraction of the diesel particle contains compounds such as aldehydes, alkanes and alkenes, and high-molecular weight polycyclic aromatic hydrocarbons (PAH) and PAH-derivatives. Many of these PAHs and PAH derivatives, especially nitro-PAHs, have been found to be potent mutagens and carcinogens. Nitro-PAH compounds can also be formed during transport through the atmosphere by reactions of adsorbed PAH with nitric acid and by gas phase radical initiated reactions in the presence of NOx. Atmospheric reactions of these gas phase PAH and nitro-PAH derivatives may lead to the formation of several mutagenic nitro-PAH, and nitro-PAH compounds, including nitrodibenzopyranones, 2 nitroflouranthene and 2 nitropyrene (Arey et al., 1988).

Almost all of the diesel particle mass is in the PM10 fraction, and approximately 94 percent of the mass of these particles is less than 2.5 microns in diameter (PM2.5). The particles have a very large surface area per unit mass which makes them excellent carriers for many of the organic compounds and metals found in diesel exhaust. Because of their small size, the particles are readily respirable and can effectively reach the lowest airways of the lung along with the adsorbed compounds, many of which are known or suspected mutagens and carcinogens (ARB, 1998).

Diesel PM was identified by the Board as a TAC in 1998 after an extensive review and evaluation of the scientific literature by OEHHA and subsequent review by the Scientific Research Panel (SRP). In 2001, the U.S. EPA identified diesel PM and diesel exhaust organic gases as a Mobile Source Air Toxic (MSAT) (U.S. EPA, 2001).

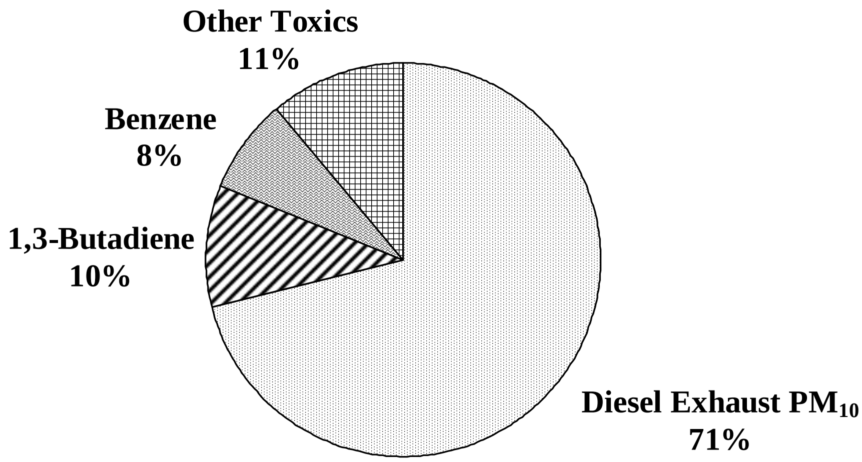
D. Health Impacts of Exposure to Diesel Exhaust and Diesel PM

Diesel PM, with the associated organic compounds, plays a key role in the carcinogenicity and chronic noncancer effects of exposure to diesel exhaust. The findings from more than 30 human epidemiological studies indicate that on average, long term occupational exposures to diesel exhaust were associated with a 40 percent increase in the relative risk of lung cancer (OEHHA, 1998). However, there is limited specific information that addresses the variable susceptibilities to the carcinogenicity of diesel exhaust within the general human population and vulnerable subgroups, such as infants and children and people with pre-existing health conditions. The carcinogenic potential of diesel exhaust was also demonstrated in numerous genotoxic and mutagenic studies on some of the organic compounds typically detected in diesel exhaust (OEHHA, 1998).

Health impacts from exposure to the PM2.5 component of diesel exhaust have been calculated for California, using concentration-response equations from several epidemiologic studies. Both mortality and morbidity effects could be associated with exposure to either direct diesel PM2.5 or indirect diesel PM2.5, the latter of which arises from the conversion of diesel NOx emissions to PM2.5 nitrates. It was estimated that 2000 and 900 premature deaths resulted from long term exposure to either 1.8 $\mu g/m^3$ of direct PM2.5 or 0.81 $\mu g/m^3$ of indirect PM2.5, respectively, for the year 2000 (Lloyd and Cackette, 2001). The mortality estimates are likely to exclude cancer cases, but may include some premature deaths due to cancer, because the epidemiologic studies did not identify the cause of death. Exposure to fine particulate matter, including diesel PM2.5, can also be linked to a number of heart and lung diseases. Another highly significant health effect of diesel exhaust exposure is its apparent ability to act as an adjuvant in allergic responses and possibly asthma (Diaz-Sanchez et al., 1996, 1999, Takano et al., 1998). However, additional research is needed at diesel exhaust concentrations that more closely approximate current ambient levels before the role of diesel exhaust exposure in the increasing allergy and asthma rates is established.

Diesel PM is a major contributor to potential ambient risk levels. Using the cancer unit risk factor developed by OEHHA for the TAC program, it was estimated that for the year 2000, exposure to ambient concentrations of diesel (1.8 $\mu g/m^3$) could be associated with a health risk of 540 potential cancer cases per million people exposed over a 70 year lifetime. This diesel PM cancer risk accounted for approximately 70 percent of the total risk associated with all known ambient air toxics as shown in Figure IV-3.

Figure IV-3: State Average Potential Cancer Risk from Outdoor Ambient Levels of Toxic Pollutants for the Year 2000[9,10,11]



The South Coast Air Quality Management District (SCAQMD) Multiple Air Toxics Exposure Study II (MATES II) estimated that the average potential cancer risk in the South Coast Air Basin from diesel PM was about 1,000 excess cancers per million people, or 71 percent of the average cancer risk from all air toxics in the South Coast Air Basin. For localized or near source exposures to diesel exhaust, such as might occur near busy roads and intersections, the potential risks will be much higher.

The Multiple Air Toxics Exposure Study III (MATES III) has been completed and is a follow up to previous air toxics studies in the Basin. The scope of the monitoring was from April 2004 to March 2006. The SCAQMD held a public consultation meeting on August 26, 2008, to discuss the revised draft of the MATES III report. The final report has not been posted, but the Draft Final Report (July, 2008) is available at: http://www.aqmd.gov/prdas/matesIII/MATESIIDraftFinalReportJuly2008.html.

1. Health Impacts of Exposure to Diesel PM from On-Road Diesel Vehicles

A substantial number of epidemiologic studies have found a strong association between exposure to ambient PM and adverse health effects (ARB, OEHHA, 2002). Staff quantified seven non-cancer health impacts associated with diesel PM emissions from

9 ARB, 2000.

10 Diesel exhaust PM10 potential cancer risk based on 2000 emission inventory estimates. All other potential cancer risks based on air toxics network data. Used 1997 data for para-dichlorobenzene. Used 1998 monitoring data for all others. Assumes measured concentrations are equivalent to annual average concentrations and duration of exposure is 70 years, inhalation pathway only.

11 Includes carbon tetrachloride (4 percent), formaldehyde (2.5 percent), hexavalent chromium (2.2 percent), para-dichlorobenzene (1.2 percent), acetaldehyde (0.7 percent), perchloroethylene (0.7 percent), and methylene chloride (0.3 percent).

on-road diesel engines in California in 2008. The non-cancer health effects include premature death, asthma attacks, acute bronchitis, hospital admissions, work loss days, and minor restricted activity days. Staff also quantified the non-cancer health impacts associated with exposures to diesel PM resulting from on-road diesel vehicle activities in an urban study area in Southern California.

a) Statewide Non-Cancer Health Impacts

The health outcomes take into account a number of factors including the relationship between air pollutant concentrations and the effect found in health studies, the relative contribution of emission sources to the pollutant in a region, and the population in a region. The regional impacts, by air basin, were added together to provide a statewide total. Appendix D provides a description of the methodology used to quantify the health impacts reported in this section.

Staff estimates that in the year 2008, approximately 4,500 premature deaths can be associated with the estimated baseline emissions from in-use on-road diesel vehicles subject to the proposed regulation. Table IV-4 shows the range of cases statewide in 2008 for each health impact evaluated by staff. As shown, staff estimates that there would be about 1,210 hospital admissions due to respiratory and cardiovascular causes; 71,000 cases of asthma-related and other lower respiratory symptoms; 450,000 days of work loss; and 2,600,000 minor restricted activity days. The analysis included health impacts of direct diesel PM and indirect diesel PM – nitrates formed from precursor NOx emitted by on-road diesel engines. The impacts of direct and indirect sources of PM are listed separately in Table IV-4. The health impacts of NOx as a precursor to ozone are not included in the estimates. Because only a subset of health outcomes was considered, the estimates in Table IV-4 should be considered an underestimate of the total public health impact of diesel PM exposure. Appendix D provides a description of the methodology used to generate these estimates.

The statewide health impacts from in-use on-road diesel vehicles are significant. To put the magnitude of the impact of on-road diesel vehicles covered by the proposed regulation in context, the number of premature deaths estimated for 2008 is similar to the number of deaths due to environmental tobacco smoke (secondhand smoke) and to the number of deaths due to motor vehicle accidents. Secondhand smoke is estimated to cause about 4,000 premature deaths per year in California (ARB, 2006b), while motor vehicle accidents killed 4,236 people in California in 2006 (NCSA, 2007).

Table IV-4: Statewide Health Impacts Associated with In-Use On-Road Diesel Vehicles (Baseline Year 2008)

Endpoint	Pollutant	Number of Cases (Mean)	Range (95% C.I.)
Premature Mortality	PM	1,100	330 – 2,000
	NOx	3,400	1,000 – 6,000
	Total	4,500	1,400 – 8,000
Hospital admissions (Respiratory)	PM	21	8 – 35
	NOx	560	320 – 830
	Total	590	330 – 865
Hospital admissions (Cardiovascular)	PM	90	47 – 130
	NOx	530	330 – 780
	Total	620	380 – 910
Asthma & Lower Respiratory Symptoms	PM	18,000	6,900 – 28,000
	NOx	53,000	21,000 – 83,000
	Total	71,000	28,000 – 111,000
Acute Bronchitis	PM	1,500	0 – 3,200
	NOx	4,200	0 – 8,700
	Total	5,700	0 – 12,000
Work Loss Days	PM	110,000	93,000 – 130,000
	NOx	340,000	290,000 – 390,000
	Total	450,000	380,000 – 520,000
Minor Restricted Activity Days	PM	640,000	520,000 – 760,000
	NOx	2,000,000	1,600,000 – 2,300,000
	Total	2,600,000	2,100,000 – 3,100,000

b) Localize Non-Cancer Health Impacts from In-Use On-Road Diesel Vehicles

To evaluate the health impacts from in-use on-road heavy-duty diesel vehicles at a local level, staff performed a localized urban study in and around the city of Commerce (Commerce Study). This study area was a 10 mile by 10 mile region with Commerce as its center.

This study area was selected due to the large number of freeways and major arterials in the area which historically have had high volumes of on-road diesel vehicle traffic. This area contains a broad mix of land uses including industrial; light industrial; commercial; and residential and about 1.1 million people reside in the study area. The expected concentrations for the vehicle activity are high enough and there is a sufficiently large exposed population to allow quantification of the non-cancer health impacts of direct diesel PM in the urban study area.

Vehicle speed, vehicle miles traveled (VMT), and emission factors were used to estimate emissions from in-use on-road diesel vehicles. Dispersion modeling was used to estimate the ambient concentration of diesel PM resulting from in-use on-road diesel vehicles travelling on the freeways and local streets within the modeling domain. For this study, ARB staff selected the U.S. EPA's approved air dispersion model AERMOD to estimate the impacts associated with diesel PM emissions on major freeways, as well as major and minor arterials within the domain. AERMOD has been successfully used in many applications including several recent health risk assessments of rail yards located in California. A detailed description of the model domain, source characterization, and meteorological data used are listed in Appendix E.

As shown in Table IV-5 below, staff estimates that in 2003, approximately 42 premature deaths were associated with exposure to the baseline uncontrolled emissions of directly emitted diesel PM from in-use on-road diesel vehicles operating in the study area. Table IV-5 shows the range of cases for this area in 2003, for each health impact evaluated by staff. As shown, staff estimates that there would be about 32 hospital admissions due to respiratory and cardiovascular causes; 1,400 cases of asthma-related and other lower respiratory symptoms; 7,400 days of work loss; and 43,000 minor restricted activity days. The health impacts of indirect PM (nitrates formed from precursor NOx emissions) and NOx as a precursor to ozone are not included in the estimates. Because only a subset of health outcomes was considered, the estimates in Table IV-5 should be considered an underestimate of the total public health impact in this area from diesel PM exposure.

Table IV-5: Non-Cancer Health Impacts Associated with In-Use On-Road Diesel Vehicles Operating in the Southern California Study Area (2003 Emissions)

Endpoint	Number of Cases per Year (Mean)	Number of Cases per Year (Range: 95% Confidence Interval)
Premature Mortality	42	12 – 72
Hospital admissions (Respiratory and Cardiovascular)	32	13 – 50
Asthma – Related & Lower Respiratory Symptoms	1,400	540 – 2,200
Acute Bronchitis	120	0 – 260
Work Loss Days	7,400	6,200 – 8,900
Minor Restricted Activity Days	43,000	36,000 – 50,000

c) Localize Potential Cancer Risk from Exposure to Diesel PM Emissions from On-Road Diesel Vehicles

As part of the Commerce Study, staff estimated the localized potential cancer risk in 2003 from exposure in this community to ambient levels of directly emitted diesel PM emitted from on-road diesel vehicles that would be subject to the proposed regulation. The results from this analysis provide a quantitative estimate for this community, as well as a qualitative indicator for other similar urban areas. The Commerce study area was selected so staff could use transportation data provided from the Southern California Association of Government (SCAG).

The potential cancer risks were estimated using standard risk assessment procedures based on the annual average concentration of diesel PM predicted by the model and a health risk factor (referred to as a cancer potency factor) that correlates cancer risk to the amount of diesel PM in the air. The methodology used to estimate the potential cancer risks assumes that an individual is exposed to an annual average concentration of a pollutant continuously for 70 years.[12] The potential cancer risk is expressed as chances per million people. Appendix E provides the details of the scenarios and the methodology used to determine the risk.

A cancer risk of 10 in a million is the most commonly used threshold above which facilities are required by the Air Toxics Hot Spots Information and Assessment Act to notify all exposed persons (ARB, 2005c). By comparison, an estimated cancer risk of 500 per million occurs at approximately 500 to 5,000 feet from the edges of the major freeways. At about a quarter to several miles from the edges of the major freeways, the estimated cancer risks drop to about 200 in a million.

The overall average potential cancer risk within the study area is about 375 in a million. This represents a significant portion of the overall estimated regional potential risk level in the South Coast Air Basin, which was estimated to be about 900 to 1000 in a million for all diesel PM emissions in 2000 (SCAQMD 2000).

E. Diesel PM Risk Reduction

To begin to address the adverse health impacts for diesel PM, in 1998, the Board identified diesel PM as a toxic air contaminant and in 2000 adopted the Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles (Diesel Risk Reduction Plan or RRP) (ARB, 2000). The Plan identified Airborne Toxic Control Measures (ATCMs) and regulations that would set more stringent exhaust emission standards for new diesel-fueled engines and vehicles, establish retrofit requirements to reduce emissions from existing engines, vehicles, and equipment, and require the sulfur content of diesel fuel to be reduced to no more than 15 parts per million by weight (ppmw). The new sulfur standard was needed to enable the effective performance of the emission control technologies. The goal of the RRP was to reduce the risk of exposure to diesel PM by 75 percent by 2010, and by 85 percent by 2020, from the 2000 baseline. The scope of the RRP was broad, addressing all categories of engines, both mobile and stationary, and included control measures for private and public fleets of on-road and off-road diesel vehicles.

[12] According to the OEHHA Guidelines, the relatively health-protective assumptions incorporated into the Tier 1 risk assessment make it unlikely that the risks are underestimated for the general population.

Since 2000, the Board has adopted a series of regulations to reduce risk from diesel particulate matter emissions. The regulations listed below have either been structured to require that each engine be equipped with the best available control technology (BACT) to reduce diesel PM emissions or require that fleets meet increasingly stringent fleet average emission rates.

- Solid waste collection vehicles (ARB, 2003a);
- Transit buses (ARB, 2005d);
- Transit fleet vehicles (ARB, 2005e);
- On-road public fleets and utility fleets (ARB, 2005f);
- Cargo handling equipment at ports and intermodal rail yards (ARB, 2005g);
- Stationary diesel engines (ARB, 2003b);
- Portable equipment (ARB, 2004);
- Ship auxiliary engines (ARB, 2005h);
- Transport refrigeration units (ARB, 2003c);
- School bus idling (ARB, 2002);
- Commercial vehicle idling (ARB, 2005i);
- In-use off-road diesel vehicles (ARB, 2007a);
- Commercial harborcraft (ARB, 2007b);
- Drayage trucks (ARB, 2007c);

Diesel engines have long useful lives with the capability of being rebuilt several times. Retrofit programs and the accelerated replacement of older engines with newer cleaner engines must play an important role in achieving the ARB's near term and long term air quality goals. The proposed regulation incorporates elements of both approaches to cleaning up the in-use on-road diesel fleet.

F. State Implementation Plan Commitments

In addition to playing a significant role in contributing to adverse health impacts to California's, diesel engines, and in particular on-road vehicles, are a significant contributor to poor air quality throughout the state. Fifteen areas in California are designated nonattainment of the federal ozone standard, including South Coast Air Basin, San Joaquin Valley, Sacramento region, San Diego, Ventura, and a number of air districts downwind of urban areas. In addition, the South Coast Air Basin and the San Joaquin Valley are designated nonattainment of the federal PM2.5 standard. Federal law mandates the development of SIPs documenting the actions the state will take to attain the federal air quality standards in these areas.

In September 2007, ARB adopted a SIP committing the State to develop measures to achieve emission reductions from sources under State regulatory authority. While multiple areas across the State exceed federal air quality standards, air quality in the South Coast and the San Joaquin Valley poses the greatest challenge and defines the amount of reductions needed. Reductions are needed by 2014 to meet the PM2.5 attainment deadline and by 2023 to meet the ozone attainment deadline. An interim target date of 2017 was adopted by ARB for the San Joaquin Valley as part of an effort to accelerate progress toward ozone attainment before 2023.

The largest share of new emission reductions in the 2007 SIP is expected from in-use on-road diesel vehicles. In 2014, reductions from both NOx and PM2.5 are needed to meet the PM2.5 standard. In 2023 and 2017, the focus from an ozone air quality standard attainment perspective is NOx. Therefore, ARB adopted 2014 reduction commitments for both NOx and PM2.5, and NOx commitments in 2017, 2020 and 2023. As part of the overall SIP commitment, ARB staff is also obligated to bring measures to the Board for its consideration. Board consideration of this proposed is one of these commitments. ARB staff has used the targeted reductions estimated in the SIP as the goal for this rulemaking.

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V. Vehicle Descriptions and Manufacturers

This chapter describes the diverse array of on-road vehicles typically used by businesses operating in California and that would be subject to the proposed regulation. It includes tables of engine, truck and bus manufacturers, descriptions, and photographs of various vehicle types with a range of body types.

A. Overview

Trucks and buses are used to both transport both people and goods and to provide services. They are used in almost every industry sector. Trucks and buses are configured differently for each application, thereby optimizing operational and fuel efficiency. Trucks and tractors (trucks designed specifically for pulling or hauling trailers) are configured differently depending on if they are being used to support a particular vocation or to primarily transport goods.

There are two basic truck configurations: tractor-trailer combinations and single unit trucks. Within each of these configurations, the vehicles will be designed differently depending on how they will be used. For example, tractors used to transport heavy equipment will have 500 to 600 horsepower (hp) engines, heavy frame construction, heavy front axles, 18 speed transmission, and tandem rear axles. The gross combination weights of these vehicles are 80,000 pounds or more. This compares with a standard tractor used locally to deliver beverages, which will have a 200 hp engine, a light frame configuration, single rear axle, and a 6 speed transmission.

Single unit vehicles range in weight class from 14,000 to well over 33,000 pounds. In addition, single unit trucks are generally sold as a cab and chassis, and can have hundreds of different bodies attached to transport dry goods, liquids, or perform a given service function such as cleaning out sewers, servicing equipment, or feeding cattle. Some single unit vehicles are also configured to carry its load and pull a trailer.

Similarly, buses range widely in size and configuration generally based on the number of passengers that can be carried. Shuttle buses carry a small number of passengers and operate locally, whereas motorcoaches are built to carry large number of passengers and travel longer distances.

B. Vehicle Classes

On-road vehicles are grouped by their gross vehicle weight rating (GVWR), ranging from class 1 to class 8. Class 1 to 3 are considered light-duty vehicles and weigh less than 14,000 pounds. Class 4 to 8 are vehicles with GVWR over 14,000 pounds and are subject to the on-road proposed regulation. In the trucking industry, GVWR is the gross vehicle weight (GVW) of a single unit truck plus its cargo weight or the GVW of a tractor plus the rated pulling capacity. These classifications are used consistently throughout the industry. Table V-1 shows the weight classifications as defined by the U.S. Department of Transportation (DOT).

Table V-1: Weight Classification Defined by U.S. DOT

		6,000	Light-duty	Light- Duty
Class 2	6,001	10,000	Light-duty	Light-Duty
Class 3	10,001	14,000	Medium-duty	Light-Duty
Class 4	14,001	16,000	Medium-duty	Medium-Duty
Class 5	16,001	19,500	Medium-duty	Medium-Duty
Class 6	19,501	26,000	Light-heavy	Medium-Duty
Class 7	26,001	33,000	Heavy-heavy	Heavy-Duty
Class 8	33,001		Heavy-heavy	Heavy-Duty

*VIUS 2002 Vehicle Inventory and Use Survey

C. Engine and Vehicle Manufacturers

1. On-Road Diesel Engines Manufacturers

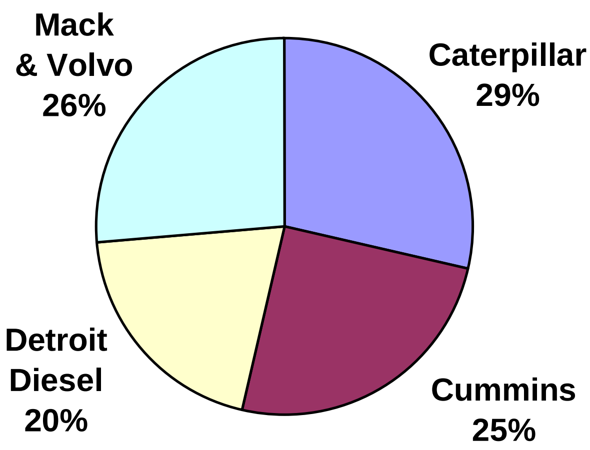
On-road diesel engines are manufactured globally for various duty ratings by different manufacturers. Some engine manufacturers produce engines for their own vehicles, but most sell them to other vehicle manufacturers. Engine manufacturers certify specific engine families to meet California engine emission standards within a specific service class or duty rating that is slightly different than the DOT vehicle rating. The engine service class used by vehicles rated greater than 14,000 pounds GWVR is the heavy-duty service class. The heavy-duty service class has three subclasses. Light heavy-duty engines are certified for use in vehicles up to 19,500 pounds GVWR, medium heavy-duty engines are certified for use in vehicles up to 33,000 pounds GVWR and heavy-heavy duty engines are certified for use in vehicles above 33,000 pounds. Operation of engines in these weight ranges ensures that the engine emissions meet California's engine exhaust emission standards. Table V-2 shows a list of common on-road engine manufacturers.

Table V-2: Common Manufacturer of On-Road Engines

Caterpillar	Cummins	Daimler Benz
Detroit Diesel	GMC	Ford
Hino	Hyundai	International
Isuzu	Mack	Mitsubishi
Navistar	Volvo	

In 2005 (the most recent year for which data is available), Caterpillar, Cummins and Detroit Diesel accounted for the majority of the engines produced to power class 8 vehicles. This is shown below in Figure V-1.

Figure V-1: Market Shares of Diesel Engine Manufacturers



As can be seen in Figure V-1, their respective market shares were 29 percent, 25 percent, and 20 percent (Diesel Progress, 2005). However, none of these engine manufacturers manufacture vehicles. The remaining market share of 26 percent was primarily divided between Mack and Volvo trucks who utilize their own engine in the vehicles they manufacture. Also small percentage of Daimler Benz diesel engines were used in Freightliner and Sterling class 8 trucks.

For class 4 through 7 vehicles, it is much more common for truck manufacturers to produce their own engines. Common class 4 through 7 truck manufacturers that produce their own engines include Ford, GMC, Hino, Isuzu, Mitsubishi, and International.

2. On-Road Vehicle Manufacturers

Presently, nearly 75 percent of vehicle manufacturers purchase engines from engine manufacturers, such as Caterpillar and Cummins, to fit their applications (Ward's, 2007). Truck and bus manufacturers design and manufacture their vehicles by integrating the engines into the frame of a complete vehicle or into a cab and chassis configuration with no bed or body attached.

All vehicle manufacturers produce different body types for a variety of applications. Most new tractors are sold with a wide range of special order options for the buyer to optimize the tractor for its intended application. In contrast, single unit trucks are primarily manufactured in somewhat more standardized cab and chassis configurations where the buyers select the configuration that most closely meets their needs, and add on the aftermarket bed and other equipment for vocational applications.

Many vehicle manufacturers tend to specialize in a particular weight class range or body style. For example, Ford, GMC and Mitsubishi produce light- to medium-duty trucks, while Freightliner and Peterbilt primarily offer heavy-duty (class 8) tractors. Table V-3 list the common manufacturers of trucks and tractors.

Table V-3: Common Manufacturers of Trucks and Tractors

Amertek	Autocar	Brockway	Capacity
Champion	Chevrolet	Diamond Reo	Dodge
Eagle	Ford	Freightliner	GMC
Hino	Hyundai	International	Isuzu
Kenworth	Lodal	Mack	Magnum
Marmon	Mercedes-Benz	Mitsubishi Fuso	Nissan
Oshkosh	Ottawa	Peterbilt	Sterling
UD	Volvo	Western Star	White

Similarly, bus manufacturers also service particular market segments. For example, Prevost and MCI primarily manufacture motorcoaches, Ford and GMC manufacture various shuttle buses, and Bluebird specializes in producing school buses. Table V-4 list the common manufacturer of buses and shuttle buses.

Table V-4: Common Manufacturers of Buses and Shuttle Buses

Bluebird	Carpenter	Champion
Collin	Eldorado National	Federal
Ford	Freightliner	Gillig
Girardin Minibus	Glaval Bus	GMC
Gosher Coach	Grumman	IC
International	Krystal Koach	MCI
Millennium	New Flyer	North American Bus
Nova Bus	Orion	Prevost
Setra	Starcraft	Thomas
TMC	Trident	Van Hool
Williams Bus & Specialty	World Trans	

D. Vehicle Types

There are thousands of vehicle types that will be subject to the proposed regulation. The following section provides an overview of a limited number of common vehicle types affected. Typical prices for new and used vehicles described below are provided in Appendix J.

1. Overview of Conventional Trucks

a) Over the Road Tractor

The most common tractors have either single or tandem rear axles. A single drive axle tractor is often used to pull shorter trailers or lighter loads and is easier to maneuver.

Day cabs are mostly single axle vehicles, and frequently used for shorter trips that can be completed during the course of a day. Tandem axle tractors are commonly used in long haul operations and for transporting heavier loads. Tractors with sleeper and tandem axles are predominately used for longer trips that require overnight stays. As conventional tractors age, they are typically sold into the secondary truck market. Here, they may be used locally or modified to become single unit vehicles with an attached bed.

Most conventional tractors are optimized for specific tasks, i.e., meaning that for a specific application like long haul, the tractor has a properly sized engine and drive train. The performance of a tractor can be altered by changing the engine size, and by changing the transmission and rear differential gear ratios. For example, a "heavy hauler", which hauls heavy loads at low speed, may trade speed for load carrying power by utilizing a lower gearing transmission and higher differential ratio without modifying the engine size. Various engine and drive train combinations allow the conversion of tractors from one application to another.

Tandem Axle Tractor with Sleeper

Single Axle Day Cab

b) Cab Over

Cab Over Tractor

A cab over is a body style of tractor that has a vertical front or "flat face", with the cab of the truck above the engine. The cab over design makes the tractor shorter than a conventional design where the engine is placed in front of the cab. Typically, the cab over is used in certain operations because it allows the operator to tow a longer trailer or have a longer cargo area while providing the same overall length as a conventional tractor trailer, thereby satisfying California vehicle length law restrictions. Compared to a conventional tractor, the cab over has the advantage of being more maneuverable. However, it also has disadvantages in that the entire cab needs to be tilted forward to access the engine, and it is somewhat more difficult to enter and exit. Demand for cab over tractors in the United States has declined to a point where truck manufacturers ceased production of cab over tractors in 2006.

(1) Glider Kit for Cab Over

A glider kit is a complete assembly of cab, front axle, wheels, and frame, plus all standard equipment (less the engine) that can be ordered from the manufacturer. The power train components and a new or remanufactured engine will need to be installed to make the complete vehicle. In some cases, the manufacturer will install the engine if it is purchased at the same time as the glider kit. Since the glider kit is not considered a new truck, the kit is exempt from federal excise tax.

c) Cab and Chassis

The cab and chassis is a single unit truck without a bed or body attached. Cab and chassis are available in all weight classes. While nearly all single unit trucks have fairly simple bolt-on bodies that are supported by the truck frame, there are literally thousands of different body types. In some applications the body will be replaced at least once before the end of the truck's useful life. In other instances, the body may be transferred to another truck.

Box Van Body

Cab and Chassis

Cab and Chassis with Dump Body

Cab and Chassis with Tank Body

The truck bed or body may vary from a simple flatbed or dry van (as described later in this chapter) with no moving parts to a body attachment with a tilt bed or having other moving parts such as a live floor or boom for lifting cargo. Power to operate the body is typically provided through a power take off (PTO) system (which draws power from the vehicles' main engine), which is a fairly common accessory to the existing transmission for most trucks. In only rare instances, such as with cement mixers, is the body welded to the frame for added strength.

Cab and chassis trucks also serve as the foundation for some manufacturers to produce complete vehicles (such as where the body is fully integrated with the rest of the truck), such as with street sweepers.

2. Common Vehicle Types

a) Dump Trucks

A dump truck (or production truck) is used for transporting loose material such as sand, gravel, or dirt for construction activities. There are several configurations of dump trucks, including standard dump, superdumps, transfer dumps, end dumps, and bottom dumps.

A standard dump truck is a full truck chassis with a dump body mounted to the frame. The dump body is raised by a hydraulic ram mounted forward of the front bulkhead, between the truck cab (traction unit) and the dump body. The tailgate can be configured to swing on hinges or it can be configured in the "High Lift Tailgate" position, wherein pneumatic rams lift the gate up and open above the dump body. The short wheelbase of a standard dump truck makes it more maneuverable than the higher capacity tractor-trailer combination of end dumps and bottom dump trucks.

Medium Duty Standard Dump Truck

A superdump truck is a standard dump truck equipped with an additional liftable, load-bearing axle. The additional axle increases the gross weight allowing for additional payload. When the truck is empty, the additional axle toggles up off the road surface on two hydraulic arms. A typical superdump truck is equipped with a hydraulically operated open-box bed hinged at the rear, the front of which can be lifted up to allow the contents to be deposited on the ground behind the truck at the delivery site.

Superdumps

A transfer dump is a combination of a standard dump truck pulling a separate trailer whose rear box is capable of being transferred from the trailer frame rails onto the empty dump bed on the truck. It is predominantly used to transport asphalt, aggregates, or other small material. The second container on the trailer rides on small wheels and rolls on rails off of the trailer frame and into the empty main dump box. The rear box locks onto the dump bed on the truck allowing it to be dumped as a single unit. After the load is dumped the second container is rolled out of the truck and back on to the trailer rails.

Transfer Dump Truck

The key advantage of this configuration is to maximize payload capacity without sacrificing the maneuverability of the standard dump truck. Transfer trucks are uniquely configured for operation in California and are not used in other parts of the country.

End dump and bottom dump trucks are both tractor-trailer combinations. Both configurations utilize either single rear axles or tandem rear axles to tow the dump trailers. The end dump trailer uses a hydraulic hoist on the trailer to dump and is powered by the tractor. Its advantage is rapid unloading. The bottom dump trailer can be a single long trailer or a double trailer with a metal hopper configuration with angled sides. It pours materials out of the bottom as it moves along the road. This is used whenever small amounts of material are needed over a large area, such as on a roadway under construction.

Bottom Dump Truck

b) Body Load

The body load truck is a truck with equipment integrated directly into the frame of the truck. The equipment is built on the truck piece by piece (above and below the frame rails) as opposed to having it installed on a bed that is bolted on top of the truck rails. These trucks usually have heavy frame with two or more axles. The integrated equipment can cost more than a half million dollars and would have to be dismantled piece by piece to be

Body Load Blender

moved to a different cab and chassis. An example of a body load application is a vehicle used for the fracturing operation performing in the oil field to increase well production.

c) Tank Truck

A tank truck is a vehicle designed to carry liquefied loads, dry bulk cargo or gases. Many variants exist due to the wide variety of liquids that can be transported. The tank on the trucks may be insulated or non-insulated, pressurized or non-pressurized, and for single load or built with internal divisions for multiple loads (such as to carry different grades of gasoline). A large tank truck typically has a capacity of up to 8,000 gallons. A smaller tank truck typically has a capacity of less than 3,000 gallons, but can be increased to as much as 9,000 gallons through the use of a trailer, commonly referred to as a “pup”.

Water Trank Truck

A tank truck is distinguished by its shape, usually a cylindrical tank upon the vehicle lying horizontally. Some other less visible distinctions among tank trucks are their intended use: compliance with human food regulations, refrigeration capability, acid resistance, pressurization capability, etc.

Fuel Tank Truck with Pup

d) Vacuum Truck

A vacuum truck is a tank truck with a pumping system to pump and store fluid for transporting from one location to another. The pumping system and the accessories are normally mounted on the truck and power by a PTO unit. The vacuum tank may have internal divisions to store both the cleaning fluids to be used at the job site, as well as the generated waste.

Vacuum Truck

e) Box Truck (Dry Van)

A box truck, also known as a cube truck, cube van, bob truck, or box van, is a truck with a cube shaped cargo area. These types of truck vary in length, and some have tandem axles. They

Dry Van

usually have a garage like rear door that rolls up. On some box trucks, the cargo area is accessible from the cabin via a small door. Box trucks are used by companies to haul a wide variety of items locally. They are also commonly used as retail rental moving trucks.

f) Refrigerated (Reefer) Truck

A refrigerated truck is a highly insulated van truck designed to carry perishable freight at low temperatures. Refrigerated trucks can be ice-cooled, be equipped with any one of a variety of mechanical refrigeration systems, or can utilize carbon dioxide (either as dry ice or in liquid form) as a cooling agent.

Reefer Truck

g) Motorcoach

Motorcoaches are generally designed and operated to transport passengers over long distances. To make the trip comfortable, these coaches often have reclining upholstered seats, a toilet, and air-conditioning. Because they are designed for long distance travel (instead of having to take on and discharge many passengers over very short runs), it is rare for a motorcoach to have more than one door (save for a wheelchair-lift access) or standing room. As these vehicles age, their use tends to change such that they are used for shorter trips.

Motorcoach

h) Flatbed Truck

A flatbed truck is a type of truck that has an entirely flat, level body with no sides or roof. This allows for quick and easy loading of goods using a crane or forklift, and is typically used to transport heavy loads that are not delicate or vulnerable to precipitation. They are also used for unusually shaped loads that require more space than is available on a closed body.

Flat Bed Truck

i) Concrete (Cement) Truck

A concrete truck (also known as in-transit mixers) is designed to transport concrete from a factory/plant to a construction site. Typically, they are charged with dry materials and water at the factory/plant, with the mixing occurring

Concrete Truck

during transport. The interior of the drum on a concrete truck is fitted with a spiral blade. The drum is typically powered by a PTO unit. In one rotational direction, the concrete is pushed deeper into the drum while the concrete is being transported to the building site. When the drum rotates in the other direction, the screw-type arrangement “discharges”, or forces the concrete out of the drum, typically into a chute.

j) Bucket Truck

A bucket truck has a working platform, such as like a bucket at the end of a hydraulic lifting system. These vehicles are also known as a boom (or man) lift truck. They are used to support work at a high elevation above ground. The bucket is designed for a person to stand in and work from. The controls for manipulating the position of the bucket are in or near the bucket. Another set of controls are on the truck for controlling the lifting system when the operator is on the ground.

Bucket Truck

k) Cranes

Lattice boom cranes can be both truck mounted or crawler (truck) mounted. With the truck mounted version, the crane's upper structure is mounted on a truck style carrier and can travel at highway speeds. Major sections of the crane’s boom are usually removed and transported separately on some larger units.

Lattice Boom Truck Crane

Two-Engine All Terrain Crane

A lattice boom crane is typically the best choice when the job requires long, vertical reaches, or significantly large lifts. The advantage of a lattice boom crane is that the mast is relatively light in comparison to a telescope crane, making it much stronger in terms of working radius. A lattice boom crane typically provides higher lifting capacity for less vehicle weight, making a 100

Two Engine Truck Mounted Crane

ton capacity lattice boom crane outperform a 200 ton capacity telescopic crane.

Two-engine all terrain cranes combine truck crane highway speeds with the off-road performance characteristics of rough terrain cranes. Multiple axles (steer, drive and tag) distribute the load. Capacity on these machines can reach 1,000 tons.

Two-engine truck mounted cranes have a long reach, high capacity booms and highway speed capabilities. Truck mounted cranes sit on a commercial truck chassis with a motive engine or secondary engine to power the crane operation.

l) Boom Truck

Single engine boom trucks look similar to two-engine truck mounted cranes. They utilize a telescoping boom and perform the same functions as all-terrain and truck mounted cranes, and have a lift capacity of about 40 tons. The boom is powered by the motive engine, eliminating the need for a secondary engine. Boom trucks come with fixed operator control stations or cabs that swing with the cranes.

Single Engine Boom Truck

m) Street Sweepers

Sweepers are designed to removed dirt and debris from roadways, and can be categorized into two main types: mechanical and air sweepers. Mechanical sweepers are equipped with water tanks and sprayers used to loosen particles and reduce dust. The brooms gather debris into a main collection area from which it is vacuumed and pumped into a collection bin.

An air street sweeper uses forced air to create a swirling knifing effect inside a contained sweeping head and then uses the negative pressure on the suction side to lift the road debris into a containment hopper. The debris laden air is then filtered and discharged. Sweepers may have a single engine with that provides power to propel the sweeper and to operate the broom or vacuum, or may have a second (auxiliary) engine to separately operate the broom or vacuum.

Two Engine Regenerative Air Sweeper

n) Tow Truck

A tow truck (also called a wrecker) is a vehicle used to transport disabled vehicles from one location to another (generally a repair garage), to recover disabled vehicles, and to assist in clearing streets and highways of breakdowns and collisions. Businesses and government agencies with a large fleet of vehicles may own one or several tow trucks for the purposes of towing their own vehicles. They are also used to impound vehicles for various reasons such as parking violations. The towing and lifting mechanisms on a tow truck are powered by a PTO unit.

Wrecker Truck

o) Drill Rig

A drill rig is a machine which drills holes (usually called boreholes) and/or shafts into the ground. Drill rigs are used to drill water wells, oil wells, or natural gas extraction wells. They are used to sample sub-surface mineral deposits, test rock, soil and groundwater physical properties, and to install sub-surface fabrications, such as underground utilities, instrumentation or tunnels. Drill rigs can be mobile equipment mounted on trucks, tracks or trailers, and can vary significantly in size. In some drill rigs, the drilling operations are supported by the drive engines using PTO. In other cases, dedicated secondary engines are used to provide the power.

Two Engine Drill Rig

p) School Buses

School buses are generally classified in one of four categories. Type-A school buses are the smallest school buses, and they are typically gasoline-fueled, although they can also be diesel-fueled. They, typically, tend to be below 14,000 pounds GVWR, and have a driver side door. Type-B school buses are larger, typically greater than 10,000 pounds GVWR, and can be gasoline or diesel-fueled. Type-B school buses are normally used for special needs student transportation. Type-C school buses, also called conventional school buses, are typically diesel fueled and have the engine in the front of bus. These school buses tend to be above 14,000 pounds GVWR.

School Bus

Type-D school buses, also called transit style school buses, are almost always diesel-fueled, having a rear-mounted engine. Type-D school buses can be greater than 33,000 pounds GVWR, and having the ability to transport up to 90 students and passengers.

3. Agricultural Vehicles

Agricultural vehicles include a wide variety of vehicles used on and off the farm for a number of different purposes.

a) Farm Vehicles

Farm use vehicles are typically single unit trucks with bodies uniquely designed for farming operations such as fertilizing, feeding, spraying, etc. While on farm vehicles typically have on-road engines and can travel on city streets, they spend a majority of their time operating off-road on the farm. Some have special equipment (SE) plates while others are not registered at all.

When a single unit truck needs replacement, typically the truck bed can be removed and transferred to another new or used single unit truck. However, it is not uncommon for some on farm vehicles having a new truck body installed on a used single unit truck or a used tractor that has been converted to a single unit truck.

Livestock Feeder

Farm Sprayer

Spreader

Silage

b) Farm to First Processing

Farm vehicles also include vehicles used to transport commodities to processing facilities. For transporting commodities, tractor trailer combinations are typically used. This would include the use of tractors and refrigerated trailers to transport lettuce as well as transporting cattle in livestock trailers.

A cotton module truck is either a single unit truck or a tractor-trailer that is used to transport the compacted cotton block from the field to the cotton gin for processing. Single unit cotton module trucks have a long chassis design to accommodate the length of the cotton module. The body or trailer has a built-in mechanism that pulls the vehicle underneath the compacted cotton module (bale) while in the field. In California, cotton module trucks mostly have SE plates allowing for short distance, on-highway travel. Normal commercial plates are needed only if the cotton module is used for long distance hauling on a major freeway.

The wheelbase for a single unit cotton module vehicle is over 300 inches, which is longer than most other single unit trucks. This means that the frame needs to be special ordered prior to configuring a new cotton module truck. It also requires a double frame to strengthen the chassis due to its overall length.

Cotton Module

A new truck with a cotton module body costs about $190,000. Transferring an existing cotton module body to a used single unit truck is possible, but finding an existing truck with an appropriate wheelbase and frame is challenging. An existing cotton module body can be transferred to a properly configured new truck for about $130,000.

c) Chemical & Fertilizer Delivery Truck

Chemicals used on the farm include pesticides and fertilizer among others. Both come in dry or wet form and are generally transported to the farm with either single unit trucks or truck-tractor and trailer combinations. Certain types of fertilizers are considered hazardous materials and their transportation is highly regulated and all pesticides and other crop protection chemical are considered hazardous materials. Transportation of these products requires special vehicles markings in the form of U.S. DOT placards and transportation vessels must meet strict safety regulations.

Chemical & Fertilizer Truck

4. Logging Truck

Logging Truck

The transportation of raw, harvested logs from a forest is done via tractor trailer. This combination consists of a tractor and a long metal beam connecting the trailing two-axle set. This beam is typically small in diameter, and several feet above the road surface. The operational requirements of a logging truck make it different from a conventional tractor.

Although it may be used to transport lumber products to a specific location (similar to work done by a conventional tractor), the majority of the time it is utilized to move harvested logs from a fell site in the forest to the saw mill for processing. Log trucks are somewhat unique in that they work in the forest and negotiate steep dirt logging roads. To perform this work, they have larger frame rails, 18 speed heavy duty transmissions, 46,000 pounds rear differential/axle sets, heavy duty rear wheels, severe service cabs, and heavy duty rear suspensions.

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VI. ESTIMATED EMISSIONS FROM ON-ROAD DIESEL TRUCKS AND BUSES

This chapter describes the emissions inventory that was developed for the proposed regulation for heavy-duty diesel vehicles operating in California. It summarizes how multiple data sources were utilized to develop estimates of both the vehicle population and VMT in California; how ARB's on-road emissions inventory model (EMFAC) was used to assess emission rates, and how the emissions estimates were developed. The chapter presents statewide emissions estimates in the baseline, without regulation. Additional details are provided in Appendix G.

A. Methodology

Emissions are calculated as the product of a population of vehicles, the number of miles each vehicle travels, and the emission rates per mile. Beneath this simple equation lies a series of data and assumptions about the population, miles traveled, and emission rates per vehicle model year in a given calendar year, growth and attrition estimates, deterioration, and other factors that affect emissions estimates. Staff updated approach for estimating commercial in-use on-road heavy-duty diesel vehicle emissions builds on the below equation by applying it separately for selected categories of vehicles. These categories were selected by evaluating different groups of vehicles that have travel, service, size, age or other characteristics in common. Staff's methodology used the following equation:

$$\sum_{MY,\,C} \left(POP_{MY,\,C} \text{ X } AC_{MY,\,C} \text{ X } ER_{MY,\,C}\right) = EMS_{CY},$$

where: $POP_{MY,\,C}$ is the population of vehicles for model year MY within each inventory category C for a given calendar year;

$AC_{MY,\,C}$ is the accrual rate (miles traveled per year) per vehicle by model year MY and inventory category C in a given calendar year;

$ER_{MY,\,C}$ is the calculated emission rate, in grams pollutant per mile driven, assuming statewide speed travel distributions in EMFAC2007 and fleet specific cumulative mileage accrual over the life of the vehicle, by model year MY and inventory category C;

EMS_{CY} is the emissions calculated in tons per day for a given calendar year.

In this new analysis, staff assessed a population and model year distribution for each vehicle category. Staff also estimated accrual rate by model year for the category and cumulative mileage accrual (odometer) by model year. Because vehicles can move between categories as they age, staff assessed the movement of vehicles between categories in order to develop more accurate cumulative mileage accrual estimates. As a result, cumulative odometer readings by model year will not necessarily be consistent with accrual schedules for each specific category. Criteria pollutant emission rates are developed using the 2007 version of EMFAC (EMFAC2007) and statewide speed distributions, and emission rates were adjusted for modeled odometer readings, by category. Carbon dioxide (CO_2) emission rates were developed based on analysis of fuel economy trends over time and across engine control technologies.

B. Population and Activity

For the purposes of this regulation, the truck and bus population was divided into four broad inventory categories. Heavy-heavy duty diesel trucks were those trucks that exceed 33,000 GVWR. They may be combination trucks (tractor-trailer) or single unit trucks. Medium-heavy duty diesel trucks were those trucks with a GVWR between 14,000 and 33,000 pounds. These trucks are most often single units, although some are combination trucks. The third category represented two types of buses: school buses and other buses. The 'other' bus category included primarily intercity, charter, or private buses that are not used to transport school children and are not operated as public transit buses. The final category was power take off, which represents the use of on-road engines to power auxiliary applications, such as a drill rig or concrete truck.

1. Base Year Population, Age Distribution, and Mileage Accrual

Table VI-1 summarizes the data sources that were used to develop estimates of vehicle population and activity, including annual average mileage accrual.

Table VI-1: Data Sources Used to Develop Population and Activity Estimates

Type / Category	Population	Activity
Heavy-Heavy / Out-of-State	CA Department of Motor Vehicles (DMV) International Registration Plan (IRP) reports; adjusted to account only for vehicles that enter California. Model-year distribution from IRP data and UC Davis survey. Category split between neighboring states (WA, OR, NV, AZ, ID) vs non-neighboring states.	Vehicle Inventory and Use Survey (VIUS) (2002) data analyzed to assess accrual for vehicles in any state that travel across state lines (registered in IRP program). Fraction of mileage accrued in California estimated using IRP data samples. Total activity in out-of-state vehicles by state of registration from International Fuel Tax Agreement Data (IFTA).
Heavy-Heavy / California-Interstate	DMV CA IRP reports provide population by model year	VIUS for nationally registered vehicles in IRP as above. CA IRP reports fraction of mileage accrued in CA, and IFTA reports for total mileage.
Heavy-Heavy / In-State Tractor	DMV registration data provides population by model year and body type. Adjusted to subtract specific fleets such as utility, drayage, and others.	VIUS data for California-registered tractors.
Heavy-Heavy / In-State Single	DMV registration data provides population by model year and body type. Adjusted to subtract specific fleets such as utility and others.	VIUS data for California-registered single unit vehicles.
Heavy-Heavy / Drayage Tractors	Population and age distributions estimated using license plate and gate count surveys conducted at the Ports of Los Angeles, Long Beach, and Oakland.	Total mileage estimated using trip-based model developed for ARB Drayage Truck Regulation. Mileage accrual assumed equivalent to the total miles traveled by drayage trucks divided by the total number of trucks.
Heavy-Heavy / Agricultural Vehicles	Age distribution from survey; population extrapolated from survey results; specialty vehicles estimated from survey and DMV registration data.	Accrual from in-use on-road diesel vehicle survey
Heavy-Heavy / Utility Vehicles	Population and age of vehicles registered to public and private utilities in DMV database.	Surveys conducted for ARB Public Agency & Utility Fleet Rule.
Medium-Heavy / In-State Vehicles	Population and age distribution in DMV registration data	VIUS 2002 data representing California registered medium-heavy duty diesel vehicles.
Medium-Heavy / Interstate Vehicles	Population estimated from IRP reports	VIUS 2002 data representing California-registered medium-heavy duty diesel vehicles.
Medium-Heavy / Agricultural Vehicles	Age distribution from survey; population extrapolated from survey results; specialty vehicles estimated from survey and registration data.	Accrual from in-use on-road diesel vehicle survey
Medium-Heavy / Utility Vehicles	Population and age of vehicles registered to public and private utilities in DMV database.	Surveys conducted for ARB Public Agency & Utility Fleet Rule.
Buses / School	California Highway Patrol data	ARB school bus surveys
Buses / Other	EMFAC2007	EMFAC2007
Other / Power Take-Off	No population estimated. Total fuel usage provided by California State Board of Equalization; age distribution assumed same as in-state single unit vehicles	Fuel usage converted to equivalent mileage assuming EMFAC speed distributions and fuel economy.

2. Base Year Population and VMT by Category and Fleet Size

Most of the inventory categories described in Table VI-1 are further split by fleet size. To achieve the fleet size split by inventory category, ARB staff reviewed California Department of Motor Vehicles (DMV) registration data by name and address and grouped vehicles by fleet. This resulted in an age distribution by fleet size (fleets of one vehicle, two or three vehicles, and four or greater) for inventory categories in the DMV registration database. Neighboring out-of-state vehicles (those registered in Arizona, Nevada, Oregon, and Idaho) were assumed to have the same fleet size distribution as California registered IRP vehicles; for non-neighboring out-of-state vehicles, staff analyzed sample International Registration Program (IRP) data. Mileage accrual was assumed to be the same within each inventory category regardless of fleet size. Table VI-2 provides the population, VMT-weighted average age, and total VMT in calendar year 2008, by inventory category and fleet size.

Table VI-2: 2008 Population, VMT, and VMT-Weighted Average Age by Inventory Category, Fleet Size, and Mileage Thresholds

Fleet	Source	Population	VMT/day	VMT-Weighted Average Age
Heavy-Heavy Non-Neighboring Out-of-State Vehicle		**450,658**	**12,194,654**	**3.1**
	Owner-operator vehicle above 7500 miles/yr	6,955	192,875	3.1
	Owner-operator vehicle below 7500 miles/yr	180	188	8.3
	2 vehicle fleet above 7500 miles/yr	2,125	58,926	3.1
	2 vehicle fleet below 7500 miles/yr	55	58	8.3
	3 vehicle fleet above 7500 miles/yr	1,505	41,740	3.1
	3 vehicle fleet below 7500 miles/yr	39	41	8.3
	Large fleets above 7500 miles/yr	428,702	11,889,217	3.1
	Large fleets below 7500 miles/yr	11,097	11,610	8.3
Heavy-Heavy Neighboring State Out-of-State Vehicle		**41,682**	**3,947,672**	**5.2**
	Owner-operator vehicle above 7500 miles/yr	5,056	501,599	5.1
	Owner-operator vehicle below 7500 miles/yr	252	1,149	11.1
	2 vehicle fleet above 7500 miles/yr	1,571	155,808	5.1
	2 vehicle fleet below 7500 miles/yr	78	357	11.1
	3 vehicle fleet above 7500 miles/yr	1,147	113,815	5.1
	3 vehicle fleet below 7500 miles/yr	57	261	11.1
	Large fleets above 7500 miles/yr	31,928	3,167,429	5.1
	Large fleets below 7500 miles/yr	1,592	7,253	11.1
Heavy-Heavy California Registered IRP Vehicle		**60,263**	**8,282,725**	**5.2**
	Owner-operator vehicle above 7500 miles/yr	15,980	2,198,998	6
	Owner-operator vehicle below 7500 miles/yr	883	5,804	10.8
	2 vehicle fleet above 7500 miles/yr	5,850	812,823	5.8
	2 vehicle fleet below 7500 miles/yr	318	2,096	10.9
	3 vehicle fleet above 7500 miles/yr	3,297	460,037	5.7
	3 vehicle fleet below 7500 miles/yr	183	1,223	11.4
	Large fleets above 7500 miles/yr	32,273	4,791,942	4.6
	Large fleets below 7500 miles/yr	1,479	9,801	11.3

Fleet	Source	Population	VMT/day	VMT-Weighted Average Age
Heavy-Heavy Duty In-State Tractor		**63,684**	**10,413,751**	**8.0**
	Owner-operator vehicle above 7500 miles/yr	16,792	3,031,868	10.1
	Owner-operator vehicle below 7500 miles/yr	4,089	44,925	15.2
	2 vehicle fleet above 7500 miles/yr	4,928	902,069	9.7
	2 vehicle fleet below 7500 miles/yr	1,189	12,992	15.4
	3 vehicle fleet above 7500 miles/yr	2,876	529,836	9.5
	3 vehicle fleet below 7500 miles/yr	673	7,370	15.3
	Large fleets above 7500 miles/yr	28,859	5,835,899	6.4
	Large fleets below 7500 miles/yr	4,278	48,792	13.6
Heavy-Heavy Single Unit In-State Vehicles		**43,275**	**3,410,860**	**8.4**
	Owner-operator vehicle above 7500 miles/yr	7,819	766,081	10.3
	Owner-operator vehicle below 7500 miles/yr	3,358	37,585	15.6
	2 vehicle fleet above 7500 miles/yr	2,826	279,769	9.9
	2 vehicle fleet below 7500 miles/yr	1,171	13,153	15.5
	3 vehicle fleet above 7500 miles/yr	1,857	185,491	9.2
	3 vehicle fleet below 7500 miles/yr	703	7,951	14.8
	Large fleets above 7500 miles/yr	20,001	2,057,340	7.1
	Large fleets below 7500 miles/yr	5,540	63,491	13.5
Heavy-Heavy Drayage Vehicles		**21,650**	**2,898,907**	**11.8**
	Serving Non-South Coast and Bay Area Facilities	1,513	236,542	9.1
	Owner-operator vehicle above 7500 miles/yr	813	127,097	9.1
	2 vehicle fleet above 7500 miles/yr	90	14,122	9.1
	3 vehicle fleet above 7500 miles/yr	102	15,887	9.1
	Large fleets above 7500 miles/yr	508	79,436	9.1
	Serving Bay Area Facilities	3,032	391,868	9.7
	Owner-operator vehicle above 7500 miles/yr	1,629	210,556	9.7
	2 vehicle fleet above 7500 miles/yr	181	23,395	9.7
	3 vehicle fleet above 7500 miles/yr	204	26,319	9.7
	Large fleets above 7500 miles/yr	1,018	131,597	9.7
	Serving South Coast Facilities	17,105	2,270,498	12.4
	Owner-operator vehicle above 7500 miles/yr	9,191	1,219,969	12.4
	2 vehicle fleet above 7500 miles/yr	1,021	135,552	12.4
	3 vehicle fleet above 7500 miles/yr	1,149	152,496	12.4
	Large fleets above 7500 miles/yr	5,744	762,481	12.4
Heavy-Heavy Agricultural Vehicle		**11,998**	**878,486**	**11.4**
	Non-Specialty Agricultural Vehicle Above 1st mileage limit (15-25k miles/yr depending on age)	4,098	645,375	10.5
	Non-Specialty Agricultural Vehicle Below 2nd mileage limit (10,000 miles/yr)	5,258	82,489	17.1

Fleet	Source	Population	VMT/day	VMT-Weighted Average Age
	Agricultural Non-Specialty Vehicle greater than 10,000 miles/yr, less than 1st threshold	1,442	62,773	12.5
	Agricultural Specialty Vehicle	1,200	87,849	11.4
Heavy-Heavy Duty Utility Vehicle		**1,357**	**33,801**	**8.2**
Medium-Heavy Out-of-State Vehicles		**7,235**	**42,871**	**4.6**
	Owner-operator fleet above 5000 miles/yr	824	5,552	4.3
	Owner-operator fleet below 5000 miles/yr	87	54	8.2
	2 vehicle fleet above 5000 miles/yr	519	3,450	4.3
	2 vehicle fleet below 5000 miles/yr	57	35	8.4
	3 vehicle fleet above 5000 miles/yr	519	3,407	4.5
	3 vehicle fleet below 5000 miles/yr	63	39	9.2
	Large fleet above 5000 miles/yr	4,594	29,980	4.7
	Large fleet below 5000 miles/yr	572	353	9.4
Medium-Heavy California Registered IRP Vehicles		**1,661**	**74,777**	**4.6**
	Owner-operator fleet above 5000 miles/yr	189	9,684	4.3
	Owner-operator fleet below 5000 miles/yr	20	95	8.2
	2 vehicle fleet above 5000 miles/yr	119	6,018	4.3
	2 vehicle fleet below 5000 miles/yr	13	61	8.4
	3 vehicle fleet above 5000 miles/yr	119	5,943	4.5
	3 vehicle fleet below 5000 miles/yr	14	68	9.2
	Large fleet above 5000 miles/yr	1,054	52,292	4.7
	Large fleet below 5000 miles/yr	131	616	9.4
Medium-Heavy California Registered In-State Vehicles		**198,525**	**12,731,247**	**6.4**
	Owner-operator fleet above 5000 miles/yr	51,066	3,786,410	7
	Owner-operator fleet below 5000 miles/yr	11,592	80,942	13.4
	2 vehicle fleet above 5000 miles/yr	16,710	1,244,223	6.8
	2 vehicle fleet below 5000 miles/yr	3,621	25,478	13.1
	3 vehicle fleet above 5000 miles/yr	9,964	740,914	6.9
	3 vehicle fleet below 5000 miles/yr	2,143	15,111	13
	Large fleet above 5000 miles/yr	88,520	6,731,027	5.7
	Large fleet below 5000 miles/yr	14,908	107,142	11.6
Medium-Heavy Agricultural Vehicles		**9,438**	**342,652**	**10.5**
	Non-Specialty Agricultural Vehicle Above 1st mileage limit (15-25k miles/yr depending on age)	1,750	183,598	9.2
	Non-Specialty Agricultural Vehicle Below 2nd mileage limit (10,000 miles/yr)	4,799	46,021	16
	Agricultural Non-Specialty Vehicle greater than 10,000 miles/yr, less than 1st threshold	1,946	78,768	10.3
	Agricultural Specialty Vehicle	944	34,265	10.5
Medium-Heavy Utility Vehicle		**2,798**	**55,942**	**6.7**
School Bus		**16,469**	**633,823**	**11.6**

Fleet Source	Population	VMT/day	VMT-Weighted Average Age
Other Bus	**9,974**	**574,946**	**6.7**
Power Take Off	**--**	**492,322**	**10.2**
TOTAL	**940,667**	**57,009,437**	**6.4**

In 2008, staff estimates that heavy-heavy duty diesel vehicles are responsible for 73.8 percent of the population and 74.2 percent of the VMT in vehicles covered by this inventory. Medium-heavy duty vehicles are responsible for 23.4 percent of the population and 23.4 percent of the VMT, while other categories including buses are responsible for 2.8 percent of the population and 2.3 percent of the VMT. Within the heavy-heavy duty vehicle category, interstate vehicles, which include California registered (CA IRP) and out-of-state registered vehicles that operate inside and outside of California, are responsible for 59 percent of the population and 43 percent of the VMT, while in-state heavy-heavy duty vehicles, those vehicles which travel only within California, are responsible for 15 percent of the population and 31 percent of the VMT. These results are summarized in Table VI-3.

Table VI-3: Percentage of Population and VMT by Vehicle Type

Vehicle Type	% of Population	% of VMT
Heavy-heavy duty vehicles (CA IRP and out-of-state registered)	59	43
Heavy-heavy duty vehicles (CA registered)	15	31
Medium-heavy duty vehicles	23.4	23.4
Buses	2.8	2.3

The age distribution of vehicles in a given calendar year has a significant impact on emissions estimates. For comparison purposes, it is useful to evaluate the VMT-weighted average age of vehicles across inventory categories. The VMT-weighted age metric accounts for both the age of the vehicles in each category, and the fact that in most categories, newer vehicles drive more than older vehicles. The average VMT-weighted age of the truck and bus fleet operating in California, including both in-state and out-of-state vehicles, is 6.4 years. Inventory categories that contain the highest fraction of vehicles in large fleets and in long haul routes, such as out-of-state and California registered interstate vehicles, are younger than this average. Inventory categories that contain the highest fraction of small fleets and do not travel outside of California are older than average. Within given inventory categories, vehicles and fleets that accrue more mileage per year tend to be newer, while vehicles accruing less mileage per year are older. On average, small fleets are older than large fleets.

3. Mileage Thresholds

Once VMT was calculated, staff estimated the proportion of total VMT that was above and below mileage thresholds relevant to the regulation. To calculate this, ARB staff started with data from Vehicle Inventory and Use Survey (VIUS) 2002 and/or other surveys used to develop mileage accrual schedules for each category. Staff sorted data from lowest to highest mileage by model year and inventory category. Each mileage threshold was then assessed; for example to estimate the 7,500 mileage threshold in each category the total population of vehicles in the accrual data was calculated, as was the population of vehicles reporting miles above and below the threshold. At the same time, staff estimated the total accrued mileage for all vehicles in the category, as well as for vehicles above and below the 7,500 mile threshold. The result was a statistic for each category that indicated the percentage of population and VMT in the category that is estimated to represent vehicles in fleets below the assessed mileage threshold.

Table VI-4 provides the percent of population and VMT below the mileage thresholds, by inventory category, in 2008. For this analysis, staff assumed the fraction of population and mileage below the mileage threshold was not impacted by fleet size.

Table VI-4: Distribution of Population and VMT by Mileage Threshold (2008)

Type / Category	Mileage Threshold	Percent of VMT Below Mileage Threshold	Percent of Population Below Mileage Threshold
Heavy-Heavy / Out-of-State	7,500	0.1%	2.7%
Heavy-Heavy / California-Interstate	7,500	0.2%	4.8%
Heavy-Heavy / In-state Tractor	7,500	1.1%	16.1%
Heavy-Heavy / In-state Single	7,500	3.6%	24.9%
Heavy-Heavy / Drayage Tractors	7,500	0%	0%
Heavy-Heavy / Agricultural Vehicles	15/20/25*	16.5%	55.8%
	10,000	9.4%	43.8%
Medium-Heavy / In-state Vehicles	5,000	1.8%	16.3%
Medium-Heavy / Interstate Vehicles	5,000	1.1%	10.8%
Medium-Heavy / Agricultural Vehicles	15/20/25*	36.4%	71.5%
	10,000	13.4%	50.8%

* 15,000 miles/yr would apply to pre-1996 model year vehicles; 20,000 miles/yr would apply to 1996-2005 model year vehicles; and 25,000 miles/yr would apply to 2006 and newer model year vehicles.

4. Fraction of Mileage Accrual in California

Out-of-state vehicles operating in California drive only a portion of their miles in California. Staff analyzed IRP data from 12 states (Alabama, Arizona, Idaho, Indiana, Nebraska, New Jersey, Nevada, Oklahoma, Oregon, Texas, and Wisconsin) to assess the fraction of miles traveled in California from out-of-state vehicles. Staff then compared this to International Fuel Tax Agreement (IFTA) data which provided estimates for the total miles traveled in 2005, 2006, and 2007 for vehicles registered in each of the fifty states and eight Canadian jurisdictions that are a party to that program.

Estimates of the fraction of out-of-state vehicle VMT that is accrued in California in 2008 are shown in Table VI-5.

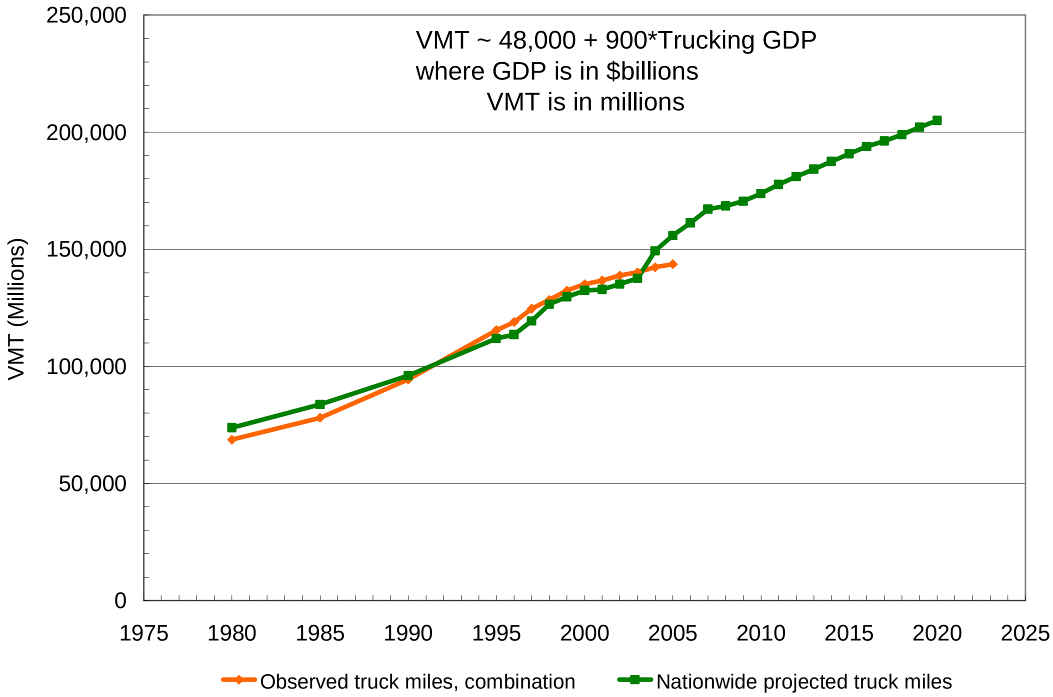
Table VI-5: Fraction of Miles Traveled in California for Out-of-State Categories

Type / Category	Fraction of Mileage Accrued in California
Heavy-Heavy / Non-Neighboring Out-of-State	9.9%
Heavy-Heavy / Neighboring Out-of-State	39.3%
Heavy-Heavy / CA IRP	57.0%
Medium-Heavy / Interstate Vehicles	18.7%

5. Forecasting Population and VMT

In order to forecast emissions in the future, staff assessed growth in population and VMT. Staff started by comparing growth rates embedded in EMFAC2007. Those growth rates are composited from individual estimates made by regional transportation planning agencies and provide a statewide growth heavy-duty vehicle VMT growth rate of approximately 2 percent per year. Staff found this statewide average growth rate to be consistent with the historical national growth in transportation related gross domestic product through 2006, as shown in Figure VI-1. The growth rates developed by transportation agencies are designed to represent average growth over long periods of time and are not designed to forecast periods of economic growth or recession.

Figure VI-1: The Historic and Projected Relationship between VMT and GDP on a Nationwide Level

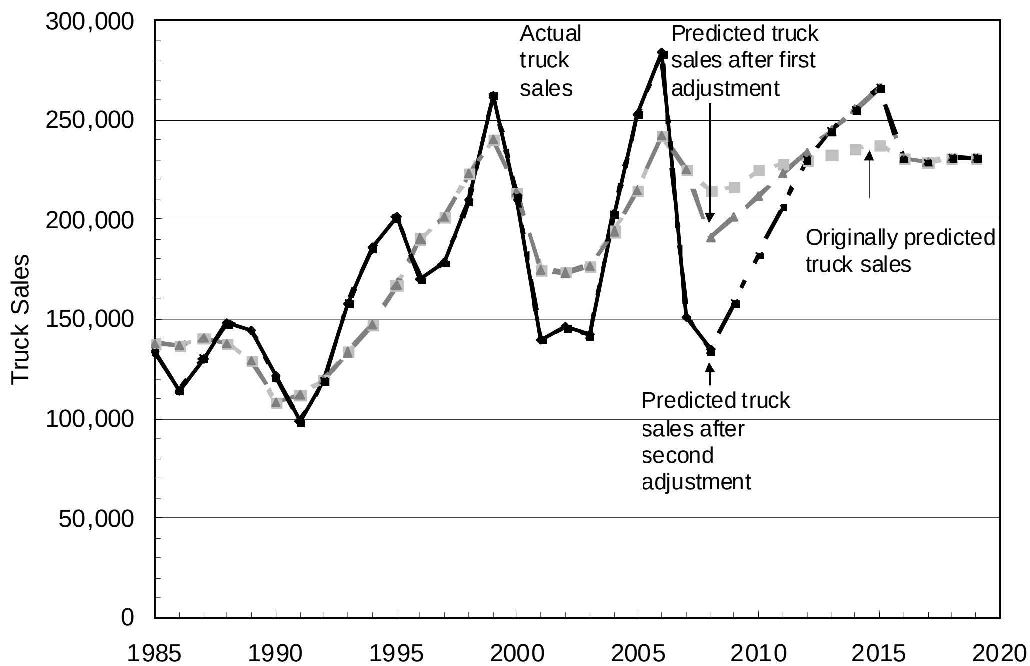


Since the beginning of 2007, the price of diesel fuel has increased dramatically, and the state as well as the national economy has slowed. Diesel fuel prices can have a major impact on driving patterns, and freight transportation choices between trucks and rail, especially for longer haul and non-perishable commodities. Staff does not yet have sufficient data to determine what the impact of the current fuel price spike has been on statewide vehicle VMT, and staff is continuing to evaluate the issue to determine if future growth rate projections should be refined. Until that work is completed, staff is continuing to rely on historical growth trends that are consistent with regional growth estimates developed by regional transportation planning agencies.

Typically, mobile source emissions inventory models, including EMFAC, estimate attrition (the number of vehicles dropping out of the fleet) as part of applying growth. Consistent with EMFAC, this inventory includes vehicles up to age 44 in any given calendar year. This means that in 2008, 1964 is the oldest vehicle model year in the inventory. Under typical attrition algorithms, the population of vehicles 44 years old would be removed from the inventory each year, and that population of older vehicles would be replaced by an equivalent number of new vehicle sales. However, through our analysis of vehicle populations for this inventory, staff realized that tractors are typically sold new to national fleets, operated for several years, and then sold to regional fleets. This results in a larger increase in the number of older vehicles in the population of in-state tractors than would be predicted by the traditional attrition algorithms. To correct this, staff used a simplified approach of holding model year distributions constant over time.

In addition to general economic growth, the implementation of new emission standards can have a significant impact on new vehicle purchase rates, and therefore penetration of different vehicle model years into the statewide vehicle population. To evaluate how emissions standards impact vehicle sales, staff developed a model that accounts for the relationship between economic growth and national vehicle sales, as well as the relationship between vehicle sales and the penetration of new emissions standards. To accomplish this task, staff first developed a historical regression model between national heavy-heavy duty vehicle sales and economic trends (as measured by national trucking industry gross domestic product). The results from this model are shown in Figure VI-2 where actual heavy-heavy duty diesel vehicle sales from 1985-2007 (solid line) are plotted against the economic regression model (dotted line) over the same period. Results show that economic trends explain a substantial amount of the historical variability in vehicle sales.

Figure VI-2: Estimated Future New Vehicle Sales by Calendar Year



Next, staff projected economic growth into the future and applied staff's regression model to estimate future vehicle sales without any impact from emissions standards. This is represented as a "first adjustment" on the chart. Staff then extrapolated 2008 vehicle sales based on sales through June 2008, and found that staff's model was over estimating 2008 sales, likely due to both an over estimate of future economic performance and pre-buy trends. Most economic indicators used in this model do not reflect the very latest economic conditions. To adjust the regression model for the likely short term over estimate of economic performance, as well as pre-buy trends, staff assumed the same differential between the 2002-2004 model year results and sales would also apply to the 2008-2009 model years. When actual sales data for the first half of 2008 was obtained by staff, the predicted vehicle sales for the entirety of 2008 decreased. Because of the projected significant decrease in demand for vehicles in calendar years 2007 through 2009, and the expected fuel economy benefit of 2010 standard compliant vehicles (as described in section D), staff assumed steady growth in vehicle sales from 2009 through 2016, at which point sales are assumed to revert to historical average trends. This is shown in Table VI-2 as a “second adjustment”.

C. Emissions Rates

Estimating emissions requires the use of an emission factor, which relates the number of miles traveled by a vehicle to that vehicle’s emissions on a per mile basis. Emission rates are a function of engine size, vehicle size, technology, driving conditions, speed, load, loaded weight, temperature, relative humidity, and many other factors. Emission rates deteriorate, which reflects an increase in emission rates over time as the engine and vehicle ages. Deterioration in diesel engines is modeled as a function of tampering, malmaintenance, and malfunction of various engine components.

To develop emission rates used in this inventory, staff used the EMFAC model. EMFAC2007 contained a number of significant improvements to heavy-heavy duty diesel vehicle emission rates, including updated base emission rates developed from recent academic studies (Coordinating Research Council (CRC), 2007) and revisions to assumptions behind tampering, malmaintenance, and malfunction of engine components. Staff then made a number of significant adjustments to emission rates which are described briefly here; more information is available in the emissions inventory technical discussion in Appendix G.

1. Medium-Heavy Duty Diesel Vehicle Emission Rates

Staff used test results from the CRC E55/59 test program to update medium-heavy duty diesel vehicle running emission rates and speed correction factors. Staff used the same analysis method as developed for the heavy-heavy duty diesel vehicle update integrated into EMFAC2007. The integration of these updated emission rates led to slight changes in NOx and PM2.5 emissions which varied by calendar year.

2. Banking Provisions in Emissions Standards

Staff evaluated the penetration of diesel particulate filter (DPF) equipped 2007 model year vehicles, and the model years in which the new technology was sold. This led to negligible changes in emission rates for the 2006-2009 model year engine emission factors. Staff also estimated the expected penetration of the cleanest 2010 compliant engines in 2010-2012 based on multiple discussions with engine manufacturers and review of their public statements. Overall, based on the latest information, staff found that because selective catalytic reduction (SCR) technology (used to meet NOx emission standards in 2010 compliant engines) provides a fuel economy benefit relative to previous technologies, the vast majority of 2010 model year engines will be equipped with SCR.

3. Carbon Dioxide Emission Rates

Staff conducted a thorough review of CO_2 emission rates based on test data in the CRC E55/59 program, U.S. Department of Energy (U.S. DOE) annual fuel economy data, IFTA data, and West Virginia University In-Use Consent Decree data. Staff analyzed fuel economy data due to the limited CO_2 dataset for heavy-duty vehicles and converted the results into CO_2 emissions rates based on fuel carbon content. Results indicate vehicles driving in California have slightly higher average fuel economy (~5.7 miles per gallon (mpg)) and therefore lower CO_2 emissions relative to what is assumed in EMFAC2007 (5.4 mpg). Staff found that fuel economy does vary on average across model years, with the highest fuel economy in 2010 standard compliant engines. Staff assumed a 3 percent fuel economy penalty associated with 2007 standard vehicles due to increased back-pressure on the engine caused by the DPF and use of exhaust gas recirculation (EGR) technology. Staff assumes a 2 percent fuel economy penalty associated with retrofit diesel particulate filters. Staff assumes a 4 percent fuel economy benefit in the 2010 emission standard vehicles due to better engine mapping for fuel efficiency coupled, with the SCR. These assumptions regarding fuel economy affect the assumption of CO_2 emissions.

D. Statewide Baseline Emissions Estimates

Staff estimated trucks and buses included in the inventory in 2008 will emit 859 tons of NOx on an average annual day, 33 tons per day of PM2.5, and 108,000 tons of CO_2 on an average annual day, as shown in Table VI-6. About 40 percent of the statewide annual average NOx and PM2.5 emissions from on-road vehicles are generated by interstate vehicles, while vehicles that operate only within California generate the remaining 60 percent of statewide NOx and PM2.5 emissions.

Table VI-6: Statewide Emissions by Truck and Bus Inventory Category (2008)

CY	Inventory Category	Vehicle Population	Vehicle CA VMT/day	NOx (tons/day)	PM2.5 (tons/day)	CO_2 (tons/day)
2008	HH Out-of-State	492,340	16,142,326	221.9	8.0	32,766
2008	HH CA IRP	60,263	8,282,725	139.6	5.2	16,783
2008	HH Tractor	63,684	10,413,751	194.1	7.9	20,897
2008	HH Single Unit	43,275	3,410,860	57.8	1.9	6,876
2008	HH Drayage	21,650	2,898,907	70.0	3.2	6,006
2008	HH Agriculture	11,998	878,486	17.3	0.7	1,788
2008	HH Utility	1,357	33,801	1	0	79
2008	MH In-state	198,525	12,731,247	125.0	4.6	19,067
2008	MH Interstate	8,896	117,648	1.0	0.0	176
2008	MH Agriculture	9,438	342,652	4.0	0.2	521
2008	MH Utility	2,798	55,942	1	0	85
2008	Buses	26,443	1,208,769	15.0	0.4	2,036
2008	PTO	0	492,322	12.2	0.8	1,349
2008	All	940,667	57,009,437	859.3	33.1	108,429

Table VI-7 shows statewide truck and buses emissions by fleet size and mileage threshold for calendar year 2008. Results show that small fleets (those with three or fewer vehicles) are responsible for roughly 36 percent of NOx and PM2.5 emissions, while large fleets (four or more vehicles) are responsible for 64 percent of baseline emissions in 2008. Results also show that while low mileage vehicles represent roughly 8 percent of the vehicles, they contribute only 0.9 percent of vehicle miles traveled and less than 2 percent of emissions.

Table VI-7: Baseline Emissions by Fleet Size and Mileage Threshold (2008)

CY	Fleet Size	Vehicle Population	Vehicle CA VMT/day	NOx tpd	PM2.5 tpd	CO_2 tpd
2008	1 vehicle/above threshold	116,314	12,050,689	209.5	8.26	22,460
2008	1 vehicle/below threshold	20,462	170,742	3.4	0.17	331
2008	2 vehicle/above threshold	35,941	3,636,157	59.0	2.30	6,701
2008	2 vehicle/below threshold	6,502	54,229	1.1	0.05	105
2008	3 vehicle/above threshold	22,739	2,275,887	37.2	1.46	4,215
2008	3 vehicle/below threshold	3,876	32,062	0.6	0.03	62
2008	4+ vehicle/above threshold	643,202	35,528,640	493.5	18.36	68,191
2008	4+ vehicle/below threshold	39,598	249,058	5.0	0.22	505
2008	Ag non specialty higher VMT	5,848	828,973	14.5	0.58	1,579
2008	Ag non specialty lower VMT	10,057	128,510	2.6	0.14	251
2008	Ag non specialty midrange VMT	3,388	141,541	2.2	0.10	248
2008	Ag specialty vehicle	2,144	122,114	2.1	0.09	231
2008	Unspecified	30,597	1,790,835	28.5	1.30	3,549
2008	All	940,667	57,009,437	859.3	33.07	108,429

Figure VI-3, Figure VI-4 and Figure VI-5 show baseline emissions forecasted to 2023 for NOx, PM2.5, and CO_2, respectively. Results show that while CO_2 emissions are expected to increase over time, NOx and PM2.5 emissions are projected to decrease as new vehicles equipped with the latest emission control technologies enter the fleet due to natural replacement, and as previously adopted rules are implemented. Even though emissions are decreasing, staff estimates suggest that in the absence of the proposed regulation it would take several decades for all vehicles operating in California to meet the 2010 emissions standard through natural replacement alone. The proposed regulation is necessary to reduce emissions to levels that would ensure attainment with federal ozone and PM2.5 ambient air quality standards. A summary of PM and NOx emissions baseline is shown summarized below in Table VI-8.

Table VI-8: Statewide PM and NOx Baseline Emissions

Calendar Year	Emissions (ton per day)	
	PM Baseline	NOx Baseline
2010	27.8	749
2014	19.0	500
2017	14.4	401
2020	12.1	346
2023	10.5	319

Figure VI-3: California Statewide NOx Emissions from Trucks, Baseline 2008-2023

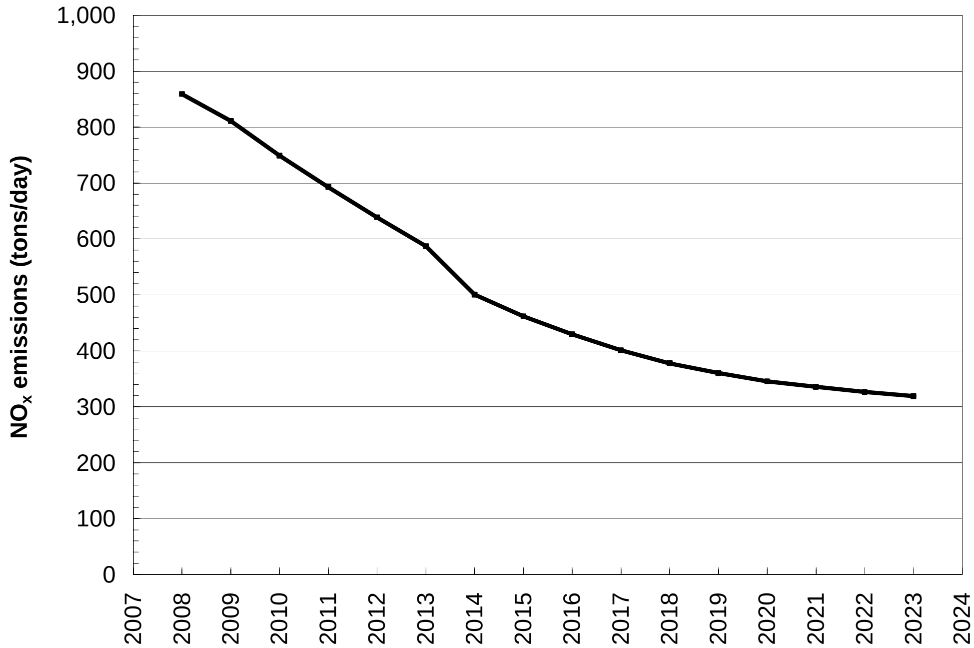


Figure VI-4: California Statewide PM2.5 Emissions from Trucks, Baseline 2008-2023

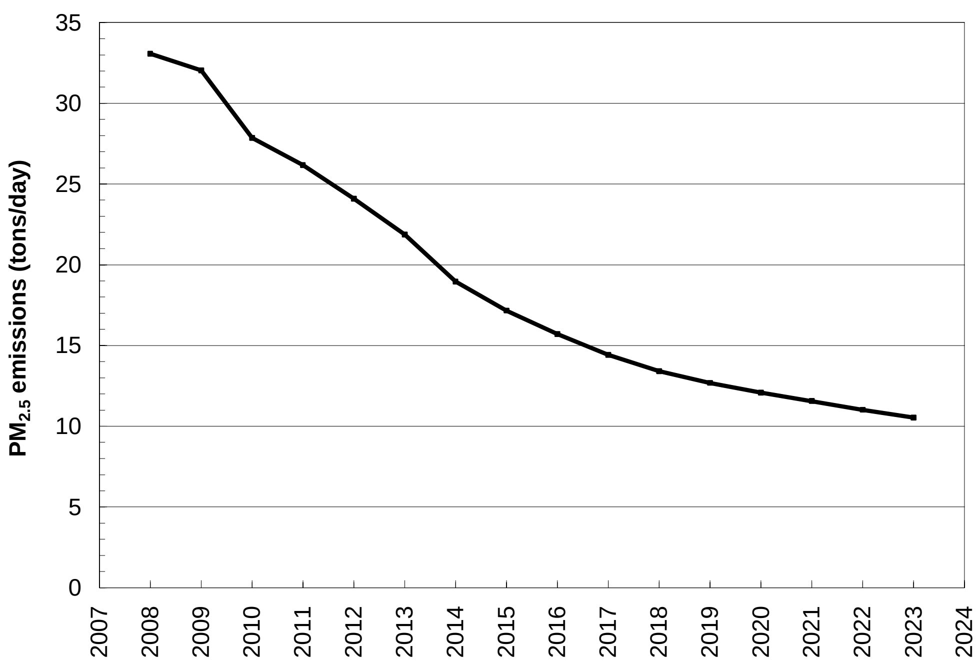
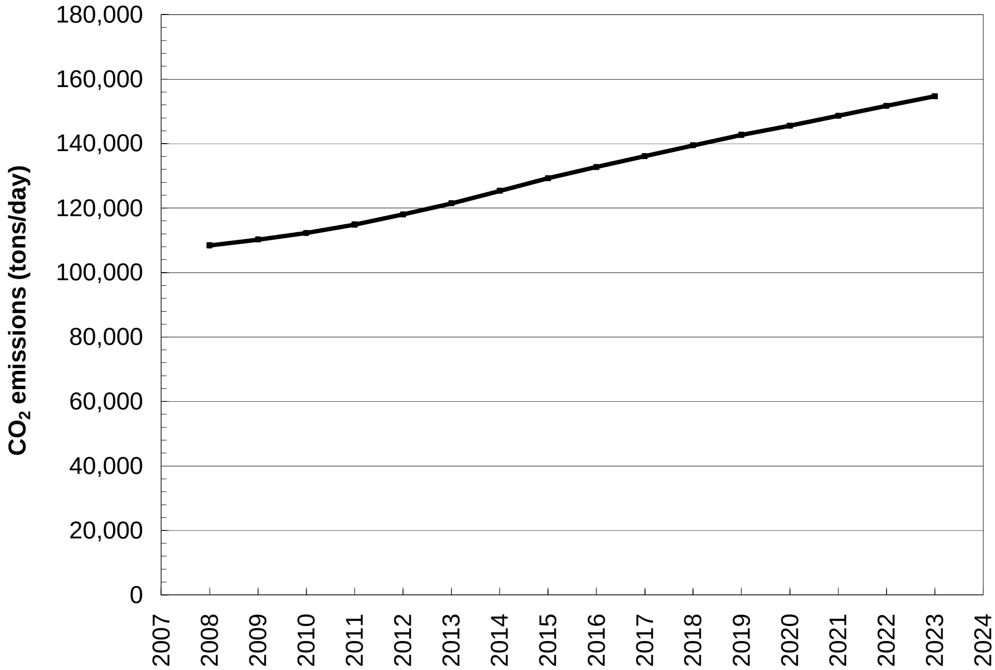


Figure VI-5: California Statewide CO_2 Emissions from Trucks, Baseline 2008-2023



E. Updating EMFAC with this New Analysis

It is important to emphasize that any emissions inventory is our best assessment of emissions based on what is known today. This assessment necessarily evolves over time. The ARB maintains an on-road emissions inventory model, called EMFAC, which provides official emissions inventory estimates that are used for planning and SIP purposes. The most recent version of this model, EMFAC2007, was released in early 2007 to support development of the ARB's statewide and regional air quality attainment plans. Since the release of EMFAC2007, staff has developed an expanded approach to assess vehicle operations in California that greatly enhances their ability to understand operations of different vehicle categories in California. Whereas EMFAC2007 separated heavy-duty vehicle operations only by weight and fuel, the emissions inventory developed for this proposed regulation separates trucks and buses into categories based on weight, fuel, body type, registration status, and in some cases vocation. This work is the culmination of several years of evaluation as a result of regulatory development and research.

Because EMFAC is ARB's official on-road emissions inventory model, staff is working towards integrating the new inventory developed for this regulation into the model. One of the most critical questions that must be answered when integrating this new inventory into EMFAC is spatial allocation, which is the distribution of statewide emissions into air basins and air districts. The assessment of engine emissions on a regional level is important for assessing regional compliance with air quality standards. To develop an improved assessment of regional vehicle travel staff is conducting a field study focusing on more than 60 locations throughout California. To date, this study has generated more than 6,000 origin-destination surveys and 120,000 pictures of vehicle license plates. Staff is currently in the process of evaluating the data, and while preliminary regional emissions estimates were presented in public workshops in July 2008, staff believes more work is necessary to develop and evaluate regional activity and emissions estimates. Over the next year staff will be working with regional transportation and air quality agencies to evaluate regional activity and emissions estimates. Staff intends to complete this in 2009 as part of the EMFAC update process, and release an updated version of EMFAC in the 2010 timeframe.

F. References

Coordinating Research Council, Inc., 2007. Heavy-Duty Vehicle Chassis Dynamometer Testing for Emissions Inventory, Air Quality Modeling, Source Apportionment and Air Toxics Emissions Inventory. August 2007. Available at: http://www.crcao.com/reports/recentstudies2007/E-55-59/E-55_59_Final_Report_23AUG2007.pdf

National 2002 VIUS. U.S. Census Bureau 2002 Economic Census: Vehicle Inventory and Use Survey. EC2TV-US. Issued December 2004

VII. ON-ROAD DIESEL RETROFIT TECHNOLOGY

The proposed regulation would require in-use on-road diesel fleets to install verified DECS and to accelerate replacement of existing vehicles to those with a engines meeting the 2010 MY engine emission standards. This chapter discusses retrofit strategies potentially available for reducing diesel emissions from in-use on-road diesel vehicles.

A. Diesel Emission Control Strategies

Reducing emissions from diesel engines is an area of active research and development. While on-road diesel engine manufacturers are optimizing technologies to reduce PM and NOx emissions to meet future California and federal new engine exhaust standards, the fields of retrofitting with exhaust aftertreatment devices and engine repowering are also growing rapidly. This activity is spurred both by the ongoing research and development for new engines, and by California's control measures for in-use diesel fleets.

1. Exhaust Retrofits

A variety of retrofit strategies can be used for controlling emissions from in-use diesel engines (Diesel Forum, 2006). The main types of technologies discussed here are add-on hardware, additives, combinations of hardware and additives, and NOx control. The hardware retrofit technologies that are most likely to be employed, i.e., diesel particulate filters (DPFs) and flow through filters (FTFs), are retrofitted onto the exhaust pipes downstream of the engine. Additive based systems reduce emissions by introducing an additive, typically precious metal, into the fuel, air intake, or exhaust system, depending on the type of additive employed. Combinations of hardware and additives could include a device retrofitted to the exhaust system and an additive introduced into the fuel stream. The most common NOx control systems use open channel catalysts together with a chemical reductant (usually urea or diesel fuel) that is injected into the exhaust stream. These technologies are discussed in more detail below.

Technical suitability of a particular type of DECS will depend on the engine and vehicle to be retrofit. Technical considerations include space constraints inside the engine compartment, operator visibility, weight of the DECS, vibration, backpressure, exhaust temperatures, and safety. For instance, for very large engines, two devices in parallel (dual) may be required to avoid excessive backpressure and allow sufficient exhaust flow.

a) Hardware Diesel Emission Control Strategies

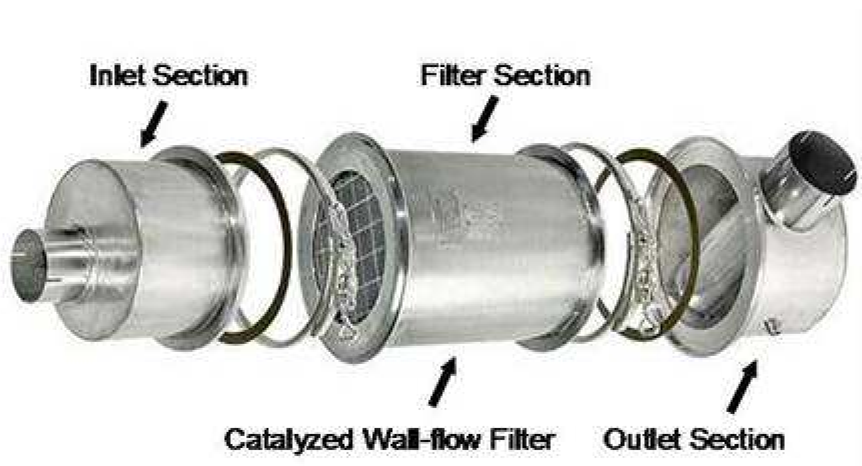
There are a number of hardware diesel emission control strategies available to reduce diesel PM emissions from in-use diesel vehicles, including DPFs and FTFs. Some DPFs also reduce CO and HC emissions through catalytic oxidation and filtration. Most DPFs sold in the United States use substrates consisting either of a ceramic wall flow filter or a silicon carbide substrate. These substrates are either coated with a catalyst material, typically a platinum group metal, or a separate catalyst that is installed upstream of the particulate filter. The filter is positioned in the exhaust stream to trap or collect a significant fraction of the particulate emissions while allowing the exhaust gases to pass through the system.

Effective operation of a DPF requires a balance between PM collection and PM oxidation, or regeneration. The volume of PM generated by a diesel engine will fill up (load) a DPF over time; thus the trapped PM must be burned off or "regenerated" periodically. Regeneration is accomplished by either raising the exhaust gas temperature or by lowering the PM ignition temperature through the use of a catalyst. In contrast, FTFs employ a catalyzed wire mesh substrate that has an intermix of flow channels creating turbulent flow conditions.

(1) Passive Diesel Particulate Filter (Passive DPF)

A passive DPF is one in which a catalytic material, typically a platinum group metal, is applied to the filter itself or some other substrate upstream of the filter. The catalyst lowers the temperature at which trapped PM will oxidize to levels that are often reached in diesel exhaust, generally 250 to 400 degrees Celsius (ºC), depending on the vehicle's duty cycle. No additional source of energy is required for regeneration, hence the term "passive". Most verified passive DPFs require exhaust temperatures of at least 225 to 280 ºC for about 25 to 50 percent of the vehicle's duty cycle. Verified passive DPFs have demonstrated reductions of at least 85 percent for PM, and are verified as Level 3 devices. A passive catalyzed DPF also reduces CO and HC by approximately the same amount as the PM reduction. A passive catalyzed DPF (See Figure VII-1) is an attractive means of reducing diesel PM emissions on certain engines and duty cycles because of the combination of high reductions in PM emissions and minimal operation and maintenance requirements.

Figure VII-1: Wall Flow Filter



The following passive devices have been verified through ARB's verification procedure and include devices that also meet the 2009 NO_2 limits as designed with the "+" symbol. All of these devices achieve a least an 85 percent reduction in PM emissions and are therefore designed as Level 3 devices. Each device is certified to operate on certain engine families as listed in the Executive Order. These devices are described below in Table VII-1.

Table VII-1: Passive DPF

Product Name	Technology Type	PLUS	PM Reduction	NOx Reduction	Applicability
Cleaire Longview	Wall Flow Lean NOx Catalyst and DPF		85%	25%	Most 1993-2006 model year on-road engines
Donaldson DPM	Wall Flow DPF		85%	N/A.	Most 1993-2006 model year on-road engines
Engine Control System Purifilter	Wall Flow DPF	+	85%	N/A	Most 1993-2006 model year on-road engines
International Truck and Engine Corporation DPX	Wall Flow DPF		85%	N/A.	Most 1994-2003 model year on-road Navistar engines
Johnson Matthey EGRT	Wall Flow EGR/DPF	+	85%	40%	Most 1998-2001 model year International, Cummins and DDC on-road engines
Johnson Matthey CRT	Wall Flow DFF		85%	NA	Most 1994-2006 model year on-road engines

(2) Active Diesel Particulate Filter (Active DPF)

Unlike passive DPFs, active DPFs use a source of energy for regeneration beyond the heat in the exhaust stream itself. Active DPF systems can be regenerated electrically, with fuel burners, or with the aid of additional fuel injection to increase exhaust gas temperature. Some active DPFs induce regeneration automatically on-board the vehicle when a specified backpressure is reached. Others simply indicate to the operator when regeneration is needed, and require the operator to initiate the regeneration process. Some active systems collect and store diesel PM over the course of a full day or shift and are regenerated at the end of the day with the vehicle or equipment shut off. The time between regeneration can range from a single, 8 hour shift to several weeks depending on a number of factors. Some systems are designed such that the filters can be removed and regenerated externally at a "regeneration station".

For applications in which the engine-out PM is relatively high, and/or the exhaust temperature is relatively cool, actively regenerating systems are more effective than a passive DPF. Because active DPFs are not dependent on the heat carried in the exhaust for regeneration, they potentially have a broader range of application than passive DPFs, and passive DPFs have more flexibility on where, they are installed since they are not required to be close to the engine.

Two active systems have been verified through ARB's verification procedure. The Cleaire Horizon uses electricity, through an integrated heating element, to heat up and burn off the collected PM while the vehicle is parked overnight. The HUSS MK-

SYSTEM used a small diesel burner to heat up the DPF and burn off the collected PM while the engine is off. This process, known as regeneration, can take anywhere from a few minutes to over a half and hour. These devices are described below in Table VII-2.

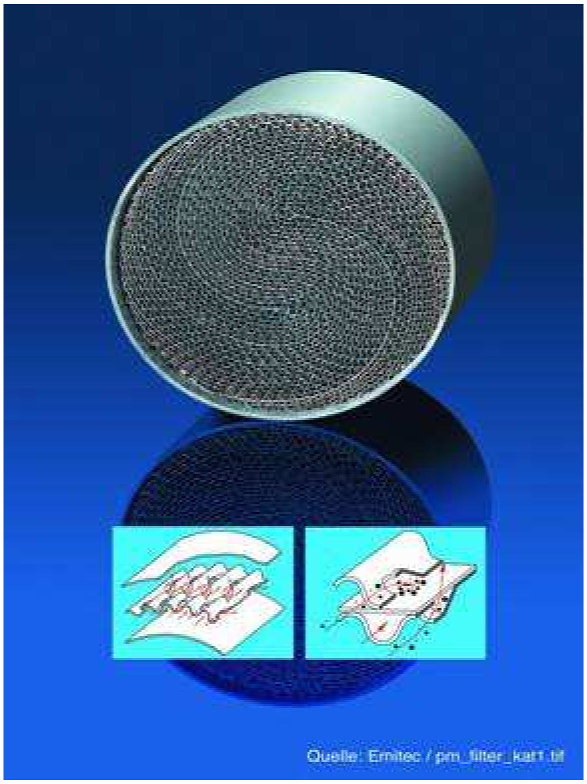
Table VII-2: Wall Flow Filter

Product Name	Technology Type	PLUS	PM Reduction	NOx Reduction	Applicability
Cleaire Horizon	Wall Flow DPF	+	85%	N/A	Most on-road engines
HUSS Umwelttechnik FS_MK	Wall Flow DPF	+	85%	N/A	Most on-road engines

(3) Catalyzed Wire Mesh Flow Through Filter

FTF technology is a form of aftertreatment that achieves PM reductions less than that of a DPF. There are several different FTF designs, but they tend to share the characteristic that they do not trap and accumulate PM like a DPF. Instead, FTF (See Figure VII-2) have a medium (such as a wire mesh) that forces the exhaust into a complex flow pattern that gives rise to turbulent flow conditions, or in some cases a partial trapping of PM. The medium is typically treated with an oxidizing catalyst that is able to reduce emissions of PM, HC, and CO. The particles that are not oxidized within the FTF flow out with the rest of the exhaust and tend not to accumulate. FTF performance can be highly variable and sensitive to exhaust temperature, but is normally consistent with a 25-50 percent reduction in PM emissions.

Figure VII-2: Flow Through Filter



There is only one device that uses the flow through technology that has been verified through ARB's verification process. The Donaldson DPM uses a multi-stage passive flow through filter incorporated in a muffler unit to achieve 50 percent reduction of particulate matter. This device is shown below in Table VII-3.

Table VII-3: Active DPF

Product Name	Technology Type	PLUS	PM Reduction	NOx Reduction	Applicability
Donaldson DPM	Flow Through Filter	+	50%	N/A	Most 1991-2002 model year on-road; CARB diesel; biodiesel.

b) Additive Diesel Emission Control Strategies

Additive DECS utilize a substance, other than diesel fuel, which is added during the operation of the vehicle, either pre-combustion or post-combustion, to reduce diesel exhaust emissions. Pre-combustion additives include fuel based and intake air based additives that utilize the fueling system or air intake systems, respectively, to introduce an additive. Post-combustion additives include exhaust based additives that introduce an additive directly into the exhaust system to reduce exhaust emissions. Most additive systems are designed to work in conjunction with a hardware component and are often offered as a combined hardware and additive system as discussed in the next subsection.

Additive DECS must undergo an assessment of multimedia toxicity effects by the California Environmental Policy Council, as required by HSC section 43830.8 prior to ARB verification.

(1) Fuel-Water Emulsion

Alternative diesel fuel is a fuel that can be used in a diesel engine without modification to the engine and that is not a reformulated diesel fuel. For example, alternative diesel fuels may include emulsified fuels, biodiesel fuels, Fischer Tropsch fuels, or a combination of these fuels with regular diesel fuel. The emissions effects of these fuels can vary widely.

Fuel-water emulsion, a demonstrated alternative to diesel fuel that reduces both PM and NOx emissions is an emulsion of diesel fuel and water. The process blends water into diesel fuel, along with an emulsion additive to keep the mixture from separating. The water is suspended in droplets within the fuel, creating a cooling effect on the fuel that decreases NOx emissions. Also, a fuel-water emulsion creates a leaner fuel environment in the engine, thus lowering PM emissions as well (U.S. EPA, 2002).

PuriNOx, produced by Lubrizol, is a low emission diesel fuel system comprised of commercial diesel fuel, water, and additives. It has been verified by ARB to reduce NOx emissions by 15 percent and PM emissions up to 50 percent. PuriNOx can be used in any older or newer diesel engines without modification to fuel systems or engine hardware. It is be blended in the field using portable and automated PuriNOx blending units that combines the PuriNOx additive package, water, diesel fuel and, when necessary, seasonal components like freeze depressants. This product is described below in Table VII-4.

Table VII-4: Fuel-Water Emulsion

Product Name	**Technology Type**	**PLUS**	**PM Reduction**	**NOx Reduction**	**Applicability**
Lubrizol PuriNOx	Emulsified Fuel	+	50%	15%	1988-2003 on-road

(2) Fuel Additives

A fuel additive, such as a fuel-borne catalyst, is a substance designed to be added to fuel or fuel system so that it is present in cylinder during combustion and its addition causes a reduction in exhaust emissions. Additives can reduce the total mass of PM, with variable effects on carbon monoxide, NOx, and gaseous hydrocarbon production. The range of PM reductions that have been published in studies of fuel additives is from 15 to 50 percent reduction in mass. Most additives are fairly insensitive to fuel sulfur content and will work with a range of sulfur concentrations as well as different fuels and other fuel additives (ARB, 2003). No fuel additive is currently verified by ARB.

c) Combinations of Hardware and Additive Diesel Emission Controls Devices

While not currently verified in California, systems combining hardware and an additive strategy are used in other parts of the world. In order to receive ARB verification, the hardware and additive strategy must be approved together as a system.

(1) Fuel-Borne Catalyst (FBC)

A fuel-borne catalyst (FBC) is a substance that is added to diesel fuel in order to aid in soot oxidation in DPFs by decreasing the ignition temperature of solid carbon. An FBC can be used in conjunction with both passive and active filter systems to aid system performance, and decrease mass PM emissions. FBC/DPF systems are in widespread use in Europe in on-road, mobile and stationary applications, and typically achieve a minimum of 85 percent reduction in PM emissions. The ARB has not verified any system using an FBC as of October 2008.

d) NOx Control Strategies

Although not as mature as PM control strategies in general, significant research into NOx control strategies that may be suitable for retrofit use is being conducted and a number of NOx control strategies for diesel engines are nearing commercial readiness.

(1) Exhaust Gas Recirculation (EGR)

EGR is an effective engine control method for reducing NOx emissions that has been used in many new engine applications for the past five years. A valve connected to the exhaust system allows a controlled portion of spent combustion gases to circulate back into the intake system where it mixes with precombustion air. The exhaust serves as a diluent to lower the in cylinder oxygen concentration and also to increase the heat capacity of the air/fuel mixture. This reduces peak combustion temperature and the rate of combustion, thus reducing NOx emissions. Though much less prevalent than EGR systems for new engines, EGR retrofits are in use both in Europe and in the United States. One such system which is combined with a passive DPF is currently verified for certain on-road engines in California. Typical NOx reductions achieved by EGR retrofits are about 40 to 50 percent.

The Johnson Matthey EGRT emission control system combines their CRT® system with EGR technology. Engine exhaust flows through a 2-stage CRT diesel particulate filter to reduce CO, PM, and HC. The EGR system re-circulates cooled, particulate-free exhaust back into the engine intake – resulting in a significant NOx reduction with no efficiency loss in the engine.

(2) Lean-NOx Catalyst Systems

Another aftertreatment-based NOx control technology is referred to as a lean-NOx catalyst (LNC). Similar in principle to an SCR system, an LNC system relies on injection of a reductant, typically diesel fuel, upstream of the catalyst to reduce NOx emissions. The NOx reductions achievable by LNC technology are sensitive to the exhaust temperature and type of hydrocarbon used, but is typically in the neighborhood of 20 to 30 percent.

The Cleaire Longview integrates a NOx reduction catalyst and catalyzed wall flow silicon carbide DPF to provide simultaneous reduction of NOx, PM, HC, and CO. The Longview system monitors various parameters and controls the amount NOx reductant injected into the system to achieve a verified 25 percent reduction of NOx emissions (See Figure VII-3).

Figure VII-3: Cleaire Longview Lean-NOx Catalyst System

(3) Selective Catalytic Reduction (SCR)

SCR systems are just now emerging as a retrofit option in the United States and are expected to be widely used to meet U.S. EPA new on-road engine standards starting in 2010. SCR systems are a form of aftertreatment technology that uses a reductant, typically urea, to convert NOx to nitrogen and oxygen over a catalyst. A precise amount of reductant is injected into the exhaust upstream of the catalyst. If the reductant is well mixed with the exhaust and the exhaust temperature is adequate, (typically between 250 and 450ºC) an SCR system can achieve NOx reductions on the order of 50 to 90 percent. SCR technology is already mature in stationary applications, and is beginning to emerge as a NOx control solution for in-use mobile sources. One of the challenges facing SCR technology is the practical need to ensure that the end-user maintains a continuous supply of reductant. Urea, as reductant, is currently is not as commercially available as diesel fuel. However, with the anticipated widespread introduction of SCR in new 2010 and later diesel engines, staff expects that urea availability will quickly expand. Also, if urea is not present in the SCR unit, it will not cause any intrinsic engine or vehicle operational problems.

Although not as widely applicable as DPFs, SCR systems may be suitable for certain retrofit applications, and a number of demonstration programs in California and across the country are underway. A discussion of SCR demonstration programs currently underway is provided later in this chapter.

Despite the potentially significant NOx reductions SCR can provide, exhaust temperatures (or duty cycle limitations) will likely dictate the actual suitability of certain vehicles to use SCR or other NOx control technologies in exhaust retrofit applications. In general, SCR systems need to operate in temperature ranges similar to those required for passive DPF systems. No level 2 or 3 systems in conjunction with SCR are currently verified.

Johnson Matthey has developed a 4-Way emission control technology system called the SCRT, which reduces NOx by 70-90 percent and PM by over 90 percent (See Figure VII-4). It also reduces CO and HC. The urea based SCR technology is combined with Johnson Matthey's 2-stage CRT® particulate filter system where the engine exhaust flows through to reduce CO, PM, and HC. A controlled amount of urea is then injected into the exhaust before it enters the SCR catalyst bed providing the necessary chemical conditions for the SCR catalyst to reduce NOx.

Figure VII-4: Johnson Matthey SCRT System

B. Verification of Diesel Emission Control Strategies

1. ARB's Diesel Emission Control Strategies Verification Program

ARB's verification program evaluates the applicability, durability, and effectiveness of PM and NOx control technology. Verification is an approval from ARB which assures end users that a verified retrofit device achieves its advertised emission reductions and is durable (based on in-use field testing). ARB adopted a procedure to verify DECS in 2003 (title 13, CCR, sections 2700 et seq.). A DECS is a device that is installed onto an in-use engine to reduce emissions for that engine, is not part of the new engine certification program, and is not covered through the new engine or emission warranty from the engine manufacturer. The purpose of the verification procedure is to verify strategies and systems that reduce diesel PM and/or NOx emissions from in-use engines. Under the verification program, the device manufacturer is required to provide a warranty against engine damage caused by the DECS. The minimum warranty period for on-road devices is listed in Table VII-5. To protect the end user, only ARB verified DECS can be used in all of ARB's mandated and most of its voluntary retrofit programs.

Table VII-5: Diesel Emission Control Strategy Warranty Period

Engine Size	Minimum Warranty Period
Light-heavy-duty, 70 to 170 hp, GVWR less than 19,500 lbs.	5 years or 60,000 miles
Medium-heavy duty, 170 to 250 hp, GVWR from 19,500 lbs. to 33,000 lbs.	5 years or 100,000 miles
Heavy-heavy duty, exceeds 250 hp, GVWR exceeds 33,000 lbs.	5 years or 150,000 miles
Heavy-heavy duty, exceeds 250 hp, GVWR exceeds 33,000 lbs., and the vehicle is: 1. Typically driven over 100,000 miles per year, and *2.* Has less than 300,000 miles on the odometer at the time of installation.	2 years, unlimited miles

ARB's verification procedure is a multi-level verification program consisting of three broad levels used to establish PM reductions, which are defined by a lower bound in performance, and optional NOx reduction levels. Currently, reductions in NOx are not required for verification, but ARB's procedure recognizes and verifies NOx reductions that are greater than or equal to 15 percent in 5 percent increments.

To enable more broadly defined verifications, staff proposed amendments to the verification program at the Board's January, 2008, meeting to use a verification ranking for NOx reductions similar to that used for PM (See Table VII-6) (ARB, 2007). Staff's proposal is to use five levels, called Marks, defined by lower bounds of NOx reduction performance. To be eligible for verification, devices which achieve NOx reductions must also achieve PM reductions. Although, systems that achieve NOx reductions alone are currently not candidates for verification under the Procedure, staff proposed to change this on a limited basis. Under this amendment, staff proposed to allow for the verification of NOx only systems that are intended to be used on engines that are certified to a 0.01 grams per brake-horsepower (g/bhp-hr) PM standard. The proposed amendments where adopted by the Board January 24, 2008, and are expected to take effect by the end of 2008. To view more on the proposed changes visit the ARB website http://www.arb.ca.gov/regact/2008/verdev2008/verdev2008.htm.

Table VII-6: Diesel Emission Control Strategy Verification Levels (as adopted by the Board in January 2008)

Pollutant	Reduction	Classification
PM	< 25%	Not verified
	≥ 25%	Level 1
	≥ 50%	Level 2
	≥ 85%, or ≤ 0.01g/bhp-hr	Level 3
NOx	< 25%	Not verified
	≥ 25%	Mark 1
	≥ 40%	Mark 2
	≥ 55%	Mark 3
	≥ 70%	Mark 4
	≥ 85%	Mark 5

Many diesel emission control systems, in particular catalyzed DPFs, increase the amount of NO_2 in the exhaust in order to burn off soot that has collected in the filter. Because NO_2 has adverse health impacts arising from direct exposure as well as from its role in the formation of ozone and secondary particulate matter, the allowable increase of NO_2 to total NOx emitted from a DECS to be verified was capped by the Board in 2006. Under these provisions, a 20 percent NO_2 limit takes effect on January 1, 2009. Devices that meet the 20 percent NO_2 limit are designated as “Plus” systems. Because the NO_2 limit will decrease at the end of 2008, manufacturers of a number of currently verified devices will have to reformulate their devices and submit an application for re-verification, or their devices will no longer be verified.

The verification program has broadened both the spectrum of control technologies available for use in California’s diesel emission control effort and the number and types of vehicles and engines that can be controlled. This multi-level approach to verification is consistent with the goal of achieving the maximum reductions in diesel PM emissions that are economically and technologically feasible. At this time, nearly all the verified emissions control strategies are exhaust aftertreatment devices.

The verification procedure requires considerable data to demonstrate emission reductions and durability. Any DECS that uses a fuel additive must demonstrate that it is non-toxic in all media by going through a multimedia assessment.

2. United States Environmental Protection Agency's (U.S. EPA's) Voluntary Diesel Retrofit Program

The U.S. EPA has also established its own Voluntary Diesel Retrofit Program, which also verifies DECS using criteria which are similar to the ARB’s verification program. To facilitate the exchange of information between programs, ARB and U.S. EPA signed a Memorandum of Agreement (MOA) for the Coordination and Reciprocity in Diesel Retrofit Device Verification. The MOA establishes reciprocity in verifications of hardware or device-based retrofits, and further reinforces U.S. EPA's and ARB's commitment to cooperate on the evaluation of retrofit technologies. Under the MOA, U.S. EPA and ARB are committed to work toward accepting PM and NOx verification levels assigned by the other's verification programs. Additionally, as retrofit manufacturers initiate and conduct in-use testing, U.S. EPA and ARB agreed to coordinate this testing so data generated may satisfy the requirements of each program. This MOA is intended to expedite the verification and introduction of innovative emission reduction technologies.

3. European Union Exhaust Emission Requirements

A diesel exhaust emission requirement in the European Unions (EU) has existed since the late 1980s for heavy vehicles. The current requirement regulates four groups of compounds, NOx, HC, CO, and PM. Heavy vehicles are measured in relations to the engine power (g/kWh) and are subject to two test cycles used since 2000, one transient and one stationary, consisting of a sequence of constant engine speed and load modes. In December 2003, the EU, United States, Japan, and China agreed to draw up a common scientific platform to measure and benchmark air pollution from vehicle traffic. When the EU adopted the Euro 4 requirement in 2005, DPFs were necessary on most larger engines. Today, the EU requirements permit somewhat higher PM and NOx emissions than the requirements in the U.S. and Japan (Acid News, 2004).

C. List of ARB Verified Technologies

Table VII-7 and Table VII-8 show a summary of DECS verified by ARB as of October 2008. The proposed regulation would not recognize a Level 1 device as BACT. As such Level 1 devices are not shown in the table.

Table VII-7: Verified Level 3 DECS (as of October 2008)

Product Name	Technology Type	PLUS	PM Reduction	NOx Reduction	Applicability
Cleaire Horizon	DPF	+	85%	N/A	Most on-road engines
Cleaire Longview	Catalyst and DPF		85%	25%	Most 1993-2006 model year on-road engines
Donaldson DPM	DPF	+	85%	N/A.	Most 1993-2006 model year on-road engines
HUSS FS_MK	DPF	+	85%	N/A	Most on-road engines
International Truck DPX	DPF		85%	N/A.	Most 1994-2003 model year on-road Navistar engines
Johnson Matthey CRT	DPF		85%	N/A.	Most 1994 - 2006 model year on-road engines
Johnson Matthey EGRT	EGR/DPF	+	85%	40%	Most 1998 – 2001 model year International, Cummins and DDC on-road engines
ECSystem Purifilter	DPF	+	85%	N/A	Most 1993-2006 model year on-road engines

Table VII-8: Verified Level 2 DECS (as of October 2008)

Product Name	Technology Type	PLUS	PM Reduction	NOx Reduction	Applicability
Donaldson DPM	Flow Through Filter	+	50%	N/A	Most 1991-2002 model year on-road engines
Lubrizol PuriNOx	Emulsified Fuel	+	50%	15%	Most 1988-2003 model year on-road engines
Environmental Solutions Worldwide Particulate Reactor™	DOC		50%	N/A	Most 1991-1997 model year on-road engines

Whenever a verification is approved, an Executive Order (EO) is issued describing the engine conditions of the verification. To determine if a particular DECS will work with a specific engine and vehicle combination, the conditions contained in the EO must be followed. The EO lists the engines by engine family and other conditions of verification, such as minimum engine exhaust temperature. Additional evaluations may then be needed, such as data logging the duty cycle of the vehicles to determine its temperature profile, or opacity test to determine the engine out PM loading of the vehicle.

This list is subject to change as additional systems are verified. The most current list of verified DECS, applicable engine families, as well as the EO letters may be found on the ARB web site, http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm.

D. Summary of On-Road Installations of Exhaust Retrofits

Retrofit technology programs have been initiated worldwide including in Sweden, Switzerland, United Kingdom, Hong Kong, Japan, Korea, Mexico, and other countries throughout the world.

1. PM Exhaust Retrofits

The interest in new programs for DPF has significantly grown in the last few years. A limited number of DPF installations began in the 1980s. However, today over 200,000 DPFs have been installed internationally (MECA, 2006a). Presently, under the ARB verified technologies, several manufacturers have verified DPFs providing a PM reduction of around 85 percent (Level 3). DPFs have been installed in many urban buses and sanitation vehicles statewide and across the country. In California alone over 720 DPFs have been installed through the Carl Moyer program and because of ARB's fleet rules. Internationally, more than 4,000 buses have been retrofitted in Sweden, and heavy-duty vehicles in Europe, Mexico, and Japan also have been retrofitted (MECA, 2006b). Additionally, DPFs have been retrofitted on heavy-duty vehicles in Great Britain, Germany, Finland, Denmark, Switzerland, Austria, and France.

California has several projects utilizing DPFs on diesel vehicles currently underway. School buses were one of the first vehicle classes to be retrofitted. Generally, school bus engines manufactured before 1987 cannot be retrofitted with either a passive or active DPF due to the lack of availability of verified devices for 2 stroke diesel engines. Depending on the year manufactured, school bus engines manufactured after 1987 are good candidates for active and passive DPFs.

2. Retrofits Funded through California Incentive Programs

ARB has provided funding for many projects through the Carl Moyer Memorial Air Quality Standards Attainment (Carl Moyer) Program. Originally, the primary objective of the program focused on NOx emissions reductions, but changes were enacted by the Legislature in 2004 to allow consideration of projects designed to reduce exclusively PM or HC emissions retrofits of virtually all on-road and off-road diesel engines. A sample of Carl Moyer projects in the Sacramento, South Coast and Bay Area Air Quality Management Districts is identified in Appendix H for 2004-2005, or Year 7 of the Carl Moyer Program, and the devices listed reflect the newest generation of devices applicable to recent projects. A summary of 280 retrofits installed on engine model years is shown in the Table VII-9 below.

Table VII-9 Summary of Carl Moyer Projects

Engine Model Year	Total
Pre 1994	17
1994-2002	237
2003-2006	26
Total	280

Since 2001, through the Lower Emission School Bus Program, ARB has successfully dispersed funds to equip about 3,800 diesel buses with verified DECS, of which 2,800 are verified level 3 devices. In addition, the program partners with school districts and local air districts who have equipped an additional 871 verified level 3 devices. Additional program funding is available through Proposition 1B, the Highway Safety, Traffic Reduction, Air Quality, and Port Security Bond Act of 2006. Through the use of Proposition 1B funds, it is estimated that up to an additional 3,500 existing diesel buses will be retrofitted with ARB verified pollution control equipment.

The following photos in Figure VII-5, Figure VII-6, Figure VII-7, and Figure VII-8 demonstrate the wide variety of applications and installations possible for DPFs.

Figure VII-5: Under Chassis Horizontal DPF Muffler Installation

Figure VII-6: Horizontal DPF Installation for Vertical Exhaust

Figure VII-7: Donaldson Horizontal DPF Installation on School Bus

Figure VII-8: Vertical DECS Installations on Tanker and Tractor

3. NOx Retrofits

DPFs can be combined LNC, EGR, or SCR to achieve significant combined NOx and PM reductions. LNC technology is attractive because it does not require core engine modifications or additional infrastructure and can be installed on older engines. There have been more than 1,000 LNC placed systems in service in the U.S.

Low pressure EGR retrofits have been installed in more than 1,000 engines in the U.S. and over 450 have been installed in engines in Hong Kong and on some existing Swedish urban buses (Meca, 2006a).

SCR technology has been equipped in numerous new vehicles in Europe. The rate has increased from 30,000 vehicles in 2006 to 500,000 heavy-duty SCR clean diesel trucks in 2008 (Diesel Progress, 2008). The rate is continuing to climb as more companies upgrade their fleets. In addition, SCR systems have successfully been installed on 30 line-haul trucks in Germany. In the United States, most engine manufactures have announced that they will add SCR aftertreatment to their heavy-duty and new midrange engines products beginning 2010.

In addition, many SCR retrofit projects are currently underway in the U.S. (CCJ Magazine, 2008). In 2008, the Sacramento Metropolitan Air Quality Management District and the Sacramento Emergency Clean Air and Transportation program provided a $500,000 grant to retrofit a fleet of 16 older class 8 trucks owned by northern California grocery store chain Raley's with Johnson Matthey's latest diesel emissions technology, the SCRT® system. A picture of one of their installations is provided in Figure VII-9. Johnson Matthey is conducting a similar demonstration in southern California (in partnership with the South Coast Air Quality Management District) using the same number of trucks, ranging from 4 to 10 years old owned and operated by Ralph's Supermarkets.

The preliminary findings on this technology after 1,000 hour testing were that the SCRT® system reduced engine-out NOx in the Raley's trucks by an average of 84 percent (compared to pre-retrofit levels). The trucks involved were EGR-equipped 2004 Cummins, 400-horsepower ISM engines (Johnson Matthey, 2008).

A summary of on-road vehicle (and equipment) or exhaust retrofit projects completed or underway worldwide can be found in Appendix H. The projects are organized by geographical location, the sponsor of the project, and project timeframe. A description of each project is given (Emissions Advantage, 2005; Environment Canada, 2004; Ministry of Environment, 2004; U.S. EPA, 2005; DieselNet, 2002).

Figure VII-9: Vertical SCRT® System on Tractor – 50 to 90 percent NOx reduction

E. Anticipated Availability of Retrofits

During the first few years of the proposed regulation, the projected increase in demand for verified PM DECS (typically diesel particulate filters) in California is less than 38,000 units per year, which is about 15 percent of the total number of diesel particulate filters sold nationally each year (including those sold with new engines). Staff has contacted several diesel particulate filter manufacturers inquiring about their manufacturing capacities, and they have indicated that their manufacturing facilities are capable of producing over a million diesel particulate filters on an annual basis. However, in the unlikely event that there is an unanticipated disruption in the manufacturing, distribution and supply for diesel particulate filters, the proposed regulation contains a provision to allow for manufacturing delays such that fleets are not penalized for such circumstances.

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VIII. Current and Future Engine Technology

This chapter discusses new on-road engine standards, and current and future engine technologies that will be available to meet the NOx and PM performance standards of the proposed regulation. This includes the use of new diesel engines, as well as hybrid and alternatively-fueled engines.

A. New On-Road Diesel Engine Standards

1. Emission Standards Overview

Heavy-duty vehicle (HDV) gaseous emissions were first regulated by California in 1969, and later by the U.S. EPA in 1974 (ARB, 1998a). Over the years, California had set its own diesel emission standards, apart from U.S. EPA, until ARB approved a State Implementation Plan (SIP) for ozone in 1994. The SIP contained measures calling for new state and national emission standards for highway heavy-duty diesel vehicles beginning in 2004. In June 1995, ARB, U.S. EPA, and the manufacturers of heavy-duty vehicle engines signed a statement of principles (SOP) agreeing on the harmonization of ARB and U.S. EPA heavy-duty vehicle or engine regulations. In October 1997, U.S. EPA adopted 2004 emission standards, along with changes to the existing federal averaging, banking, and trading program (ABT), for heavy-duty diesel engines sold in the other 49 states. ARB then adopted the U.S. EPA 2004 emission standard in 1998 (ARB, 1998b). Table VIII-1 shows the U.S. EPA heavy duty diesel engine emission standard changes over the years (U.S. EPA, 2007).

Table VIII-1: U.S. EPA Heavy-Duty Diesel Engine Emission Standards

Engine Model Year	Hydrocarbon (HC)	Carbon Monoxide (CO)	Oxides of Nitrogen (NOx)	HC+NOx	Particulate Matter (PM)
1974-78[13]	---	40	---	16	---
1979-83[14]	1.5	25	---	10	---
1984-87	1.3	15.5	10.7	---	---
1988-89	1.3	15.5	10.7	---	0.6
1990	1.3	15.5	6.0	---	0.6
1991-93	1.3	15.5	5.0	---	0.25
1994-97	1.3	15.5	5.0	---	0.1
1998-2003	1.3	15.5	4.0	---	0.1
2004-06[15, 16]	0.5	15.5	2.0	2.4/2.5[15, 16]	0.1
2007 +[17]	0.14	15.5	0.20	---	0.01

To meet lower NOx emissions standards in 2004, engine manufacturers primarily used exhaust gas recirculation technology along with other design changes. The 2007 engine standard required additional reductions in NOx emissions and a 90 percent reduction in particulate matter emissions. The U.S EPA took a "systems" approach when adopting the 2007 or later model year emission standards by also adopting diesel fuel standards with very low sulfur content. To meet the new engine standard, engine manufacturers further reduced NOx emissions by improving enhanced exhaust gas recirculation and by incorporating other design changes. However, to meet the PM standard, the widespread introduction of exhaust after treatment technology was required. Nearly all heavy-duty diesel engines manufactured in 2007 had exhaust after treatment control technology.

2. Consent Decree

In the 1990s, 7 large manufacturers of heavy-duty diesel engines (HDDEs) violated certification regulations by turning off, or defeating, emission control equipment during in-use highway driving. To address this violation, the Department of Justice, the United States Environmental Protection Agency and the ARB signed consent decrees with the 7 engine manufacturers. In the consent decrees, the settling manufacturers were

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[13] Combined HC+NOx standard of 16 g/bhp-hr.

[14] Combined HC+NOx g/bhp-hr.

[15] Under a consent decree with EPA, many engine manufacturers implemented the 2004 standards in October 2002.

[16] Emission Standard allows for the options of 2.4 g/bhp-hr non-methane.

[17] Emission standards phased in between 2007 and 2010 for NOx and Nonmethane Hydrocarbons. Phase-in compliance is based on a percent-of-sales: 50 percent compliance between 2007 and 2009 and 100 percent compliance in 2010. No phase-in schedule applies to particulate matter emission standards which must be met starting with the 2007 engine model year.

required, among other things, to produce HDDEs that comply with prescribed emission standards that are lower than those required in they state and federal regulations at that time (U.S. DOJ, 1998). Specifically, these engines were required to meet a 2.5 gram per brake horsepower-hour (g/bhp-hr) standard for non-methane hydrocarbons (NMHC) plus oxides of nitrogen (NOx) emissions no later than October 1, 2002 (about 50 percent lower than the engines produced at the time). In addition, because it was found that the Federal Test Procedure (FTP) was not adequate to ensure that exhaust emissions were controlled during all in-use driving, it was agreed that compliance with supplemental test procedures would be necessary. Thus, the majority of the settling manufacturers agreed to produce engines by October 1, 2002, that would meet supplemental test procedures including the Not-To-Exceed test and the EURO III European Stationary Cycle (ESC) test. The consent decree states that these requirements were to be met for a period of 2 years. Together with the FTP test, the supplemental test procedures required control of emissions during the majority of real world operating conditions to ensure that in the future defeat devices would no longer be employed.

3. U.S. EPA 2007 and Later MY Emission Standards

In January of 2001, the U.S. EPA followed the 2004 Final Rule with another rule to reduce emission standards for 2007 and subsequent model year heavy-duty engines, in light of the advance development of the aftertreatment technologies. When fully implemented, these emission standards represent a 90 percent reduction of NOx emissions, 72 percent reduction of non-methane hydrocarbon (NMHC) emissions, and 90 percent reduction of PM emissions compared to the 2004 emission standards (ARB, 2001). The emission standards are applicable to both natural gas-fueled engines and liquefied petroleum gas-fueled engines derived from the diesel cycle engine.

The standards for NOx and NMHC emissions are phased in from 2007 to 2010, and provide engine manufacturers an average banking and trading program to encourage the early introduction of cleaner engines. The phase in schedules shown in Table VIII-2, which represents the percentage of new engines produced for sale in California that are required to meet the more stringent emission standards beginning in 2007. Full implementation is required starting with the 2009 model year.

Table VIII-2: Exhaust Emission Standards and Phase-In Schedule for 2007 and Later Model Year Heavy-Duty Diesel On-Road Engines

Pollutant	Standard (g/bhp-hr)	Phase in by Model Year (percent of sales)			
		2007	2008	2009	2010
NOx	0.20	50%	50%	50%	100%
NMHC	0.14	50%	50%	50%	100%
PM	0.01	100%	100%	100%	100%

a) Ultra-Low Sulfur Diesel Requirement

The U.S. EPA's 2007 Final Rule began to phase-in in model year 2007 (full compliance not required until 2010) and applied to heavy-duty highway engines and vehicles (CFR, 2007a). These standards were based on a "systems" approach. It relied on the use of low sulfur fuel and the use of high efficiency catalytic exhaust emission control devices or comparably effective technologies. ULSD (ultra low sulfur diesel) enables advanced pollution control technology for trucks and buses so that engine manufacturers can meet the 2007 emission standards. EPA has required the sulfur content to be reduced to 15 parts per million. Refiners began producing the cleaner burning diesel fuel, ULSD, for use in highway vehicles nationwide beginning June 1, 2006 (U.S. EPA, 2000).

b) California Adoption of U.S. EPA 2007 and Later MY Emission Standards

The California amendments include nearly identical emission standards, test procedures, and other requirements contained in the U.S. EPA's 2007 Final Rule (ARB, 2001b). In addition to the emission standards and test procedures, other requirements include the elimination of the current exemption that allows turbocharger-equipped engines to vent crankcase emissions to the ambient air. The amendments ensure that the requirements for 2007 and subsequent model year HDDEs are identical to those adopted by the U.S. EPA in January 2001.

c) Credit for Early Compliance of U.S. EPA 2007 Emission Standards

The U.S. EPA's 2007 Final Rule provides incentives for early introduction of lower emitting engines (CFR, 2007b). Engines that satisfy the adopted requirements and that are introduced into the marketplace before 2007, will receive credits equal to 1.5 times the number of diesel-cycle engines that are introduced prior to 2007. For example, two early introduction engines will reduce the number of required phased in engines during 2007-2009 by three. Each early engine must meet all requirements applicable to the 2007 model year engines. If the engine complies only with the PM requirements, then the offsets may be used only for 2007 PM credits. Engines that can meet one half of the adopted NOx emission standard (0.10 grams per brake horsepower-hour) earlier than the phase in period, in addition to all other requirements applicable to the 2007 model year engines, will be classified as "Blue Sky Series" engines.[18] These engines will receive a credit of 2.0 times the number of 2007 model year compliant engines. For example, two "Blue Sky Series" engines will reduce the number of required phased in engines by 4.

d) Averaging, Banking, and Trading program

The U.S. EPA adopted a special provision for the Averaging, Banking, and Trading program in the final rule that allows a manufacturer to create a single engine family meeting both the phase out and phase in standards during 2007-09 through averaging (CFR, 2007b). These provisions allow a manufacturer to split an engine family,

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[18] Engines with lower emission levels than the mandatory standards (U.S. EPA, 2002).

declaring half of the engines in it to be "phase out" engines, generating credits against the 2.5 g/bhp-hr NMHC+NOx standard, and half to be "phase in" engines, using these credits to demonstrate compliance with the 0.20 NOx standard. A single set of Family Emission Limits (FELs) would be declared for both subfamilies, and no banked credits or credits from other engine families could be used, or vice-versa. As a result, a manufacturer could, if desired, produce only engines meeting approximately a 1.2 g/hp-hr NOx FEL during the 2007-09 model years.[19, 20] This corresponds to a roughly 50 percent NOx reduction on a 2.5 g/hp-hr NOx+NMHC engine. None of these split family provisions affect the separate requirement to demonstrate compliance with the 0.01 g/bhp-hr PM standard. Some manufacturers have sufficient credit so that they will not need to produce engines meeting the 0.2 g/bhp-hr NOx standard until 2011 or 2012. The NTE limits require the engines to be certified to a maximum of 0.5 g/bhp-hr.

B. New Diesel Engines

As discussed in above, since 2007, both ARB and U.S. EPA have required that the new diesel engines meet a more stringent PM and NOx emission standards.

1. Controls to Meet PM Requirements

For PM, all engines must meet the same PM standard of 0.01 g/bhp-hr. This has meant that since 2007, most medium-heavy and heavy-heavy duty diesel engines produced have been equipped with DPFs from the engine manufacturer. Typical DPF designs have included systems that are a hybrid of a purely active and passive system, which allows for better control of filter regeneration over a much wider set of engine operating parameters than either type of system could handle individually. For example, such a system would operate in an active mode during prolonged low temperature applications, while later operating similar to a passive system under high load, high temperature applications.

2. Controls to Meet NOx Requirements

While the requirements for PM controls were not phased in, for NOx, the 2007 and later standard of 0.2 g/bhp-hr is phased in between 2007 and 2010 (when 100 percent of production must meet this standard). Under the standards, only a percentage of each model year's production (50 percent) is required to meet the standard, or as an alternative, all production from a particular manufacturer must meet an equivalent average. This has meant that most engines produced between 2007 and 2009 have actually met a 1.2 g/bhp-hr NOx standard, which is halfway between the 2006 standard of 2.5 g/bhp-hr and the 2010 standard of 0.2 g/bhp-hr. This has allowed engine

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[19] The NOx FEL of the split family could vary somewhat depending on the NMHC emissions level, from 1.16 for an engine emitting at the 0.14 g/bhp-hr NMHC standard, to 1.22 for an engine emitting no NMHC.

[20] It should be noted too that this level is within the threshold values for application of the in-use add-on standards (1.3 g/bhp-hr NOx threshold) and the 1.5x NTE NOx and NMHC multipliers (1.5 g/hp-hr NOx threshold) (see 40 CFR 86.007-11(a)(3) and (4)).

manufacturers to phase in the introduction of new NOx control technology, which has been a mix of engine and combustion changes. However, to meet the 0.2 g/bhp-hr NOx standard, the use of exhaust aftertreatment will most likely be required.

a) Controls to Meet the 1.2 g/bhp-hr NOx Average

To reduce engine out NOx emissions to meet a 1.2 g/bhp-hr NOx average, engine manufacturers in the recent years utilized a number of different emission control strategies, including:

- turbocharging;
- cooled exhaust recirculation;
- high pressure fuel injection;
- changes to injection timing, and;
- combustion chamber design optimization.

Turbocharging is a system that utilizes engine exhaust gases, coupled with an air pump, to supply higher pressure intake air to engine, providing a higher air fuel ratio. Generally, an intercooler would be also used to reduce the compressed air temperature. This would permit more air to enter the combustion chamber producing better engine efficiency and performance.

The use of cooled EGR will lower the peak flame temperature by diverting small amounts of exhaust gases to mix with the incoming air/fuel charge. Typically, the re-circulated gas would be cooled by an EGR cooler before mixing with the incoming fuel.

Changes to the combustion process, such as increased fuel injection pressures, changes (delays) to engine timing, and optimization of combustion chamber design will effectively control the temperature and pressure of the air/fuel mixture and the timing of the fuel injection to produce improved combustion characteristics and lower emissions.

The use of these technologies has had the effect of decreasing cylinder intake air temperatures, reducing peak flame temperature, and creating more uniform combustion propagation in the cylinder, which reduce overall engine out NOx emissions. In using these technologies, it was not necessary for engine manufacturers to use higher level NOx control technologies, such as SCR or other exhaust aftertreatment systems.

b) Controls to Meet the 0.2 g/bhp-hr NOx Average

Beginning in 2010 when all engines must meet the 0.2 g/bhp-hr NOx standard, it will be increasingly more difficult for the engine manufactures to meet the requirements by just engine modification alone. Consequently, engine manufacturers have implemented or are considering implementing aftertreatment technology to meet these very low NOx standards. As will be discussed later in this chapter, this also includes the use of alternative fueled and hybrid engines.

EGR has been commonly used in 2004-2009 model year engines for NOx control, and one engine manufacturer had indicated that it is able to meet the 2010 NOx emission requirement by hardware improvement based on the EGR. Through an enhanced cooled EGR, coupled with the high pressure fuel injection systems, it is believed that sufficient NOx control can be achieved without the use of aftertreatment control in heavy-duty diesel engine applications.

However, most other engine manufacturers have indicated that they intend to utilize SCR to achieve the required reductions in NOx emissions from 2010 and later diesel engines. The selection of this technology is based on a number of reasons, including:

- the high level of NOx control it provides;
- the maturity of the technology, and;
- substantial improvements in fuel economy.

Currently in Europe, there are over 300,000 commercial vehicles equipped with SCR systems (VDA, 2008). SCR systems can provide engine out NOx reductions of 85 percent or greater when properly designed. In addition, heavy-duty vehicles equipped with SCR systems have demonstrated fuel economy savings of 5 percent or more. Cummins has built and shipped over 45,000 SCR engines to date and Cummins Emission Solutions has built and shipped over 200,000 SCR systems (Cummins, 2008).

Currently, Cummins, Daimler (Detroit Diesel), Paccar, Volvo, and Mack have announced their intention to use SCR system in their 2010 model year and later product offerings. Staff estimates that this mean that nearly 80 percent of new engine production beginning in 2010 will have SCR installed (Ward's, 2007).

3. Impact of ABT on 2010 Engine Emissions

As part of the 2007 on-road engine standards, U.S. EPA adopted a special provision for the ABT program in final rule that allows a manufacturer to create a single engine family meeting both the phase out and phase in standards through averaging during 2007-2009 engine model year period. The ABT program permits the engine manufacturers to generate emission credits from cleaner engines to offset the emissions from new manufactured engines that are dirtier.

Under this program, some manufacturers have acquired sufficient credit so they will not need to produce engines meeting the 0.2 g/bhp-hr NOx standard until 2011 or 2012. In other words, there will be engines manufactured beyond 2010 that, while certified to the 2010 model year emission standard, will actually producing emissions higher than 2010 emission standards because of the use of emission credits. The ABT program does cap the amount of credits that can be used for any given engine family, and no engine may be certified to a NOx level above 0.5 g/bhp-hr beginning in 2010.

Despite the availability of credits with many engine manufacturers, as previously discussed, nearly all have are announced that they will use SCR in their 2010 and later product offerings, greatly minimizing the potential for less NOx reductions than anticipated from these engines.

C. Availability of Vehicles with Cleaner Engines

Between 2010 and 2014, staff estimates that demand for new or near-new vehicles as a result of the proposed regulation will increase to about 20,000 each year. Of this, staff expects that about 7,000 of these vehicles each year will be purchased new, with 2010 and later model year engines. The remaining 13,000 vehicles are expected to be near-new used vehicles, having engines that are 5 years old or newer.

To evaluate whether there are sufficient vehicles available to meet this demand, staff evaluated the availability of both new and used vehicles. In evaluating the availability of new vehicles, staff relied on data that shows that while new class 8 truck production has, as recently as a few years ago, been as high as over 250,000 per year, recent demand has reduced this to about 150,000 annually. Medium-heavy duty vehicle sales in 2006 were over 200,000 trucks (Ward's, 2007). Since the proposed regulation will result in an incremental increase of only about 7,000 new vehicles a year, staff believes there is sufficient engine and vehicle production capacity to meet this increased demand.

Staff also considered the currently available availability of near-new used vehicles. In its evaluation, staff found over 100,000 used trucks for sale on just two popular used vehicle websites (Truckpaper.com, 2008) (Commercialtrucktrader.com, 2008), with about 60 percent of the listings being vehicles that were 8 years old or newer. Based on the rate of new vehicle listings that are posted each month, staff estimates that over the course of year, over 150,000 used vehicle listings for near-new used vehicles would be made on just these two websites alone. Since staff estimates that the proposed regulation will necessitate the purchase of an additional 13,000 near-new used vehicles each year, and considering that California represents about 10 percent of the vehicle market, staff believes that there will be sufficient used vehicles to meet the demands of fleets to comply with the regulation. When one considers that this assessment did not include vehicles that are available for sale each day at thousands of dealerships across the country, this assessment is highly conservative.

Beyond 2014, staff expects the incremental demand for replacement vehicles to decrease, reducing pressure on the used and new vehicle market to supply additional vehicles to California.

D. Repowers

Repowering is often an attractive strategy for owners of vehicles whose engines have reached the end of their useful life before the other vehicle components need retirement. Repowering is most cost effective when a new or newer vehicle replacement costs are much higher than the costs of repowering.

While repowering is sometimes an attractive compliance option for using newer, cleaner engines, it is not always a viable option for all vehicle types and configurations due to space limitations and other requirements associated with newer, more advanced model year engines. In many cases, the existing engine compartment may be too small to physically fit the new engine, or does not allow for proper air circulation within the allowable space. In addition, repowers may often require significant changes or modifications to the cooling system, wiring harness, engine control module, exhaust system, and transmission. While some vehicles repowered to 2004 to 2006 model year engines have been funded through the Carl Moyer Program, the feasibility of repowering with vehicles to 2007-2010 model year engines is unclear, and may be limited due to higher costs and limited space.

E. Hybrid Vehicles

Hybrid technology utilizes a combination of an engine and onboard energy storage system that provides motive power for starting and accelerating a vehicle, and recapturing energy when the vehicle is decelerated. Hybrid vehicles not only can provide reductions in diesel PM and NOx, typically through reduced fuel consumption, but can also reduce greenhouse gas emissions. In the future, hybrid vehicles may become even more effective platforms for additional improvements in fuel efficiency and air quality. This would arise from the use of electrification, more efficient components, the use of down-sized, optimized engines and combustion schemes, and through enhanced energy storage systems.

1. Status of Industry and Availability

Hybrid truck technology has made significant strides in the last several years and is now commercially available for certain vehicle types. However, unlike passenger cars where hybrid technology has been in production for nearly a decade, the first hybrid production trucks are only now just starting operation in the medium- and heavy-duty vehicle sector. Integrating hybrid technology into truck platforms presents very different challenges than for passenger cars, and requires different strategies and solutions involving packaging and weight concerns, system designs, and component sizing.

So far, unlike the automotive industry, the leaders in medium- and heavy-duty hybrids are U.S. based manufacturers (WestStart-CALSTAR, 2008). Many truck and system manufacturers are now developing heavy hybrid prototypes or pre-production units; but this effort has not yet achieved critical mass. One of the key early barriers to success is that production volumes are low, so (incremental) prices remain high. Currently, truck and bus manufacturers produce a limited quantity of medium-duty hybrid vehicles for sale in North America. Kenworth’s class 6 T270 and class 7 T370 hybrids, International’s medium duty DuraStar hybrid, Freightliner Business class M2e hybrid, and Peterbilt’s class 7 Model 335 are just few of the hybrid vehicles available in the market today. The costs of hybrid vehicles are expected to decrease as production volumes increase.

2. Hybrid Application

Diesel engines are predominant in the heavy-duty vehicle sector because of the power, efficiency, durability, and reliability they provide. In certain applications, a diesel-electric hybrid system can increase several of these important advantages, in that it can add more power at low engine speeds and improve diesel's already high efficiency. Since hybrids create some of their efficiency gains through regenerative braking and power-on-demand, the applications that benefit most from diesel-electric hybrid technology are those that are driven in stop and go conditions, such as transit buses and urban delivery vehicles, or applications where diesel engines would otherwise idle to perform work while stationary, such as in utility boom trucks. Moreover, such fleets are often subject to public policy initiatives that require or encourage actions to reduce heavy-duty vehicle emissions, and diesel-electric hybrid technology is proving to be an effective means to meet those goals.

Studies have shown that in an urban test cycle, a hybrid vehicle can produce fewer emissions (Barker and Hitchcock, 2003) and consumes less fuel (Electric Mobility Canada, 2007) than a comparable conventional diesel vehicle. Since hybrid vehicles use stored energy to assist or perform work, there is less energy demand on the engines. As a result, engine size can be reduced relative to a conventional vehicle performing a similar function. Furthermore, regenerative braking can recover otherwise lost kinetic energy for use later, instead of releasing it to the environment as heat. A utility truck is a good example of an application where stored energy is used to perform on-site work and the activation of the diesel engine during the on-site work is only needed to replenish the battery when the state of charge becomes low. In this example, laboratory testing has shown an average fuel savings of more than 25 percent (SwRI, 2007).

While long-haul, interstate tractor-trailer seldom apply their brakes (relative to more urban truck applications), and travel mostly on the open road, the benefit of hybrid technologies, which typically recoup energy "wasted" when the brakes are applied, does not seem to be advantageous. However, hybrid vehicle manufacturers are making efforts to introduce hybrid technology to this market segment by taking advantage of changes in terrain a vehicle would see while traveling. Using such an approach, a long-haul truck with hybrid technology could outperform a conventional tractor-trailer in terms of fuel savings. A good example would be a tractor-trailer transporting cargo across the mountains. In such case, the hybrid system on the vehicle will assist the tractor-trailer in climbing uphill, while recovering energy while the vehicle is descending. The first class 8 prototype hybrid truck using hybrid technology is expected to be placed into service in early 2009 (Buchholz, 2008).

3. Future of Hybrids

Staff believes that hybrid technology can and will play an important role in meeting AB32's GHG emission reduction goal and California's cleaner air needs. There are few technologies that can achieve the hybrid's benefits of increasing efficiency while reducing emissions. While the production of hybrid diesel vehicles is low today, as fuel costs increase and hybrid technology matures, increased use of hybrid vehicles in the future is anticipated.

F. Alternative Fueled Vehicles

The use of alternative fueled vehicles provides another viable method for fleet operators to reduce emissions from their fleet. Typically, alternative fuels burn cleaner than diesel fuel leading to reduced emission. Alternative fuels include natural gas, both liquefied and compressed, as well as propane, amongst the most common diesel fuel replacement (See Figure VIII-1). As of 2006, over 634,500 alternative fueled vehicles were in use in the United States, and over 105,000 of them were in California (U.S. DOE, 2008a).

Natural gas, both compressed and liquid form, is the most widely used alternative fuel in medium- and heavy-duty vehicle applications. Natural gas is primarily produced in North America and costs less per equivalent gallon of diesel. While the commercial refueling network is relatively well developed within California, many stations remain open for private use only (CEC, 2008a). Several types of vehicles commonly operate on natural gas, including buses, street sweepers, various tractors, step vans, yard trucks, and solid waste collection vehicles. Currently, California has over 30,000 alternative fueled buses using compressed and liquid natural gas in transit fleet service. These types of buses typically have an incremental cost (relative to a comparable diesel vehicle) of around $30,000 to $40,000, but this cost can typically be recovered through lower per mile operating costs (UCS, 2008).

Major vehicle manufacturers have offered natural gas buses in their product lines for many years. In 2007, 15 vehicle manufacturers produced heavy-duty trucks and buses utilizing alternative fuels (U.S. DOE, 2008b). Over the next several years, staff anticipates an increase in the number of alternative fueled vehicle engines available that are certified to the 0.2 g/bhp-hr NOx standard. For example the Cummins Westport ISL G engine, certified in 2008, was the first engine to meet the 0.2 g/bhp-hr NOx standard (Cummins Westport, 2008). In addition, certain air quality management jurisdictions require the use of alternative fuel vehicles in certain applications. For example, the SCAQMD actively requires many vehicles subject to their fleet regulations to operate on alternative fuels.

Figure VIII-1: Vehicle with Oversized Fuel Tank to Accommodate the Lower Energy Density of Alternative Fuels

G. All Electric Heavy-Duty Vehicles

With continuing improvements in battery technology, the development of heavy-duty all-electric trucks is becoming a reality. All electric vehicles can be ideal for short distance and inner city applications. Currently, the Port of Los Angeles, working in conjunction with the SCAQMD, is conducting tests on a prototype heavy-duty all electric truck. This electric truck is designed to pull up to 60,000 pounds with a top speed of 40 miles per hour. The battery on the truck can be recharged in a few hours, and the truck has a 60 mile range. Funding has been appropriated for technology improvements, manufacturing and testing of an additional 20 electric trucks. Testing for the additional vehicles is planned to begin in mid-2008.

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IX. EXISTING DIESEL EMISSION REDUCTION REGULATIONS

A number of ARB regulations exist to reduce the emissions and risk from new and existing mobile diesel vehicles and equipment, and portable equipment powered by diesel engines. They include:

- Public transit agency - urban buses
- Public transit agency - transit fleet vehicles
- Solid waste collection vehicles
- Public agency and utility vehicles
- Drayage trucks
- Cargo handling equipment
- In-use off-road vehicles
- Transport refrigeration units
- Portable engines and equipment
- Diesel fuel standards
- Off-road engine standards

A. In-Use On-Road Diesel Vehicle Regulations

Because diesel engines can be rebuilt to extend their useful life, as a result, diesel engines typically have useful lifetimes in excess of 1,000,000 miles. Current regulations allow the engine to be rebuilt to standards in effect at the time of manufacture rather than at the time of rebuild. This practice of rebuilding older engines does not provide the emissions reductions that replacement with a newer cleaner engine (repowering) does. To address this issue, the Diesel RRP recommended a large-scale program to retrofit diesel particulate filters, and other feasible technologies, on existing diesel engines.

Since 2000, the ARB has adopted five regulations requiring the retrofit of in-use on-road diesel vehicles with verified DECS to reduce emissions of PM and other criteria pollutants. Five of those regulations apply to on-road diesel vehicles. These regulations have been adopted to reduce emissions from urban buses, transit fleet vehicles, solid waste collection vehicles, public agency and utility fleets, and drayage trucks. Table IX-1 lists the five regulations with their date of adoption, and the number of vehicles subject to each regulation.

Table IX-1: Regulations Requiring Retrofits of On-Road Diesel Vehicles

Regulation	Adoption Date	Number of Vehicles Regulated
Urban Bus	February 2000	9,000
Transit Fleet Vehicles	February 2005	4,000
Solid Waste Collection Vehicles	September 2003	13,000
Public Agencies and Utility Fleets	February 2005	31,000
Drayage Trucks	December 2007	100,000

1. Transit Urban Bus Fleets

In February 2000, the ARB adopted the Fleet for Transit Agencies – Urban Bus requirements. Under the rule, urban bus operators were required to reduce NOx emissions from the urban bus fleet to meet a 4.8 g/bhp-hr NOx fleet average and meet fleet wide PM reductions relative to a baseline established in 2002. Urban bus engine manufacturers were required to meet a more stringent California urban bus exhaust emission standard through the 2006 model year, then starting with the 2007 model year, the standard would align with the California heavy-duty engine exhaust emission standards.

Also, transit agency operators were required to choose between a diesel and an alternative fuel path. If a transit agency chose a diesel fuel path, then the transit agency was required to reduce the diesel PM emissions of its diesel urban bus fleet relative to its January 1, 2002, emissions by 40 percent in 2004, 60 percent in 2005, and 85 percent in 2007.

The alternative fuel path option has both a purchasing and emissions reduction component. For fleets on the alternative fuel path, at least 85 percent of annual urban bus purchases must be fueled by alternative fuels, which include CNG, propane (LPG), ethanol, methanol, gasoline/electric hybrid, electricity, fuel cells, or advanced technologies that do not rely on diesel fuel. For transit agencies on the alternative fuel path, the 85 percent exhaust PM emission reductions requirement does not have to be met until January 1, 2009.

2. Transit Fleet Vehicles

In February 2005, the ARB adopted a regulation for transit fleet vehicles. These are vehicles that are not urban buses, that are greater than 8,500 pounds GVWR, powered by a heavy-duty engine, fueled by diesel or alternative fuel, and owned and operated by a transit agency. Like the urban bus regulation, the transit fleet vehicle regulation has a NOx fleet average requirement and a requirement for PM emissions reduction. Each transit agency must reduce the fleet average NOx for its transit fleet vehicles to at least 3.2 g/bhp-hr by December 31, 2007, and further reduce the average to at least 2.4 g/bhp-hr by December 31, 2010. The regulation also requires each transit agency to reduce the total diesel PM emissions for its transit fleet vehicles by 40 percent as of December 31, 2007, and by 80 percent as of December 31, 2010, compared to baseline emissions as of January 1, 2005. To allow for growth, a transit agency may also meet a fleet PM average of 0.01 g/bhp-hr, in lieu of achieving the final percent reduction requirement. Transit agencies may comply with the regulation's requirements by using alternative fuels, retrofitting engines with verified DECS or by replacing with engines or vehicles that meet the 2007 heavy-duty engine exhaust emission standards.

3. *Solid Waste Collection Vehicles*

This regulation, adopted in September 2003, reduces diesel PM emissions from diesel-fueled commercial and residential solid waste and recycling collection vehicles. It applies to owners of heavy-duty diesel-fueled vehicles over 14,000 pounds GVWR, with model year engines from 1960 to 2006, that are used to collect residential and commercial solid waste for a fee. Each fleet is divided into three groups based on engine model year: Group 1 (1988-2002), Group 2 (1960-1987), and Group 3 (2003-2006). Vehicle owners are required to apply best available control technology (BACT) to their vehicles according to a specified implementation schedule that sets compliance deadlines and the percentage of each group that must be equipped with BACT by each deadline. BACT is defined in this regulation as:

- an engine certified to the 2007 model year standard of 0.01 g/bhp-hr PM standard;
- an engine certified to the 0.10 g/bhp-hr PM standard that is then equipped with the most effective ARB-verified diesel emission control strategy such as a diesel particulate filter;
- application of the highest level ARB verified DECS to a diesel engine, or
- an alternative-fuel engine, or any diesel or dual-fuel engine retrofitted with an ARB verified DECS that reduces PM by the greatest amount possible for the particular engine and application.

4. *Public Agency and Utility Fleets*

In February 2005, ARB adopted a fleet regulation to reduce diesel PM emissions from vehicles operated by municipalities and utilities. The regulation applies to any municipality or utility that owns, leases, or operates on-road diesel-fueled heavy-duty vehicles with a 1960 to 2006 model year medium-heavy duty or heavy-heavy duty engine and a manufacturer's GVWR greater than 14,000 pounds.

Each fleet is divided into three groups based on engine model year: Group 1 (1960-1987), Group 2 (1988-2002), and Group 3 (2003-2006). The municipalities and utilities are required to apply BACT to their vehicles according to a specified implementation schedule that sets compliance deadlines and the percentage of each group that must be equipped with BACT by each deadline. BACT can be an alternative fuel engine, a diesel engine certified to a 0.01 g/bhp-hr PM standard, or application of the highest level ARB verified DECS to a diesel engine. The implementation schedule for most fleets covered by the regulation is summarized below in Table IX-2.

Table IX-2: Implementation Schedule for Most Municipal and Utility Fleets Vehicles

Group	Engine Model Years	Percentage of Group to use BACT	Compliance Deadline, as of December 31st
1	1960 –1987	20% 60% 100%	2007 2009 2011
2	1988-2002	20% 60% 100%	2007 2009 2011
3	2003-2006 (Includes dual-fuel and bi-fuel engines)	50% 100%	2009 2010

5. Drayage Trucks

In December 2007, the ARB adopted a regulation to reduce emissions from diesel-fueled drayage trucks – described as trucks that transport containers, bulk, and break-bulk goods to and from ports and intermodal rail yards. The regulation applies to owners and operators of diesel-fueled drayage tractors having a GVWR greater than 33,000 pounds that operate at California ports, intermodal rail yards, or both. There are approximately 20,000 of these tractors frequently servicing the ports and intermodal rail yards. The requirements of the regulation will be implemented in two phases. In Phase 1, by December 31, 2009, all drayage trucks must be equipped with a 1994 to 2003 model year engine and a level 3 verified DECS for PM emissions or they must be equipped with a 2004 mode year or newer engine. In Phase 2, all drayage tractors are required to meet the 2007 model year engine standard by December 31, 2013. All drayage trucks involved in work at affected ports and rail yards must be registered in a drayage truck registry (DTR) by late 2009.

B. In-Use Off-Road Diesel Vehicles and Equipment

Since 2005, the ARB has adopted two regulations requiring reductions of emissions of PM and other criteria pollutants from in-use off-road diesel vehicles. The types of vehicles subject to these regulations include cargo handling equipment at California's ports and intermodal rail yards and off-road heavy-duty diesel vehicles, such as those used in construction, mining, and industrial operations. The ARB has also adopted a regulation for transport refrigeration units (TRU) which are refrigeration systems powered by diesel internal combustion engines designed to refrigerate or heat perishable products that are transported in various containers, including semi-trailers, truck vans, shipping containers, and rail cars. Table IX-3 lists the regulations with the adoption date, and the number of engines subject to each regulation.

Table IX-3: Regulations for In-Use Off-Road Diesel Vehicles

Regulation	Adoption Date	Number of Engines Regulated
Cargo Handling Equipment	February 2005	4,000
In-Use Off-Road Diesel Vehicles	July 2007	180,000
Transport Refrigeration Units	February 2004	40,000

1. Mobile Cargo Handling Equipment

In December 2005, the ARB adopted a regulation to reduce emissions of diesel PM and NOx from mobile cargo handling equipment at ports and intermodal rail yards. Mobile cargo handling equipment is any motorized vehicle equipped with a diesel-cycle engine that is used primarily off-road to handle cargo or to perform scheduled or predictable maintenance or repair activities. Equipment types include, but are not limited to, yard trucks, top handlers, mobile cranes, sweepers, side handlers, rubber-tired gantry (RTG) cranes, forklifts, dozers, and loaders.

Beginning January 1, 2007, newly purchased, leased, or rented (new) cargo handling equipment must meet the following performance standards:

- new yard trucks that are registered on-road vehicles must meet the certified on-road engine standards for the current year;
- new yard trucks that are not registered on-road vehicles must meet the current certified on-road engine standards or the final Tier 4 off-road emission standards for the rated horsepower of the engine; and
- new non-yard truck equipment must ultimately meet the current certified on-road diesel engine standards or the Tier 4 off-road diesel engine standards. If the current model year off-road engine standard is pre-Tier 4, the off-road engine must be equipped with the highest level verified DECS within one year of acquiring the new equipment.

The regulation also establishes in-use performance standards for yard trucks and non-yard truck equipment. In-use yard trucks must meet the 2007 or later current model year certified on-road engine standards, the certified final Tier 4 off-road engine standards, or apply verified DECS that will result in emissions that are less than or equal to the final Tier 4 off-road engine standards. Compliance begins on December 31, 2007, for pre-2003 model year engines and is phased in based on the size of the fleet.

In-use non-yard truck equipment must comply through engine replacement and/or by retrofitting with the highest level available verified DECS. Replacement engines must meet current model year on- or off-road engine standards, and for pre-Tier 4 off-road engines, the highest level available verified DECS must be installed within one year. If retrofitting in lieu of engine replacement, a second compliance step may be required depending on the engine certification and the level of verified DECS installed.

Compliance begins on December 31, 2007, for pre-1988 model year engines and is phased in based on the size of the fleet.

2. In-Use Off-Road Diesel Vehicles

In July 2007, ARB adopted a regulation to reduce diesel PM and NOx emissions from in-use off-road heavy-duty diesel-fueled engines with maximum power of 25 horsepower (hp) or greater. These engines are used to provide motive power in a workover rig or to provide motive power in any other motor vehicle that cannot be registered and driven safely on-road, and is not an implement of husbandry or recreational off-highway vehicle. The proposed regulation only addresses engines that drive self-propelled vehicles (i.e., does not apply to stationary equipment or portable equipment like generators). Examples include loaders, crawler tractors, skid steers, backhoes, forklifts, and airport ground support equipment.

The regulation establishes increasingly stringent fleet average emission rate targets for PM and NOx for all off-road vehicles operating in the state. By the applicable compliance each year, the regulation requires each fleet to meet the fleet average emission rate targets for PM or apply the highest level verified DECS to 20 percent of its horsepower. Each year, the regulation also requires large and medium fleets to meet the fleet average emission rate targets for NOx or to turnover a certain percent of their horsepower (8 percent in early years, and 10 percent in later years). “Turnover” means repowering with a cleaner engine, rebuilding the engine to a more stringent emissions configuration, retiring a vehicle, replacing a vehicle with a new or used piece, or designating a dirty vehicle as a low use vehicle. If retrofits that reduce NOx emissions become available, they may be used in lieu of replacement as long as they achieve the same emission benefits.

Large fleets are subject to the PM and NOx requirements beginning in 2010. Medium fleets are subject to the PM and NOx requirements beginning in 2013. Small fleets are subject only to the PM requirements beginning in 2015.

Off-road diesel vehicles that are exempt from the regulation include those operated 100 hours or less per year, vehicles used in agricultural operations, and vehicles used for personal use only. Vehicles that are operated for 100 hours or less have reporting requirements but no performance requirements.

3. Transport Refrigeration Units

In February 2004, the ARB adopted a regulation to reduce diesel emissions from in-use diesel-fueled TRUs and TRU generator set equipment used to power electrically driven refrigerated shipping containers and trailers that are operated in California. The regulation applies to owners and operators of both California–based and non-California-based TRUs. The engines are required to meet the in-use PM performance standards shown in Table IX-4 according to a schedule that is phased in starting December 31, 2008. The proposed in-use performance standards are aligned with the federal interim Tier 4 standards for new nonroad engines.

Table IX-4: TRU In-Use Performance Standards

Engine Horsepower (hp)	Emission Category	Engine Certification (g/hp-hr)	DECS Retrofit
<25 hp	Low Emission TRU (LETRU)	0.30	Level 2
<25 hp	Ultra-Low Emission TRU (ULETRU)	NA (pick another option)	Level 3
≥25 hp	Low Emission TRU (LETRU)	0.22	Level 2
≥25 hp	Ultra-Low Emission TRU (ULETRU)	0.02	Level 3

The performance standards may be met by using a certified engine meeting the applicable standard, installing the required level of verified DECS, or using an alternative technology. The TRU emission requirements apply to in-use engines older than seven years. Owners/operators must meet the TRU engine performance standards on the following schedule.

- MY 2001 and earlier engines must meet LETRU standards by December 31 2008, and ULETRU standards by December 31, 2015.
- MY 2002 engines must meet LETRU standards by December 31, 2009, and ULETRU standards by December 31, 2016.
- MY 2003 and later engines must meet ULETRU standards by December 31 of the seventh year past the engine's model year (i.e., MY 2003 engines must meet ULETRU standards by December 31, 2010, MY 2004 by December 31, 2011, and so on).

C. Portable Engines and Equipment

Portable engines and equipment units are used for a variety of applications, such as: pumps, ground support equipment at airports, cranes; oil well drilling and workover rigs, and dredging equipment. ARB has adopted the two regulations described below that apply to portable engines and equipment units. One regulation establishes a uniform, voluntary system of statewide registration and regulation of portable equipment, while the other is an ATCM to minimize the public's exposure to diesel PM emitted from diesel-fueled portable engines. Once registered in the voluntary program, owners and operators of portable engines and equipment units can operate throughout the State without having to obtain permits from individual air pollution control and air quality management districts (district). If the owner of an engine or equipment unit chooses not to register under the Statewide program, the engine or equipment is then subject to district permitting requirements.

1. Statewide Portable Equipment Registration Program

Sections 41750 through 41755 of the HSC required the ARB to create and maintain a program for the voluntary registration and regulation of portable engines and equipment units in California. In March 1997, the Board adopted a regulation establishing the PERP which became effective on September 17, 1997. The Board has since approved amendments to the PERP Regulation on December 11, 1998, February 26, 2004, June 22, 2006, and March 22, 2007. The regulation includes recordkeeping and reporting requirements and sets fee schedules for registration and inspection of portable engines and equipment registered through the program. Most of the engines associated with portable equipment are diesel-fueled, making these engines also subject to the requirements of the Portable Engine ATCM.

2. Portable Engine Air Toxic Control Measure

In February 2004, the ARB adopted an ATCM that requires a phase in of cleaner technology engines that would result in the reduction and eventual elimination of high emission engines. The ATCM requires that most portable engines larger than 50 horsepower (hp) to be certified to Tier 1, 2, or 3 U.S. EPA/ARB off-road engine standards by January 1, 2010. Uncertified (Tier 0) diesel engines that are designated as emergency use or low use may operate beyond 2010 if they will be replaced with Tier 4 engines within 2 years of them becoming available. In addition, starting in 2013, all fleets of portable engines would have to meet diesel PM emission averages that become progressively more stringent in 2017 and 2020. Options available to satisfy the fleet requirements include replacing engines, using add-on control devices, switching to alternative fuels, and receiving credit for electrification.

In March of 2007, the ATCM was amended to allow statewide registration and district permitting of Tier 1 and Tier 2 engines that had been operating in California between March 1, 2004 and October 1, 2006. These amendments also allowed local air districts to permit resident Tier 0 engines at their discretion. In order to be newly registered in PERP or permitted by a district after January 1, 2010, the ATCM requires that the engines must be certified to the most stringent ARB or U.S. EPA nonroad emission standards in effect at the time of application.

D. Diesel Fuel Standards

Since 1993, California's diesel fuel regulations have limited statewide the allowable sulfur content of California motor vehicle diesel fuel to 500 parts per million by weight (ppmw) and the aromatic hydrocarbon content to 10 percent by volume with a 20 percent limit for small refiners. These regulations reduce emissions from diesel engines and equipment: 7 percent NOx, 25 percent PM, 80 percent sulfur oxides (SO_2), and several toxic substances, such as benzene and polynuclear aromatic hydrocarbons (PAHs). These standards apply to all diesel fuel sold in California, regardless of the application into which it is sold.

The regulation limiting aromatic hydrocarbon content allows refiners to sell proprietary formulations with aromatic hydrocarbon content greater than the basic limits, provided these formulations have been certified as meeting ARB emission requirements. Most refiners have taken advantage of the regulation's flexibility to produce alternative diesel formulations that provide the required air quality benefits at a lower cost.

In July 2003, the ARB amended the diesel fuel regulations to reduce the maximum sulfur content allowed in diesel fuel from 500 ppmw to 15 ppmw. This low sulfur diesel regulation was needed for two primary reasons: to enable the effective use of the emissions control technology required by heavy-duty diesel vehicles and engines that must meet the U.S. EPA/ARB 2007 PM and NOx emission standards, and to enable the use of the exhaust treatment technologies required by new and retrofitted diesel engines to meet the diesel PM reduction targets established by the Diesel RRP. As of September 1, 2006, all diesel fuel sold at retail locations in California must meet the sulfur content of 15 ppmw. Beginning January 1, 2007, the requirement to use low sulfur diesel fuel was extended to intrastate locomotives and marine vessels.

E. Off-Road Engine Standards

ARB has the authority to regulate engines in new off-road equipment equal to or greater than 175 hp and non-preempted off-road equipment less than 175 hp. ARB and U.S. EPA have worked closely to harmonize the off-road compression ignition (CI) engine standards. ARB is preempted from regulating new farm and construction equipment less than 175 hp, as the U.S. EPA has the sole authority to regulate this type of equipment. However, ARB is not preempted from regulating in-use equipment regardless of engine horsepower.

Emissions from engines utilized in off-road equipment between 175 and 750 horsepower were uncontrolled prior to 1996. Estimates of NOx emission rates from uncontrolled off-road engines range from 8.2 grams per brake horsepower-hour (g/bhp-hr) to 14 g/bhp-hr. In January 1992, the Board adopted exhaust emission standards for off-road dieselcycle engines 175 hp and greater, effective beginning with 1996 model year engines.

In August 1996, U.S. EPA, ARB, and off-road diesel engine manufacturers signed a Statement of Principles which called for harmonization of ARB and U.S. EPA off-road diesel engine regulations, as appropriate, in exchange for an accelerated introduction of progressively more stringent standards. U.S. EPA adopted emission standards in 1998 and again in 2004 that provided for new NOx plus non-methane hydrocarbons (NMHC), PM and CO emissions standards for engines within different power categories in a four tiered approach, commonly referred to as "Tier" standards. In California, these standards, which are harmonized with U.S. EPA, are contained in Title 13, California Code of Regulations (CCR), sections 2423(b)(1). Table IX-5 summarizes the emission standards for these engines.

The date upon which each tier takes effect depends on the engine horsepower (size). As of January 1, 2000, all engine sizes were subject to Tier 1 standards. In 2006, all engine sizes were subject to Tier 2, while some Tier 3 standards also took effect (engines less than 75 horsepower or greater than 750 horsepower do not have a Tier 3 standard). The Tier 4 standards are divided into two stages: interim, which begins between 2008 and 2012 for most engines, and final, which is effective for all off-road engines by 2015. The final Tier 4 standards will result in diesel engines that will be over 90 percent cleaner than 1988 vintage engines. The Tier 4 standards require most engines to meet a 0.01 g/bhp-hr diesel PM emission rate and a 0.3 to 0.5 g/bhp-hr NOx emission rate in the 2011-2015 timeframe.

Table IX-5: ARB and U.S. EPA Off-Road Compression-Ignition (Diesel) Standards (NMHC+NOx/CO/PM in g/bhp-hr where applicable)

HP (kW)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015+
< 11 (8)	See Table 2 footnote (a)					7.8 / 6.0 / 0.75 (10.5 / 8.0 / 1.0)					5.6 / 6.0 / 0.60 (7.5 / 8.0 / 0.80)			5.6 / 6.0 / 0.30[a] (7.5 / 8.0 / 0.40)							
≥ 11 (8) < 25 (19)						7.1 / 4.9 / 0.6 (9.5 / 6.6 / 0.80)					5.6 / 4.9 / 0.60 (7.5 / 6.6 / 0.80)			5.6 / 4.9 / 0.30 (7.5 / 6.6 / 0.40)							
≥ 25 (19) < 50 (37)	-				7.1 / 4.1 / 0.60 (9.5 / 5.5 / 0.80)					5.6 / 4.1 / 0.45 (7.5 / 5.5 / 0.60)				5.6 / 4.1 / 0.22 (7.5 / 5.5 / 0.30)					3.5 / 4.1 / 0.02 (4.7 / 5.5 / 0.03)		
≥ 50 (37) < 75 (56)	-			- / 6.9 / - / -[b] (- / 9.2 / - / -)						5.6 / 3.7 / 0.30 (7.5 / 5.0 / 0.40)				3.5 / 3.7 / 0.22[c] (4.7 / 5.0 / 0.30)					3.5 / 3.7 / 0.02[c] (4.7 / 5.0 / 0.03)		
≥ 75 (56) < 100 (75)														3.5 / 3.7 / 0.30 (4.7 / 5.0 / 0.40)				0.14/ 2.5/ 3.7/ 0.01[b,d] (0.19/ 3.4 / 5.0 /0.02)			0.14 (0.19) 0.30 (0.40) 3.7 (5.0) 0.01[b] (0.02)
≥ 100 (75) < 175 (130)	-								4.9 / 3.7 / 0.22 (6.6 / 5.0 / 0.30)				3.0 / 3.7 / 0.22 (4.0 / 5.0 / 0.30)								
≥ 175 (130) < 300 (225)	-	1.0 / 6.9 / 8.5 / 0.40[b] (1.3 / 9.2 / 11.4 / 0.54)							4.9 / 2.6 / 0.15 (6.6 / 3.5 / 0.20)			3.0 / 2.6 / 0.15[e] (4.0 / 3.5 / 0.20)					0.14 / 1.5 / 2.6 / 0.01[b,d] (0.19/ 2.0 / 3.5 /0.02)			0.14 (0.19) 0.30 (0.40) 2.6 (3.5) 0.01[b] (0.02)	
≥ 300 (225) < 600 (450)							4.8 / 2.6 / 0.15 (6.4 / 3.5 / 0.20)														
≥ 600 (450) ≤ 750 (560)																					
Mobile Machines > 750 (560)	-					1.0 / 6.9 / 8.5 / 0.40[b] (1.3 / 9.2 / 11.4 / 0.54)						4.8 / 2.6 / 0.15 (6.4 / 3.5 / 0.20)					0.30 / 2.6 / 2.6 / 0.07[b] (0.40 / 3.5 / 3.5 / 0.10)				0.14 (0.19) 2.6 (3.5) 2.6 (3.5) 0.03[b] (0.04)
GEN >750 (560) ≤1207 (900)																					0.14 (0.19) 0.50 (0.67) 2.6 (3.5) 0.02[b] (0.03)
GEN>1207 (900)																	0.30 / 0.50 / 2.6 / 0.07[b] (0.40 / 0.67 / 3.5 / 0.10)				

a) The PM standard for hand-start, air cooled, direct injection engines below 11 hp (8 kW) may be delayed until 2010 and be set at 0.45 g/bhp-hr (0.60 g/kW-hr).
b) Standards given are NMHC/NOx/CO/PM in g/bhp-hr (or g/kW-hr).
c) Engine families in this power category may alternately meet Tier 3 PM standards [0.30 g/bhp-hr (0.40 g/kW-hr)] in 2008-2011 in exchange for introducing final PM standards in 2012.
d) The implementation schedule shown is the three-year alternate NOx approach. Other schedules are available.
e) Certain manufacturers have agreed to comply with these standards by 2005.

: Tier 1 : Tier 2 : Tier 3 : Tier 4 Interim / Final

F. References

ARB, 1998b. California Air Resources Board. Final Statement of Reasons for Rulemaking, Including Summary of Comments and Agency Response: Public Hearing to Consider Amendments to Heavy-Duty Vehicle Regulations: 2004 Emission Standards; Averaging, Banking and Trading; Optional Reduced-Emission Standards; Certification Test Fuel; Labeling; Maintenance Requirements and Warranties; April 23, 1998.

ARB, 2001b. California Air Resources Board. Final Statement of Reasons for Rulemaking, Including Summary of Comments and Agency Responses: Public Hearing to Consider Amendments to Adopt Reduced Emission Standards for 2007 and Subsequent Model Year New Heavy-Duty Diesel Engines; October 25, 2001.

CFR, 2007b. Code of Federal Regulations. NOX and Particulate Averaging, Trading, and Banking for Heavy-Duty Engines; Title 40, Chapter 1, Part 86, Section 86.007-15; July 1, 2007

Diesel, 2005. Diesel Technology Forum: Farming, Mining & Construction; http://www.dieselforum.org/where-is-diesel/farming-mining-construction; 2005

X. PROPOSED REGULATION FOR IN-USE ON-ROAD DIESEL VEHICLES

The chapter provides an overview of the proposed regulation and explains its major requirements and provisions. This chapter also describes how the proposed regulation applies to owners of vehicles, those who hire or dispatch vehicles, rental fleets, and vehicle dealers.

This chapter is intended to satisfy the requirements of Government Code section 11343.2, which requires that a non-controlling “plain English” summary of the regulation be made available to the public.

A. Proposed Regulation Overview

The proposed regulation would apply to any person, business, or federal government agency that owns or operates affected vehicles in California. Affected vehicles include on-road heavy-duty diesel fueled vehicles with a manufacturer’s GVWR greater than 14,000 pounds, on-road and off-road yard trucks over 14,000 pounds GVWR, and diesel fueled shuttle vehicles of any GVWR that have a capacity of 10 or more passengers and routinely drive an average of 10 trips per day to or from airport terminals, marine terminals, and rail based stations. The proposed regulation would apply to these vehicles regardless of where the vehicle is registered – that is, it affects intrastate, interstate, and international vehicles. Also, any vehicle that is designed to be driven on-road would be subject to the regulation even though it might not be registered to be driven on-road. The proposed regulation would not apply to military tactical support vehicles, authorized emergency vehicles, and private motor homes not used for commercial purposes.

The proposed regulation establishes PM and NOx emissions requirements for the vehicles subject to the regulation. These requirements will be discussed in greater detail later in this chapter. The regulation is included in Appendix A, and an outline of the subsections of the regulation is provided in Appendix A1.

In general, the regulation would require owners to reduce PM and NOx emissions from their fleet by upgrading the vehicles to meet BACT standards for PM and NOx. The BACT standard for PM is an engine equipped with the highest level verified DECS for PM or an engine originally equipped with a diesel particulate filter (DPF) by the engine manufacturer. The BACT standard for NOx is an engine newly manufactured in 2010 or later, or a 2010 emissions equivalent engine. A fleet may meet these performance requirements by retrofitting a vehicle with a verified DECS that will achieve PM or NOx reductions or both as required, replacing an engine with a newer cleaner one, or replacing a vehicle with one having a cleaner engine.

The regulation provides three options for complying with the performance requirements. A fleet would be able to comply with a prescribed BACT schedule that would determine, based on the vehicle’s engine model year, which engines would be required to have the highest level verified DECS and which would be required to be replaced. A fleet could also meet a BACT percent limit option. This option specifies the minimum number engines each year that must have applied the highest level verified DECS to meet the PM performance requirements regardless of engine model year, and the minimum number of engines required to meet the 2010 engine requirements to satisfy the NOx performance requirements. Engines originally equipped with a DPF by the manufacturer would count towards the number of verified DECS. The third option is the fleet average option. The owner would use PM and NOx emission factors established by the regulation to calculate the average emissions of the fleet. By the applicable compliance date each year, the owner would have to demonstrate that the fleet met the PM and NOx fleet average emission rate targets set by the regulation. The targets would decline over time, requiring fleets to reduce their emissions further as time goes on.

During the first two years of the regulation, starting January 1, 2011, fleets would be required to install PM verified DECS for certain engine model years. The regulation would then require owners to reduce both PM and NOx emissions from the fleet by accelerating engine or vehicle replacement between January 1, 2013 and the end of 2022 so that by January 1, 2023, all engines would be the cleanest available – that is, manufactured in 2010 or later or be retrofitted to achieve equivalent emission reductions.

The proposed regulation would also establish requirements for any in-state or out-of-state motor carrier, Californiabased broker, or any California resident who hires or dispatches vehicles subject to the regulation. In addition, California sellers of a vehicle subject to the proposed regulation would have to notify vehicle buyers that the regulation may apply.

B. Purpose

As stated in subsection (a) of the proposed regulation, the purpose of the regulation is to reduce emissions of diesel PM, NOx, other criteria pollutants, and greenhouse gases from in-use on-road diesel-fueled vehicles. While the regulation contains performance requirements for PM and NOx emissions reductions, it does not require the reduction of greenhouse gas emissions. Reductions of greenhouse gas emissions will be achieved through credits to promote the use of hybrid diesel vehicles and alternative fuels, and through the replacement of older vehicles with newer, more efficient vehicles.

C. Applicability

The proposed new regulation would apply to any person, business, or federal government agency that owns or operates affected vehicles in California. Affected vehicles include heavy-duty diesel fueled vehicles with a GVWR greater than 14,000 pounds, on-road and off-road yard trucks over 14,000 pounds GVWR, and diesel fueled shuttle vehicles of any GVWR that have a capacity of 10 or more passengers and routinely drive an average of 10 trips per day to or from airport terminals, marine terminals, and rail based stations. The proposed regulation would be applicable regardless of where the vehicle is registered.

The proposed regulation would not apply to military tactical support vehicles, authorized emergency vehicles, and private motor homes not used for commercial purposes. The regulation would also not apply to vehicles subject to the following regulations:

- Solid waste collection vehicle as defined by title 13, CCR, section 2021(b);
- Municipality and utility owned vehicles as defined by title 13, CCR, section 2022(a), except that vehicles owned or operated by a privately owned utility would become subject to the regulation on January 1, 2021;
- Urban buses as defined by title 13, CCR, 2023(a)(13);
- Transit fleet vehicles as defined by title 13, CCR, 2023(a)(12);
- Mobile cargo handling equipment at ports and intermodal rail yards;
- Off-road vehicles subject to title 13, CCR, sections 2401, 2421, 2411, 2432, and 2449;
- Dedicated snow-removal vehicles, as defined in section 2025(d)(12)
- Two-engine cranes, as defined in title 13, CCR, section 2449(c)(56); and
- Historic vehicles as defined in section 2025(d)(28).

1. How Regulation Applies to Sellers and Dealers of Vehicles

The proposed regulation applies differently to sellers of affected vehicles, such as vehicle dealers and auction houses or financing companies who do not operate the vehicles, than to other fleet operators. The only part of the regulation that would apply to such sellers of vehicles is the disclosure of regulation applicability requirement in section 2025(v). That is, sellers must notify buyers that the regulation may apply.

Vehicles that are temporarily owned by dealerships or are incidentally owned by financing companies and are awaiting sale would not be subject to the recordkeeping, reporting, or performance requirements of the regulation provided the vehicles are not being operated (other than operation for sales demonstration or maintenance). Thus, dealers and financing companies that do not operate vehicles and that do not offer them for rent would not need to report their vehicles and need not comply with any performance requirements of the regulation. Dealers that hold vehicles for sale and also rent them out or lease them would be responsible for compliance as described below for rental and lease companies.

2. How Regulation Applies to Rental and Lease Companies

The regulation would treat rental and lease companies just like any other fleets. Thus, the default situation in the regulation is that rental vehicles are the responsibility of the rental company rather than the user.

For vehicles leased for a period of a year or more, if a rental or lease company and the lessee agree in the lease agreement that the vehicle will be the responsibility of the lessee, it may be excluded from the rental company’s fleet that year and included in the fleet of the lessee. If rental and leasing companies are selling vehicles which were formerly part of their rental fleet and the rental vehicle was operated less than 1,000 miles and 100 hours in the past year, such vehicles may be treated like other vehicles being held for sale, as described in the section above.

Vehicles under a long term lease of period of a year or more that was in place before the regulation takes effect would be the responsibility of the lessee rather than the leasing company.

D. Definitions

The proposed regulation provides definitions of all terms that are not self-explanatory. There are approximately 70 definitions to help clarify the regulation's requirements. The definitions listed in subsection (d) of the proposed regulation were either developed by staff, with input from the public during workshops and workgroup meetings, or the California Code of Regulations, California Vehicle Code (VC) or existing ARB regulations or other sources. Please refer to Appendix A, subsection (d) for a list of definitions.

1. Combat and Tactical Support Equipment

Combat and tactical support equipment means equipment that meets military specifications, is owned by the U.S. Department of Defense and/or the U.S. military services or its allies, and is used in combat, combat support, combat service support, tactical or relief operations or training for such operations. Such equipment would be exempt from the proposed diesel regulation for national security reasons. Appendix F contains a letter from the Department of the Navy listing the equipment types included as combat and tactical support equipment.

2. Fleet

A fleet is defined as all of the vehicles under common ownership by a person, business, or governmental agency. A fleet may consist of one or more vehicles. This definition in the proposed regulation also includes additional clarification for federal fleets, rental and lease fleets, fleets owned by school bus operators and school districts, and small fleets.

a) School Bus and School Bus Sub-Fleets

A school bus fleet is a fleet of school buses designed, used or maintained for the transportation of an pupil to or from school or school activities, which meets the definition outlined in the VC, section 545. School bus sub-fleets means the school buses in a fleet comprised of school buses and vehicles other than school buses.

b) Small Fleets

This definition also includes a definition of a small fleet, which is a fleet of 3 or fewer vehicles under common ownership. Common ownership or control means a vehicle being owned or managed by the same person or entity or controlled by a single board of directors. This would include vehicles being operated by different legal subsidiaries under a corporate umbrella. Therefore, a fleet under common ownership or control could not be split into smaller regional fleets around the state to utilize the small fleet provisions.

3. Agricultural Operations

Agricultural operations are defined in the proposed regulation as the activity of growing or harvesting crops for the primary purpose of making a profit or providing a livelihood including any horticultural, viticultural, aquacultural, forestry, dairy, livestock, poultry, bee or farm product. However, raising plants at nurseries that sell exclusively retail are not included in the definition.

The definition also includes the cutting or removing of both of timber, other solid wood products, including Christmas trees, and biomass from forestlands for commercial purposes. The services also include all the related work associated such as construction and maintenance of roads, fuel breaks, firebreaks, stream crossings, landings, skid trails, beds for falling trees, fire hazard abatement, and site preparation that involves disturbance of soil or burning of vegetation following forest removal activities. Forest operations include the cutting or removal of trees, tops, limbs and or brush which is processed into lumber and other wood products, and or for landscaping materials, or biomass for electrical power generation. Forest operations do not include conversion of forestlands to other land uses such as residential or commercial developments.

4. Agricultural Vehicle

Agricultural vehicles are those that are used exclusively for agricultural operations. These vehicles include dedicated fertilizer and crop protection chemical delivery trucks, farmer owned vehicles used to support the farm, vehicles that come to the farm to perform specialized farm work, and vehicles that transport harvested crops to first processing centers. Vehicles that perform other functions in addition to agricultural operations do not fit the definition of an agriculture vehicle.

Vehicles that are used exclusively for delivering fertilizer or crop protection chemicals to farms can be considered agricultural vehicles if the company holds the proper license and the vehicles display the required placards. These chemical or fertilizer supply trucks are limited to those that are required by the United States DOT to have certain placards, and whose owners are licensed to sell pesticides or fertilizers by the California Department of Pesticide Regulation or the California Department of Food and Agriculture, respectively. Trucks exclusively involved in agricultural operations, including flatbed trucks, logging trucks, silage trucks, or water trucks that are owned by a farming business, are also considered agricultural vehicles. Additionally, vehicles that are not owned by a agricultural business but exclusively perform a agricultural function on a farm, such as spreading manure, also fall under the definition of an agricultural vehicle. Finally, vehicles used exclusively to transport harvested agricultural products from the field or ranch to first point of processing such as packinghouse or a creamery are deemed agricultural vehicles. Such vehicles would include tomato trucks, milk trucks, grain trucks, trucks hauling grapes and others.

E. Performance Requirements

The proposed regulation provides three options for complying with the NOx and PM performance requirements. These three options are described below. Once a fleet meets any one of these compliance options for NOx and PM, they have met the performance requirements for that year. In addition, the proposed regulation allows fleets to meet the NOx and PM performance requirements separately, using different compliance options for each pollutant. For example, a fleet may choose to meet the fleet average option for NOx, and separately comply with the BACT percent limit for PM.

1. BACT Schedule

The proposed regulation provides that a fleet would be able to comply with the proposed NOx and PM performance requirements by complying with a prescribed BACT schedule that would determine, based on the vehicle's engine model year, which engines would be required to have the highest level verified DECS and which would be required to be replaced. The proposed BACT schedule is provided below in Table X-1. A fleet may meet these requirements by retrofitting a vehicle with a verified DECS, replacing an engine with a newer cleaner one, or replacing a vehicle with one having a cleaner engine.

Table X-1: Best Available Control Technology Compliance Schedule

Compliance Deadline, as of January 1	Engine Model-Years	BACT Requirements
2011	Pre-1994	PM BACT
2012	2003 – 2004	PM BACT
2013	2005 – 2006	PM BACT
	1994 – 1999	NOx and PM BACT
2014	2000 – 2002	NOx and PM BACT
	All Model Years	PM BACT
2015	Pre-1994	NOx and PM BACT
2016	2003 - 2004	NOx and PM BACT
2017	2005 - 2006	NOx and PM BACT
2018	All pre-2007	No new requirements
2019	All pre-2007	No new requirements
2020	All pre-2007	No new requirements
2021	2007 or equivalent	NOx and PM BACT
2022	2008	NOx and PM BACT
2023	2009	NOx and PM BACT

The BACT requirement for PM is an engine equipped with the highest level verified DECS for PM or an engine originally equipped with a DPF by the engine manufacturer. To install the highest level verified DECS, a fleet owner must install all available Level 3 verified DECS on their engines first. If no Level 3 DECS is verified for the vehicle's engine, then the fleet owner must install Level 2 verified DECS to meet the PM BACT requirement. No regulatory credits provided for Level 1 DECS. The BACT requirement for NOx is an engine newly manufactured in 2010 or later or a 2010 "emissions equivalent engine". A discussion of emission equivalent engines is provided below.

For fleets using this compliance option, starting January 1, 2011, any vehicle with a model year engine older than 1994 would have to meet the PM BACT requirements. This requirement would expand to include 2003 and 2004 model year engines in 2012. Then, beginning January 1, 2013, the regulation would require owners to reduce both PM and NOx emissions from the fleet by accelerating engine or vehicle replacement through the end of 2022, such that by 2023, all engines would be the cleanest available – that is, manufactured in 2010 or later or be retrofitted to achieve equivalent emission reductions.

2. BACT Percentage Limits

A fleet may also choose to comply with the proposed NOx and PM performance requirements by meeting a BACT percent limit option. This option specifies the minimum number of engines each year that, as a percentage of all the vehicles in a fleet, must have the highest level verified DECS installed to meet the proposed PM BACT requirements, regardless of engine model year. Engines in the fleet that were originally equipped with a DPF by the manufacturer would count towards the number of verified DECS installed.

In addition, this option also specifies the minimum number of engines that, also as a percentage of all the vehicles in a fleet, are required to meet the proposed BACT requirement for NOx. Like in the BACT Schedule option described above, the proposed BACT requirement for NOx is an engine newly manufactured in 2010 or later, or a 2010 emissions equivalent engine (See Table X-2).

Table X-2: Percent of Fleet That Must Comply with PM and NOx BACT Standard

Compliance Deadline as of January 1	Percent of Total Fleet Complying with BACT	
	PM BACT	NOx BACT
2011	25%	N/A
2012	50%	N/A
2013	75%	25%
2014	100%	50%
2015	100%	50%
2016	100%	60%
2017	100%	80%
2018	100%	80%
2019	100%	80%
2020	100%	90%
2021	100%	90%
2022	100%	90%
2023	100%	100%

The use of this option allows a fleet to select the order of vehicles that will be retrofit and replaced, regardless of their age. This will provide additional flexibility to fleets such that they may be able to keep older vehicles in their fleet longer than would be allowed under the BACT schedule.

3. Fleet Averaging Option

The third option to meet the proposed NOx and PM performance requirements is through the use of a fleet average. Under this option, the fleet owner would use PM and NOx emission factors established by the regulation to calculate the average emissions of the fleet. The appropriate NOx and PM emission factors are shown below in Table X-3 and Table X-4, respectively.

Table X-3: PM Emissions Factors by Engine Model Year (g/mile)

Engine Certification Standard Model Year	Medium-Heavy Duty (MHD)	Heavy-Heavy Duty (HHD)
Pre-1991	1.65	3.36
1991-1993	0.84	1.25
1994-2006	0.43	0.81
2007-2009	0.06	0.11
2010 and newer	0.06	0.11

Table X-4: NOx Emissions Factors by Engine Model Year (g/mile)

Engine Certification Standard Model Year	Medium-Heavy-Duty (MHD)	Heavy-Heavy Duty (HHD)
2003 and older	14.2	22.0
2004-2006	6.7	12.0
2007-2009	4.0	7.0
2010 and newer	0.8	1.6

Using these emission factors for each vehicle, a fleet owner would have to demonstrate that the fleet met the proposed PM and NOx fleet average emission rate targets set by the regulation by the applicable compliance date each year. The targets decline over time, requiring fleets to reduce their emissions further as time goes on. The fleet average targets for PM and NOx are shown in Table X-5 below.

Table X-5: Fleet Targets for PM and NOx (g/mile)

Compliance Deadline, as of January 1	PM Targets for each compliance deadline		NOx Targets for each compliance deadline	
	MHD	HHD	HHD	HHD
2011	0.38	0.710	-	-
2012	0.29	0.530	-	-
2013	0.17	0.320	8.5	14.4
2014	0.06	0.110	5.8	9.8
2015	0.06	0.110	5.8	9.8
2016	0.06	0.110	4.6	7.8
2017	0.06	0.110	4.0	6.0
2018	0.06	0.110	4.0	6.0
2019	0.06	0.110	4.0	6.0
2020	0.06	0.110	3.2	4.4
2021	0.06	0.110	3.2	4.4
2022	0.06	0.110	1.6	3.0
2023	0.06	0.110	0.8	1.6

Similar to the BACT percent limit option discussed above, the use of this option allows a fleet to select the order of vehicles that will be retrofit and replaced, considering their relative emissions. This will provide additional flexibility to fleets such that they may be able to keep older vehicles in their fleet longer than would be allowed under the BACT schedule, so long as they have cleaner vehicles (with lower emissions) to offset the older vehicles that have higher emissions.

4. Emission Equivalency for Older Engines

In meeting the performance requirements of the proposed regulation, staff intends to allow for the use of verified DECS to achieve reductions for both PM and NOx emissions. To provide clarity to fleets as to how these DECS would compare to certified engines, staff's proposal includes specific standards to establish emission equivalency. Staff has proposed emission equivalency standards to 2004, 2007, and 2010 certified engines. These equivalency standards are provided in Table X-6 below.

Table X-6: PM and NOx Equivalency Standards

Engine Emission Performance Standard (Model Year)	Actual Engine Model Year	Performance Standard Using DECS	
		NOx	PM
2010 and newer	2010 and newer	Met by definition	DPF equipped by engine manufacturer
	2007-2009	70% reduction	Met if equipped with DPF by engine manufacturer
	2004-2006	85% reduction	Highest Level DECS[1]
2007-2009	2007-2006	Met by definition	DPF equipped by engine manufacturer
	2004-2006	40% reduction	Highest Level DECS[1]
	2003 and prior	70% reduction	Highest Level DECS[1]
2004-2006	2004-2006	Met by definition	N/A[2]
	2003 and prior	55% reduction	N/A[2]

[1] As defined by title 13, CCR, section 2025(d)(34).
[2] These engines do not meet PM BACT since they were not equipped with a DPF from the engine manufacturer.

As can be seen in Table X-6, to meet a 2010 emission equivalency standard, a 2007 model year vehicle would need a verified DECS that achieved a 70 percent reduction of NOx provided the vehicle was equipped with a DPF by the manufacturer. If no DPF is in place then the highest level verified DECS is required. Similarly, to meet a 2007 emission equivalency standard, a 2004 engine would need a verified DECS that achieved a 40 percent reduction of NOx and the highest level verified DECS. To meet a 2004 emission equivalency standard, a 2003 engine would need to have a verified DECS that achieved a 55 percent reduction of NOx. No PM reduction would be needed, since these engines were not produced or certified using a DPF.

F. Other Requirements

1. School Bus Fleets

Diesel-fueled school buses as defined in the VC, section 545 with a GVWR above 14,000 pounds will need to install a verified DECS to meet the requirements of the proposed regulation. Unlike all the other vehicle sectors subject to the NOx and PM performance requirements of the proposed regulation, school buses would only be required to meet the proposed PM requirements, and would be subject to several special provisions and timetables specifically designed for this sector. School buses manufactured prior to April 1, 1977, before minimum federal safety standards were established, will be required to be removed from service by January 1, 2012. All remaining diesel-fueled school buses must meet one of the following three proposed compliance options:

- BACT Compliance Schedule (See Table X-7)
- BACT Percentage Limits Compliance Option
- Fleet Average Compliance Option

School buses would be considered in compliance with the proposed regulation when they have installed the highest level verified DECS by the designated compliance date under the option selected. Depending on the compliance option chosen and the verified DECS that is installed, a school bus fleet may be subject to proposed reporting requirements.

If it is not technologically feasible for the school bus engine to be retrofitted with a Level 2 or Level 3 verified DECS by the compliance deadline, then compliance may be delayed annually until January 1, 2018 provided no verified DECS becomes available. By January 1, 2018, these school buses that cannot be retrofitted would need to have their engines replaced with an engine that is equipped with a highest level DECS or the school bus would need to be replaced with one meeting the PM BACT criteria.

Table X-7: Proposed PM BACT Schedule for School Buses

Compliance Deadline as of January 1	Engine Model Year
2011	2000 and newer
2012	1994 – 1999
2013	1987 – 1993
2014	Pre – 1997

Engines equipped with a DPF by the engine manufacturer as original equipment are considered in compliance with the requirement. School buses registered as historic vehicles or designated as low use vehicles are exempted from performance requirements; however, there are reporting requirements for these vehicles. Low use school buses are vehicles operated less than 1,000 miles per year.

As discussed later, Proposition 1B, approved by California voters in 2006, will provide $200 million, through the Lower Emission School Bus Program, to replace all remaining eligible pre-1977 model year school buses. Additionally, these bond funds will replace approximately 1,000 model year 1977 to 1986 school buses, and install DPFs on about 3,500 buses. All buses replaced or retrofitted through the Lower Emission School Bus Program will be in compliance with the proposed regulation.

2. Drayage Trucks

Drayage trucks are diesel-fueled, heavy-duty trucks that transport containers, bulk, and break-bulk goods to and from ports and intermodal rail yards to other locations. Drayage trucks are already subject to requirements of title 13, CCR, section 2027, (known as the drayage truck rule) which requires all vehicles entering ports and intermodal rail yards to have PM controls by December 31, 2009, except for 2004 to 2006 model year engines.

The proposed regulation will add a phase one requirement for drayage trucks with 2004 to 2006 model year engines. The proposed regulation requires that 2004 model year engines be equipped with the highest level verified DECS by January 1, 2012, and that 2005 to 2006 model year engines be equipped with the highest verified DECS by January 1, 2013. This requirement would align the drayage truck rule with the proposed regulation. In addition, the proposed regulation would require that all drayage trucks comply with the PM and NOx performance requirements starting January 1, 2021.

3. Privately-Owned Utilities

In addition to other changes that are applicable to municipalities, as described in Chapter XI, the proposed regulation would require that all utility vehicles comply with the PM and NOx performance requirements starting January 1, 2021.

4. Verified DECS Installation and Maintenance

Fleet owners choosing to comply using verified DECS, they would have to meet installation requirements for verified DECS. Before installing a verified DECS on a vehicle, the fleet owner should be familiar with the Executive Order for the verified DECS and would need to:

- Ensure that the verified DECS is verified for use with the engine and vehicle, as described in the Executive Order for the verified DECS;
- Ensure that use of the vehicle is consistent with the conditions of the Executive Order for the verified DECS;
- Ensure that the diesel emission control strategy is installed in a verified configuration; and
- Ensure that the engine to be retrofit is tuned up so that it meets engine manufacturer's specifications prior to verified DECS installation.

This requirement also specifies that the owner of a vehicle with a verified DECS would have to ensure that the maintenance on the verified DECS and engine is performed as specified by each manufacturer.

5. Labeling

The proposed regulation would include requirements for the application of labels on certain agricultural vehicles and two-engine sweepers. Agricultural vehicles that operate below specific mileage thresholds (limited-use and low-use agricultural vehicles) would need to be labeled within 30 days of required reporting date. Similarly, two-engine sweepers that have Tier 0 auxiliary engines would be limited to operating less than 250 hours per year until January 1, 2014 would also need to be labeled within 30 days of their required reporting date. No other labeling requirements are proposed.

6. *Requirements for Entities Hiring and Dispatching Vehicles*

The proposed regulation would require in-state and out-of-state motor carriers, California-based brokers and California residents that operate or direct the operation of any vehicle to retain records documenting that all of the drivers they hire or dispatch are in compliance with the proposed regulation. These motor carriers or brokers would have an affirmative defense for violations by an operator they dispatched if they can demonstrate that they verified the compliance status of the operator at the time they were hired or dispatched.

7. *Adding Vehicles*

For fleets not meeting the "BACT Schedule" requirements, fleet owners must report to the ARB within 30 days the addition of any vehicle to the fleet; and the fleet may not operate that vehicle in California prior to reporting. The fleet owner must also demonstrate that the fleet complies with the requirements of the proposed regulation. A fleet owner who selects the BACT percentage limits option may not add vehicles that cause the percentage calculated for the fleet to fall below the percentage for the previous compliance date. Furthermore, a fleet owner who selects the fleet averaging option may also not add vehicles that cause the fleet to exceed the fleet average target rates for the previous compliance date.

G. Special Provisions and Compliance Extensions

The following special provisions and compliance extensions are proposed. Fleets utilizing these special provisions and compliance extensions must meet, as appropriate, all the record keeping and reporting requirements, as described later in this chapter.

1. *Small Fleets*

Fleets with three or fewer vehicles would be exempt from the proposed 2010 and 2011 PM exhaust retrofit requirements. By January 1, 2013, a small fleet would need to show that it has at least one vehicle equipped with a 2004 model year or newer engine having a verified highest level DECS installed. By January 1, 2018, that vehicle would need to meet the proposed PM and NOx performance requirements of the regulation. If these requirements are met with a vehicle that has a 2010 or equivalent engine, no more action is required. If these requirements are met with a vehicle that has a 2007 to 2009 engine or equivalent, the engine will need to meet 2010 performance standard between 2021 to 2023. For fleets with two vehicles, the second vehicle would be required to meet the PM and NOx performance requirements by January 1, 2014.

For fleets of three vehicles, two compliance paths are available. After having shown that it equipped its first vehicle with a 2004 model year or newer engine with a highest level verified DECS, a fleet of three vehicles could comply by:

- having its two remaining vehicles meet the PM and NOx performance requirements by January 1, 2014, or;

- electing to have the second vehicle meet the 2010 engine emissions requirements by January 1, 2014, and the third vehicle meet the PM and NOx performance requirements by January 1, 2016.

2. Agricultural Vehicle Provisions

The proposed agricultural vehicle provisions provide additional time for certain agricultural vehicles to be upgraded to meet 2010 engine emission performance requirements, and allows them to operate without PM exhaust retrofits up to specified dates. By January 1, 2023, all agricultural vehicles must meet the 2010 model year engine emissions requirements.

Agricultural vehicles that operate below the mileage thresholds would be exempt from the PM and NOx performance requirements for a specified period provided they remain below the thresholds shown in Table X-8. These are defined as either Low-Mileage Agricultural or Limited-Mileage Agricultural vehicles, based on their annual mileage as shown in Table X-8. Vehicles that operate over these thresholds would have to meet the same requirements as any other vehicle subject to the proposed regulation.

Table X-8: Agricultural Vehicle Mileage Threshold

<table>
<tr><th>Type of Exempt Vehicle</th><th>Model Year Engine</th><th>Mileage Threshold (Less Than)</th><th>Expiration Date of January 1</th></tr>
<tr><td>Low-Mileage Ag</td><td>Any</td><td>10,000</td><td>2023</td></tr>
<tr><td rowspan="3">Limited-Mileage Ag</td><td>1995 and older</td><td>15,000</td><td rowspan="3">2017</td></tr>
<tr><td>1996 to 2005</td><td>20,000</td></tr>
<tr><td>2006 and newer</td><td>25,000</td></tr>
</table>

To qualify, an agricultural fleet operator must report, by January 31, 2010, the number of low-mileage and limited-mileage agricultural vehicles that operated in 2009. Once reported, the number of each type of these may not increase in any fleet. Until January 1, 2017, an agricultural fleet operator may operate no more than this number of vehicles below each of their respective mileage thresholds. Then, beginning in 2017, the agricultural fleet operator is limited to operating only that number of vehicles reported in 2010 as being low-mileage agricultural vehicles. Vehicles that had been designated as limited-mileage agricultural vehicles must meet the NOx and PM performance standards of the proposed regulation, or replace a retiring low-mileage agricultural vehicles that will be retired. For the purposes of this provision, retire means that the vehicle is scrapped, rendered inoperable, or sold out of the agricultural fleet.

Also, vehicles qualifying as specialty agricultural vehicles would be exempt from the PM and NOx performance requirements until January 1, 2023. Specialty agricultural vehicles include a specific subset of agricultural vehicles, including:

- nurse rigs;
- cotton module trucks;
- feed trucks used by cattle and calf feed lots, and;

- water trucks owned and operated by farmers for dust control and irrigation.

However, under these provisions, the number of specialty agricultural vehicles operating in the San Joaquin Valley Air Basin cannot exceed 1,100 trucks, and the total number operating statewide cannot exceed 2,200, as reported to the ARB. Once these thresholds are reached, a vehicle that would otherwise meet the definition of specialty vehicle would not be eligible for consideration as a specialty agricultural vehicle, and would have to meet the other provisions of the proposed regulation.

3. Exemption from the Performance Requirements

a) Low Use Vehicles

A vehicle that is operated less than 1,000 miles and 100 hours per year would be exempt from all performance requirements. Staff has also proposed to allow an out-of-state vehicle the option, available only to be used once each year per fleet, to operate a single vehicle in California for a 3 day period regardless of miles travelled .

b) Delay from the NOx Performance Requirements

Staff proposes to delay the proposed NOx performance requirements for vehicles operated more than the low use thresholds (1,000 miles), but below a specified higher mileage threshold. However, these vehicles would still remain subject to the proposed PM requirements. For truck-tractors and vehicles with a GVWR greater than 33,000 pounds, the higher mileage threshold would be 7,500 miles per year. In addition, yard trucks, as well as vehicles that use power take off to perform work while stationary must also demonstrate that they operate less than 250 hours per year. All other vehicles would be eligible to delay the proposed NOx performance requirements if operated less than 5,000 miles per year. These same vehicles that use power take off to perform work while stationary must also operate less than 175 hours per year. This delay in meeting the proposed NOx performance requirements would expire on January 1, 2021.

Vehicles that operate exclusively in less polluted areas of the State would not be required to meet the engine replacement requirements until January 1, 2021, but would remain subject to the PM requirements. These vehicles would remain subject to the reporting requirements, and would require to comply with the electronic tracking system requirements described later in section (I). These areas are shown below in Figure X-1.

Figure X-1: NOx Exempt Areas of California

Also, vehicles that are defined as unique vehicles would not be subject to the replacement requirements until January 1, 2021, but would still be included in determining the fleet average or the BACT percent limit. However, these unique vehicles would remain subject to the proposed PM performance requirements. For a vehicle to be eligible for the delay of the NOx performance requirements, the owner would need to demonstrate the following:

- A used vehicle having a 2007 model year or newer engine and, that performs a similar function is not available.
- A suitable cab and chassis upon which the vehicle bed could be mounted is not available
- A verified NOx emissions control device that could reduce the vehicle's exhaust NOx emissions is not available.
- The vehicle's engine has been equipped with the highest level verified DECS, if one is available and can be safely installed.

Staff is also proposing that truck-tractors exclusively pulling 57 foot trailers be eligible to delay the NOx performance requirements until January 1, 2018, provided the engine is a 2004 model year engine and the highest level verified DECS is installed. All other vehicles in a fleet having such tractors would need to meet the proposed NOx and PM performance standards on the prescribed schedule.

4. Requirements for Valid Operator Number

Fleets that opt to comply with the proposed performance standards of the regulation by using the BACT percent limit or the fleet average options, as well as fleets that utilize the small fleet provisions, or any other special provisions of section 2025(l), (o)(1), (2), (8) or (9) must possess one of the following:

- a valid California motor carrier of property number,
- a valid identification number assigned by the United States DOT, or
- a valid operating authority number issued by the Public Utilities Commission, or other applicable valid operating authority number approved by the Executive Officer.

5. Credit for Hybrid and Alternative Fuel Vehicles

A fleet would receive credit towards compliance with the proposed fleet average requirements for using hybrid vehicles as long as it can be demonstrated that the fuel economy of the hybrid vehicle is at least 20 percent better than an equivalent vehicle. The credit would expire January 1, 2018. The credit would “double count” the number of hybrid vehicles in the fleet that are used to calculate the PM and NOx fleet emissions average and the target rates, or for determining compliance with the percent limit requirements.

Also, for fleets using vehicles equipped with alternative fuel or heavy-duty pilot ignition engines, credit would be granted for the purpose of calculating the NOx and PM fleet average target rates towards compliance with the fleet average. In using this credit, the PM emission factor would be zero, and the NOx factor would be based on the emission factor corresponding to the engine standard for which the engine is certified.

6. Special Provisions for Certain Two-Engine Sweepers

Staff is proposing that the auxiliary engine of a private two-engine sweeper be treated the same as the propulsion engine of any other vehicle subject to the proposed regulation. In doing so, staff is proposing that the auxiliary engine in these vehicles be required to meet the PM performance requirements on the same schedule as the propulsion engine.

However, to provide more time for certain sweepers that are used infrequently, staff is proposing that private two-engine sweepers that have Tier 0 auxiliary engine not be allowed to operate more than 250 hours per year until January 1, 2014, and thereafter be allowed to keep the sweeper and operate it up to 100 hours per year.

Additional discussion about provisions applicable to private two-engine sweepers is provided in Chapter XI and XVI.

7. Credit for Early Action

Vehicles that are retrofit with the highest level DECS before January 1, 2010, would be exempt from meeting the NOx BACT replacement requirements until January 1, 2014. This provision incentivizes vehicle owners to install verified DECS before the required deadlines.

8. Verified DECS Failure

If a verified DECS fails or is damaged during the warranty period and it cannot be repaired, then it must be replaced with the same level or higher verified DECS. Should a DECS fail or be damaged outside of its warranty period and it cannot be repaired, then replacement depends on if the fleet still meets applicable targets without the failed device. If the fleet does not meet the most recent compliance target without the damaged device, then the DECS must be replaced with the highest level verified DECS within 90 days.

9. Fuel-Based Strategy for Verified DECS and Use of Experimental Strategies

The proposed regulation contains special provisions that would allow a fleet to use a Level 2 fuel based strategy across its whole fleet if the highest level verified DECS for a large portion of its fleet would be a Level 2. The rule also contains a special provision that would give up to a two year extension for fleets that used a fuel-based strategy but find that it had been discontinued.

Also in the proposed regulation, an owner could apply to the Executive Officer to use an experimental, or non-verified, DECS. This compliance method can be used if a verified DECS is not available or if the owner can demonstrate that an existing verified DECS is not feasible for their vehicle or application, or if use of the non-verified strategy is needed to generate data to support verification of the strategy

10. Vehicles Used for Emergency Operation

The proposed regulation defines vehicles used for emergency operations, and proposes to exempt them from the proposed NOx and PM performance requirement, but they still must be reported. For vehicles used both for emergency operations and for other purposes, hours of operation and mileage accrued when the vehicle is used for emergency operations would not need to be included when determining whether the vehicle meets the low use vehicle definition of section (d)(38). Records documenting dispatch by a governmental emergency management agency for travel to and from an emergency event must be kept.

11. Compliance Extension for Manufacturer Delays

A vehicle owner would not be penalized for equipment manufacturer delays for verified DECS or vehicles, as long as the owner placed the order for the required equipment or vehicle at least four months prior to the required compliance date or within 60 days of a verified DECS failure. The new equipment or vehicles would, however, need to be immediately placed into operation upon receipt.

12. Verified DECS That Impair Safe Vehicle Operation

The proposed regulation provides for instances where a owner may request the Executive Officer to determine if a verified DECS should not be considered the highest level available because it cannot be safely installed or operated on a particular vehicle or its use would violate occupational safety and health requirements or local air district permit conditions. The requesting party would have to provide documentation to support its claims that the verified DECS cannot be safely installed or operated. Documentation would have to include reports and findings of federal, state or local government agencies, independent testing laboratories, engine or equipment manufacturer studies, or other equally reliable source. The Executive Officer would review the documentation submitted and make his or her determination based upon the totality of the evidence. The Executive Officer would send a written determination letter to the requesting party within 60 days of the request being submitted. The section also provides details on hearing and appeal procedures.

H. Reporting

For the proposed fleet average and BACT percent limit compliance options in the proposed regulation, accurate and effective enforcement of the proposed regulation will depend on ARB getting an accurate depiction of the entire fleet from each fleet owner. That is, an inspector will not be able to gauge compliance by looking at any one vehicle. Thus, accurate reporting will be essential. To this end, the reporting requirements in subsection (q) of the regulation are thorough.

Owners who choose a compliance option other than the BACT schedule would be required to notify the ARB of this selection. These owners would be required to submit annual compliance reports that demonstrate compliance with the requirements of the proposed regulation. The first annual compliance report would be due January 31, 2011 (for the period of January 1, 2010 through December 31, 2010), and annually thereafter. Compliance reports must include the following information:

- Fleet owners name;
- Name of company or agency;
- Motor carrier identification number;
- Corporate parent name (if applicable);
- Company parent taxpayer identification number (if applicable)
- Company taxpayer identification number;

- Street address and mailing address;
- Name of responsible person;
- Title of responsible person;
- Contact name;
- Contact telephone number;
- Contact email address (if available)

Fleets owners would also need to report a list of each vehicle subject to this regulation, along with the following information for each vehicle:

- Vehicle type;
- Vehicle identification number;
- Vehicle manufacturer;
- Vehicle model;
- Loaded vehicle weight rating as defined in section 2025(d)(31);
- Vehicle model year;
- License plate number;
- Where the vehicle is registered and type of registration plate;
- Whether the vehicle will be designated as a low-use vehicle;
- Whether the vehicle is used for emergency operations;
- Whether the vehicle is a specialty vehicle as defined in section 2025(m)(2);
- Whether the vehicle is a hybrid vehicle as defined in section 2025(d)(29);
- Whether the vehicle is an alternative-fueled vehicle as defined in section 2025(d)(6).

For each engine, the manufacturer, model, family, serial number, and model year must also be reported. For reporting the verified DECS installed, fleet owners must report the type, manufacturer, family name, serial number, date installed, and verification level and year of verification.

To ease reporting, staff intends to develop and provide electronic reporting forms via the internet for both the initial and annual reporting requirements. Fleets would also be able to report via hard-copy if preferred. In addition, staff plans to conduct outreach to fleet owners to explain and clarify these reporting requirements.

I. Electronic Tracking System

Fleet owners may be required to use an electronic tracking device, such as a global positioning system (GPS), to comply with some of the requirements of the proposed regulation. The tracking device must acquire date, time, and engine-on data at a minimum of 15 minute intervals, with no more than 30 minute data gaps. The tracking device must also acquire location data for vehicles claiming to operate exclusively in NOx exempt areas and for out-of-state vehicles that must document low-use in

California when their total miles of operation exceeds 1,000 miles and total hours of operation exceed 100 hours. Tracking records must also be collected by an independent entity with no business relationship to the owners of the vehicles being tracked, other than to provide the tracking service.

J. Recordkeeping, Retention and Audits

Fleet owners would be required to maintain all applicable records for all vehicles subject to the proposed regulation. For vehicles meeting the proposed BACT schedule, the fleet owner would maintain verified DECS records where these are used to comply with the BACT schedule, or records of any verified DECS failure and replacement, or records to document a manufacturer delay. In addition to these records, fleet owners complying with the BACT percent limits or the fleet averaging option would have to maintain copies of the all information previously discussed.

The proposed regulation requires owners to maintain records to document changes they have made since the last reporting. For example, if a vehicle is added to a fleet, the owner has 30 days to demonstrate that the fleet is still in compliance with the requirements for the previous compliance date. If an inspector views a fleet in the interim period before the fleet has submitted the documentation, and finds a vehicle that was not included in the last reporting, the owner would have to demonstrate, using bills of sale, purchase orders, shipping records, or other documentation, when the vehicle entered the fleet.

The fleet owner or responsible person shall maintain the records for each vehicle subject to the reporting and record keeping requirements of the proposed regulation and until 3 years after the vehicle is retired or January 1, 2025, whichever is earlier. If the ownership of the fleet is transferred, the seller is required to transfer the fleet records to the buyer. Dealers must also maintain records of the disclosure of regulation applicability for three years after the sale.

ARB staff can request an audit to verify the accuracy of a fleet owner's records. The proposed regulation describes the responsibility of the fleet owner to make the requested records available to ARB. If the records are not made available within 30 days of the request, the ARB may assess penalties for non-compliance. This includes reimbursing the ARB auditor per diem and travel expenses under certain conditions as determined by the Executive Officer.

K. Right of Entry

The proposed regulation would provide ARB inspectors the right, for the purpose of inspection to determine compliance with the regulation, to enter any facility where vehicles are located or vehicle records are kept. Inspectors would need to first obtain any necessary safety clearances and present proper credentials.

L. Disclosure of Regulation Applicability

The proposed regulation would require vehicle sellers disclosure to vehicle purchasers that they are potentially affected by the regulation. Any person residing in California selling a vehicle with an engine subject to this regulation must provide the following disclosure in writing to the buyer on the bill of sale:

> "An on-road heavy-duty diesel or alternative-diesel vehicle operated in California may be subject to the California Air Resources Board Regulation to Reduce Particulate Matter and Criteria Pollutant Emissions from In-Use Heavy-Duty Diesel Vehicles. It therefore could be subject to exhaust retrofit or accelerated replacement requirements to reduce emissions of air pollutants. For more information, please visit the California Air Resources Board website at http://www.arb.ca.gov/dieseltruck".

M. Penalties

Any person who fails to comply with the regulation or who submits false information will be treated under sections 39674, 39675, 42400, 42400.1, 42400.2, 42402.2, and 43016 of the Health and Safety Code. The Executive Officer, in assessing penalties, will consider factors, including but not limited to the willfulness of the violation, the length of time and magnitude of noncompliance, and whether the fleet made an attempt to comply.

XI. PROPOSED CHANGES TO OTHER DIESEL EMISSIONS CONTROL REGULATIONS

This chapter discusses modifications proposed for a number of existing ARB diesel regulations. These changes are intended to ensure that these existing regulations and the proposed regulation do not create overlapping requirements for the same vehicles, as well as to clarify a number of issues with the existing regulations, to provide additional compliance flexibility, and to generally improve enforceability of the existing regulations.

The other existing regulations proposed to be amended are:

- Diesel Particulate Control Measure for Public Agency or Utility On-road Heavy- duty Diesel-fueled Vehicles
- In-Use On-Road Diesel-Fueled Heavy-Duty Drayage Trucks
- Regulation for In-Use Off-Road Diesel Vehicle Regulation
- Regulation to Establish a Statewide Portable Equipment Registration Program
- Regulation for Mobile Cargo Handling Equipment at Ports and Intermodal Rail Yards
- Airborne Toxic Control Measure to Limit Diesel-Fueled Commercial Motor Vehicle Idling
- Exhaust Emissions Standards and Test Procedures – 1985 and Subsequent Model Year Heavy-Duty Engines and Vehicles
- Airborne Toxic Control Measure for Diesel Particulate Matter from Portable Engines Rated at 50 Horsepower and Greater

A. Proposed Modifications for Cranes and Sweepers

Cranes with two engines and private sweepers with two engines are subject to multiple regulations, with varying compliance dates and different levels of stringency. To better regulate these vehicles, and ensure that the clean-up of these vehicles is conducted efficiently, staff is proposing a number of changes to other regulations currently regulating cranes and sweepers with two engines. This will ensure that achieving emissions reductions from both engines on these vehicles does not create unnecessary overlapping requirements or add unnecessary costs. Details on the basis for the proposed changes are discussed in Chapter XVI.

1. Cranes

Two-engine cranes are mobile diesel-powered machines with a hoisting mechanism mounted on a specially constructed truck chassis or carrier; one engine is used for propulsion, and a secondary engine is used to lift and move materials and objects. There are three general categories of two-engine cranes: lattice boom (conventional), all terrain, and truck mounted. All terrain and truck mounted cranes are very similar and can be both categorized as truck mounted hydraulic cranes. The motive or drive engine is typically an on-road engine. The secondary engine is an off-road engine.

Without the proposed modifications, two-engine cranes would continue to be required to meet varying requirements in the following regulations:

- Portable Engine and Equipment Regulation
- Statewide Portable Equipment Registration Program
- Mobile Cargo Handling Equipment at Ports and Rail Yards Regulation
- In-Use Off-Road Diesel Vehicle Regulation

To establish a better regulatory structure that would reduce emissions from these vehicles more effectively and at a lower cost, staff is proposing the following changes to existing regulations:

- Add both engines of two-engine cranes to the off-road vehicle regulation (the drive engine would be included regardless if it is certified as an on-road engine or as an off-road engine)
- Remove the upper engine of a two-engine crane from the scope of the Portable Engine Equipment Regulation and exclude the same engine from most performance requirements in the PERP. However, the proposal would not remove the registration and inspection requirements of PERP.
- Remove all cranes (excluding rubber tire gantry cranes) from the scope of the Cargo Handling Equipment regulation, thereby placing the control of two-engine and off-road cranes used at ports and intermodal rail yards in the In-Use Off-Road Diesel Vehicle Regulation, and single engine cranes in the proposed regulation. No changes would be made regarding rubber-tired gantry cranes.

Excluding single-engine cranes from the Cargo Handling Equipment regulation would further support consistency in complying with one regulation, since many owners only provide crane service to the ports on a temporary basis but have fleets that would be required to comply with other overlapping regulations.

2. Proposed Modifications for Sweepers

Private two-engine sweepers have many of the same regulatory issues as two-engine cranes. To address this, staff is proposing to control the emissions from the drive engines and auxiliary engines on private two-engine sweepers (that is, they are not subject to the Fleet Rule for Public Agency and Utilities) somewhat differently, in that both engines in two-engine sweepers are proposed to be included in the proposed regulation. This change would ensure the requirements of cleaning-up both engines would not conflict.

Under staff's proposal, the drive (propulsion) engine of a private two-engine sweeper would be treated the same as the propulsion engine of any other vehicle subject to the proposed regulation. In doing so, staff is proposing that the auxiliary engine in these vehicles be required to meet the proposed PM performance requirements on the same schedule as the propulsion engine, and that private two-engine sweepers that have an uncertified Tier 0 auxiliary engine not be allowed to operate more than 250 hours per year through January 1, 2014, and up to 100 hours per year thereafter.

Without the proposed changes, privately owned two-engine sweepers are impacted by the following regulations:

- Portable Engine and Equipment Regulation
- Statewide Portable Equipment Registration Program (PERP)
- Mobile Cargo Handling Equipment at Ports and Rail Yards Regulation
- Public Agency and Utility Fleets Regulation

To establish a better regulatory structure that would reduce emissions from these vehicles more effectively and at a lower cost, staff is proposing the following changes to existing regulations:

- Remove the upper engine of a privately owned two-engine sweeper from the scope of the Portable Engine and Equipment Regulation and exclude the same engine from most performance requirements in PERP. However, the proposal would not remove the registration and inspection requirements of PERP.
- Amend the Public Agency and Utility Fleet regulation to allow municipalities to receive retirement credit for the sale of used two-engine sweepers having 2004-2006 model year propulsion engine to businesses in California.
- Remove all sweepers from the scope of the Cargo Handling Equipment regulation, making them subject to the proposed regulation.

Removing these vehicles from the Cargo Handling Equipment regulation would provide consistency for owners and operators in complying with only one regulation and would address other issues such as safety, certification, and compliance flexibility.

B. Proposed Amendments to Existing Regulations

1. Purpose and Definitions of Diesel Particulate Matter Control Measures Definition

This regulation (title 13, CCR, section 2020) defines terms that apply generally to several regulations that control diesel PM emissions. The proposed amendments would modify the definition of the term “municipality”. The current definition includes agencies of the United States of America, thereby making federal agencies subject to the regulation for Public Agency and Utility Fleets. The proposed amendment would modify the definition of municipality to exclude Federal agencies and consequently exclude fleets owned by the Federal government from the Public Agency and Utility Fleet Regulation. Tribal (Indian) reservations and rancherias are also proposed to be excluded in the revised definition of “municipality”. Fleets owned and operated by these entities would be subject to the proposed regulation.

2. Public Agency and Utility Fleets

Staff is proposing modifications that would expand the scope of this regulation and would add new language to address ambiguities and omissions in the regulation when initially adopted.

a) Scope and Applicability

Staff's proposed revision of section 2022(a) would expand the scope and applicability of the regulation to include light heavy-duty engines that were inadvertently omitted from the original scope of the regulation. Staff is also proposing to expand the scope to include 2007 model year and newer engines certified under the ABT provisions at PM levels greater than the 2007 model year standard of 0.01 g/bhp-hr. This revision is consistent with the original intent of the regulation to require upgrades of all engines that did not meet the PM BACT standard of 0.01 g/bhp-hr. This revision would ensure that any 2007 MY engines certified under the ABT provisions to a higher PM emissions levels would be subject to the BACT requirement.

b) Compliance Extensions

In conjunction with the expanded scope and applicability, a new provision section (2022.1(d)(7)) would allow municipalities and utilities to apply for a one-year extension of the intermediate 2009 compliance deadline for light heavy-duty engines. The municipality or utility would have to document that the addition of the light heavy-duty engines to the fleet would prevent the fleet from complying with the 2009 compliance deadline.

Staff does not expect many municipalities and utilities to apply for this extension since a telephone survey of 38 municipalities and public utilities indicated that most fleets had already accounted for all of their heavy-duty vehicles over 14,000 pounds GVWR, including those with light heavy-duty engines, in their total fleet for the regulation.

c) Retirement Credit for Out-Of-State Sales

A municipality or utility may receive credit toward their BACT requirement by retiring a vehicle according to the provisions of the rule. Retirement credit is granted if any of the following apply:

- the engine is dismantled for scrap;
- the vehicle is sold outside of California;
- the vehicle is transferred to another person or entity in California after it has been brought into compliance with the BACT requirements, or;
- the vehicle has been converted for use as a low usage or low-population low usage vehicle.

Staff's proposed amendments provide a means of ensuring that owners receive BACT credit for vehicles sold out-of-state, and that vehicles sold out-of-state for retirement credit cannot be re-sold in California unless they met the BACT requirements.

New language proposed in section 2022.1(f)(1)(k) would establish a process for qualifying a vehicle for retirement through out-of-state sales. This process requires the municipality or utility to obtain a “VIN Stop” – a Department of Motor Vehicles (DMV) registration hold based on a vehicle identification number that prevents a vehicle from being re-registered in California after it is retired. A municipality or utility would not be granted BACT credit for a retired vehicle re-registered in California if the municipality or utility sold the vehicle prior to the VIN Stop being issued. This proposal formalizes an informal process that was initiated earlier by staff in cooperation with the DMV.

Proposed language in section 2022.1(h) establishes contract requirements for out-of-state sales through a third party vehicle seller. The contract language would ensure that the seller informs buyers of the prohibitions against re-registering or operating retired vehicles in the state.

Staff is also proposing to modify the definition of “retirement” in section 2022(b)(8) to grant credit for the sale within California of two-engine sweepers with 2004 – 2006 model year propulsion engines, provided that, in the case of private sector buyers, they comply with the proposed regulation. This would make cleaner used sweepers available for purchase by private fleets.

d) Optional Delay of Immediate and Final Compliance Date for Group 2 and Group 3 Privately Owned Utility Vehicles

For privately-owned utilities, staff is proposing an optional two-year delay of the intermediate and final BACT PM requirement deadlines, accompanied with a requirement that by December 31, 2013, 30 percent of their total fleet vehicles meet a 2010 engine emission performance standard, and that an additional 20 percent of their total fleet vehicles meet a 2007 or newer engine emission standard.

e) Other Changes

Staff is proposing to add new definitions for “lease”, “operate”, “sold outside of the State of California”, “third party vehicle seller”, “dual engine street sweeper”, and “VIN stop” to support the changes being proposed.

3. Mobile Cargo Handling Equipment at Ports and Intermodal Rail Yards

As discussed above, staff is proposing to exclude sweepers and mobile cranes from the scope of the Cargo Handling Equipment regulation. No changes would be made regarding rubber-tired gantry cranes.

4. Drayage Trucks

Staff is proposing modifications to the drayage truck regulation to add a phase one requirement for drayage trucks with 2004 – 2006 model year engines, a change in liquefied natural gas (LNG) fueled truck applicability, and clarifications on the applicability of alternative and dual-fueled diesel trucks.

Staff is proposing to require that 2004 model year engines be equipped with the highest level verified DECS for PM by January 1, 2012, and that 2005-2006 model year engines be equipped with the highest level verified DECS for PM by January 1, 2013.

Staff is also proposing additional changes to be consistent with the proposed regulation. Staff is proposing to define pilot injection LNG fueled trucks consistent with the alternative fueled vehicle definition in the proposed regulation. This change would exempt pilot injected LNG fueled trucks from the emissions requirements of the drayage truck regulation. Staff is also proposing to include 'alternative diesel-fueled and dual-fueled' trucks in the applicability section (b)(1).

Finally, staff is proposing to add or modify the following definitions: 'Dual-Fueled Engine', 'Alternative Diesel Fuel', 'Compression Ignition Engine', and 'Diesel-Fueled'. All definition additions or changes would not modify the applicability or intent of the drayage truck regulation.

5. In-Use Off-Road Diesel Vehicle Regulation

Staff is proposing to change the scope of the regulation for in-use off-road diesel vehicles to include both the drive engine and the secondary engine of all two-engine cranes operated in California. The drive engine would be included regardless of whether it is certified as an on-road engine or as an off-road engine. Because of this, staff is proposing to add a definition of "two-engine crane," in title 13, CCR, section 2449(c)(56)

Staff is also proposing to modify section 2449.3(b)(2)(c) to exclude the horsepower from cranes from a fleet's maximum horsepower.

In addition, just as other on-road vehicles are required to have on-road engines when sold new and if operated on the road, on-road vehicles subject to the In-Use Off-Road Diesel Vehicle Regulation (such as workover rigs and on-road two-engine cranes) must have on-road engines in them when sold new. New language is proposed in section 2449(e)(15) that would clarify the repower requirements for workover rigs and other on-road vehicles subject to the regulation. The proposed amendments would require that any replacement engine must be an on-road engine if the workover rig or other on-road vehicle is to be registered and driven on public roadways.

Staff is proposing to modify section 2449 (e)(7) to clarify the exemption provision for low-use vehicles. The current regulatory language in the section exempts low-use vehicles from all of the performance requirements in section 2449(d). The proposed modifications would require low-use vehicles to comply with the requirements for adding vehicles to the fleet and with the idling requirement. This is consistent with staff's original intent in proposing the regulation.

6. Portable Engine and Equipment

Staff is proposing amendments to the Portable Engine and Equipment Regulation as it applies to two-engine cranes and two-engine sweepers. Under the Portable Equipment Regulation, currently these engines must be replaced by December 31, 2010, if they do not meet U.S. EPA or ARB emission certification standards. In many cases these vehicles have Tier 0 engines and it is not feasible, if not impossible, to repower these vehicles with new certified engines. Meaning, the only alternative would be to replace the entire vehicle with a new vehicle having a certified engine. To address this, staff is proposing to amend the Portable Equipment Regulation to exclude the secondary engines on two-engine cranes and privately owned two-engine sweepers from the requirements of the Regulation. The Regulation would also be amended to delete the diesel PM standards and fleet requirements of title 17, CCR, section 93116.3(b)(4) for lattice boom cranes. Lattice boom cranes would be included in the proposed definition of two-engine cranes that would be added to the In-Use Off-Road Diesel Vehicle Regulation.

Additionally, staff is proposing that two new sections be added to the Portable Equipment Regulation. New section 93116.1(b)(8), would require the auxiliary engine on a two-engine crane to comply with the requirements of the regulation for in-use off-road diesel vehicles, and new section 93116.1(b)(9) would require the secondary engine on a privately owned two-engine sweeper to comply with the requirements of the proposed regulation.

Staff is also proposing to amend the Portable Equipment Regulation by adding a new definition for “crane” which would cross-reference the proposed new definition of two-engine crane in the In-Use Off-Road Diesel Vehicle Regulation. A new definition for “street sweeper”, which references the new proposed definition of “dual-engine street sweeper” in the regulation for Public Agency and Utility Fleets will also be added.

7. Statewide Portable Equipment Registration Program (PERP)

The PERP requirements are proposed to be amended in order to establish new performance requirements for registered secondary diesel engines on two-engine cranes and privately owned two-engine sweepers. With this change, these secondary engines would be exempt from the performance requirements of the PERP regulation, except for the limits on opacity of emissions.

For two-engine cranes, the secondary engine would be required to comply with the applicable requirements of the In-Use Off-Road Diesel Vehicles Regulation. In addition, the PERP regulation would define “crane” by referencing Section 2449 (c) of the In-Use Off-Road Diesel Vehicle Regulation and its definition of a “two-engine crane”.

For privately owned two-engine sweepers, the PERP regulation would define “street sweeper” such that it would cross-reference the definition of “dual engine street sweeper” in the Public Agency and Utility Fleets Regulation. The secondary engine of a two-engine sweeper would have to comply with the applicable performance requirements of the proposed regulation.

In addition, currently non-registered Tier 0 secondary engines on cranes and sweepers would be allowed to be newly registered under PERP, and would then be subject to the inspection requirements and fees listed in the PERP regulation.

Under the proposed amendments, an owner who chooses to continue to register the secondary engine of a crane or street sweeper under PERP would be exempt from its recordkeeping and reporting requirements, but would remain subject to the inspection and testing fees. In addition, they would, respectively, be required to comply with the applicable recordkeeping, reporting and other administrative requirements of the regulation for in-use off-road diesel vehicles and of the proposed regulation.

C. Changes to Idling Requirements for Certain On-Road Vehicles

Staff is proposing changes to title 13, CCR, section 2485 (ATCM to Limit Diesel-Fueled Commercial Motor Vehicle Idling) and section 1956.8 (Exhaust Emissions Standards and Test Procedures – 1985 and Subsequent Model Heavy-Duty Engines and Vehicles) to exempt armored cars and workover rigs from the vehicle idling limits.

When an armored car is at a pick-up location, at least one guard must stay inside the vehicle. Since the environment inside of an enclosed armored car can become extremely uncomfortable, idling of the engine for climate control is essential to the health and safety of the onboard guard. For this reason, staff is proposing to add new section 2485(d)(2)(M) to exempt armored cars idling while providing services for which the vehicle was designed.

Staff is also proposing that the idling requirements for workover rigs be amended. Staff is proposing to add a new provision in section 2485(d)(2)(N) to exempt workover rigs from the motor vehicle idling limit while they are performing the work for which the vehicle was specially designed. This proposal would allow a workover rig to carry out its specialized function when the vehicle is stationary and the engine is working

Staff is proposing to modify the engine requirements of title 13, CCR, section 1956.8 to be consistent with the change proposed to the Commercial Vehicle idling ATCM for workover rigs and armored cars. The proposed changes to these engine requirements would add armored cars and workover rigs to the list of exempted vehicles in section 1956.8(a)(6)(B).

XII. Environmental Impact

This chapter discusses the potential impacts that the proposed regulation may have on public health and the environment, including air, water and soil. Based on our analysis, staff expects significant environmental benefits and does not anticipate any significant adverse public health or environmental impacts associated with the proposed regulation.

The proposed regulation will provide significant PM and NOx emission benefits by accelerating the introduction of newer cleaner engines and the installation of retrofits for PM exhaust emissions control on existing engines. While verified DECS can have a fuel economy penalty, this is expected to be offset by improvements in fuel economy from accelerated introduction of newer engines.

A. Legal Requirements

The California Environmental Quality Act (CEQA) and ARB policy require an analysis to determine the potential environmental impacts of proposed regulations. Because the ARB's program involving the adoption of regulations has been approved by the Secretary of Resources pursuant to Public Resources Code, section 21080.5, the CEQA environmental analysis requirements may be included in the Initial Statement of Reasons (ISOR or Staff Report) for this rulemaking in lieu of following the CEQA format of an Initial Study and an Environmental Impact Report or Negative Declaration. In addition, ARB staff will respond, in the Final Statement of Reasons for the regulation, to all significant environmental issues raised by the public during the public review period or at the Board public hearing.

Public Resources Code section 21159 requires that the ARB's environmental impact analysis include the following:

- An analysis of the reasonably foreseeable environmental impacts of the methods of compliance;
- An analysis of reasonably foreseeable mitigation measures; and
- An analysis of reasonably foreseeable alternative means of compliance with the regulation.

Compliance with the proposed regulation is expected to directly affect air quality and potentially affect other environmental media. Our analysis of the reasonable foreseeable environmental impacts of the methods of compliance is presented below. Regarding mitigation measures, CEQA requires the lead agency to identify and adopt feasible mitigation measures that would minimize any significant adverse environmental impacts described in the environmental analysis.

The proposed regulation is designed to primarily reduce emissions of diesel PM – a toxic air contaminant – and NOx. The diesel PM reductions are needed to reduce the public health impacts from exposure to diesel PM as required by Health and Safety Code (HSC) sections 39666 and 39667, and to fulfill the goals of the October 2000

Diesel Risk Reduction Plan (ARB, 2000). The NOx emissions reductions are needed to provide the ozone and particulate matter precursor emissions reductions necessary to achieve attainment in those areas of the State that violate the National and State ambient air quality standards for ozone and particulate matter. The regulation is also necessary to fulfill ARB's obligations under HSC 43013 and 43018 to achieve the maximum feasible and cost effective emission reductions from all mobile source categories, including on-road diesel engines.

Alternatives to the proposed regulation are discussed in Chapter XVIII of this report. ARB staff has concluded that there are no alternative means of compliance that would achieve similar diesel PM and NOx emission reductions at a lower cost.

B. Reasonably Foreseeable Environmental Impacts

Staff has identified both benefits and potentially adverse environmental impacts of compliance with the proposed regulation.

1. Statewide Air Quality Impacts

On-road engines are major contributors to PM2.5 and ozone pollution. The proposed regulation will provide diesel PM and NOx emissions reductions that will have a substantial positive air quality impact throughout California. By reducing ambient levels of PM2.5 and ozone, the regulation will help with the progress towards attainment of National and State ambient air quality standards for PM2.5 and ozone. Significant health benefits will be obtained with the reductions of ambient levels diesel of PM, a toxic air contaminant.

The emissions benefits of the proposed regulation are summarized in Table XII-1 below and discussed in more detail later in this chapter. Staff estimates that between 2010 and 2025, as older engines are replaced with newer engines or retrofitted with diesel exhaust control systems, PM emissions will be reduced by an average of 2,160 tons per year and NOx by an average of 30,000 tons per year.

The PM and NOx emissions reductions from the proposed regulation and the resulting reduction in ambient levels of these compounds will help with efforts to achieve ambient air quality standards for both PM2.5 and ozone in non-attainment areas of the State.

Table XII-1: Emission Benefits from Implementation of the Proposed Regulation

Benefits of Regulation (2010 – 2030)	PM	NOx
Emissions Removed (total tons)	34,600	480,000
Annual Average Reductions (tons per year)	2,160	30,000

a) Methodology

The proposed regulation would initially require older vehicles to install DPFs; several years later, it would require replacement of that vehicle with a compliant vehicle. Applying the proposed compliance schedules amongst fleets requires assessing compliance within each inventory category by fleet size, and then assessing the fraction of VMT subject to low-mileage provisions.

To assess potential compliance patterns staff evaluated previous vehicle buying patterns by fleets based on survey data collected, as well as the cost model developed for this regulation. Using these data, staff assessed the likely model year truck or bus that would be purchased in a given calendar year. Based on an analysis of historical buying patterns, the largest fleets were most likely to purchase new vehicles, even if the regulation does not require it -- while smaller fleets operating older vehicles were likely to comply by doing the minimum that the regulation requires. For example, if the regulation requires that a fleet purchase a 2010 compliant vehicle to replace a 2007 non-compliant vehicle in 2021, staff assumed a smaller or older fleet would purchase a 2010 vehicle, an average in-state fleet would purchase a 3-5 year old vehicle, and an out-of-state truck fleet would purchase a new vehicle. Details on these assumptions are provided in Appendix G.

b) Reduction of PM and NOx Emissions

The projected PM emissions reductions from implementation of the proposed regulation are presented in Table XII-2 and Figure XII-1, while the NOx emissions reductions are shown in Table XII-3 and Figure XII-2

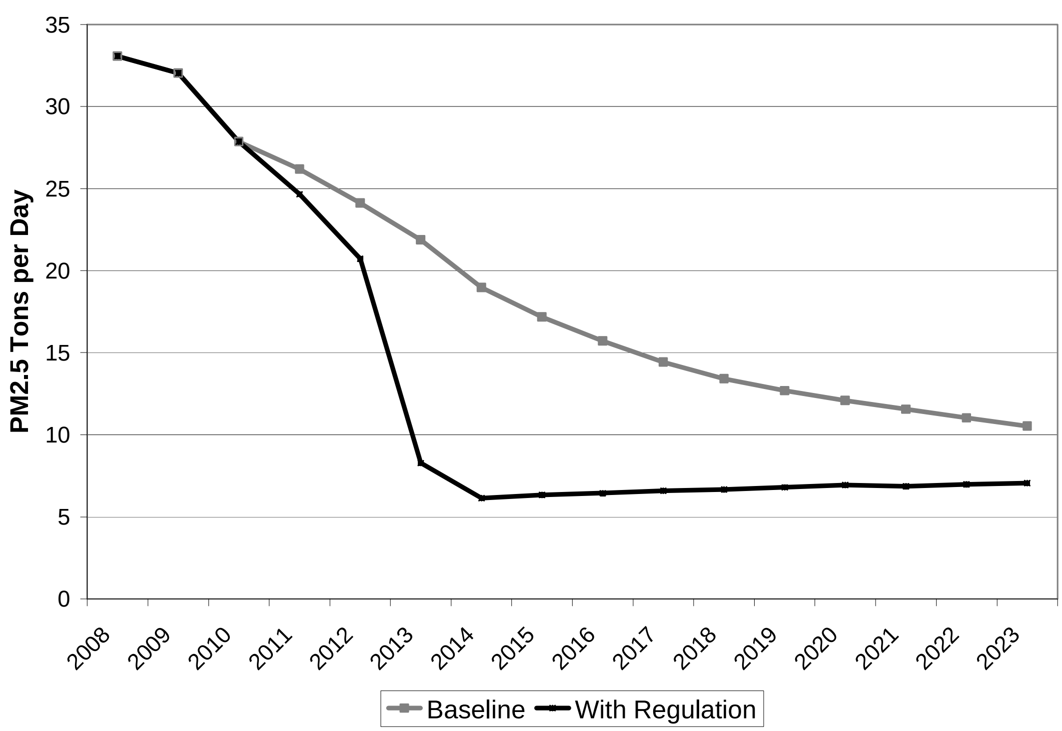
As the baseline inventory estimates show, a decline in overall PM and NOx emissions from on-road diesel engines is expected as the on-road fleet becomes increasingly dominated over time by engines that comply with existing emission regulations. However, this decline in emissions is not sufficient to meet ambient air quality standards. Without additional emissions reductions from these engines, this downward trend in emissions is expected to reverse and emissions are expected to rise in the future as the effect of growth in the population of the on-road sector surpasses the effect of the existing standards.

Staff estimates that with implementation of the proposed regulation, diesel PM emissions will be reduced by about 13 tons per day (tpd) in 2014 and 3.5 tpd in 2023 relative to baseline levels. These reductions represent a 68 percent decrease in PM emissions in 2014 and a 33 percent decrease in 2023. Also, the projected PM emission rate in 2020 (6.9 tpd) will be 79 percent lower than the 2000 baseline level of 33.1 tpd. Therefore, while the proposed regulation comes close, but does not achieve the goal of the Diesel RRP of reducing diesel PM by 85 percent by 2020. It does achieve the maximum feasible PM emission reductions.

Table XII-2: Statewide PM Emissions Benefits from the Proposed Regulation

Calendar Year	PM Emissions (tons per day)		Projected Reductions	
	Baseline	With the Regulation	(tons per day)	Percent from Baseline
2010	27.9	27.9	—	—
2014	19.0	6.1	12.8	68%
2017	14.4	6.6	7.8	54%
2020	12.1	6.9	5.2	43%
2023	10.5	7.1	3.5	33%

Figure XII-1: Projected PM Emissions With and Without the Regulation



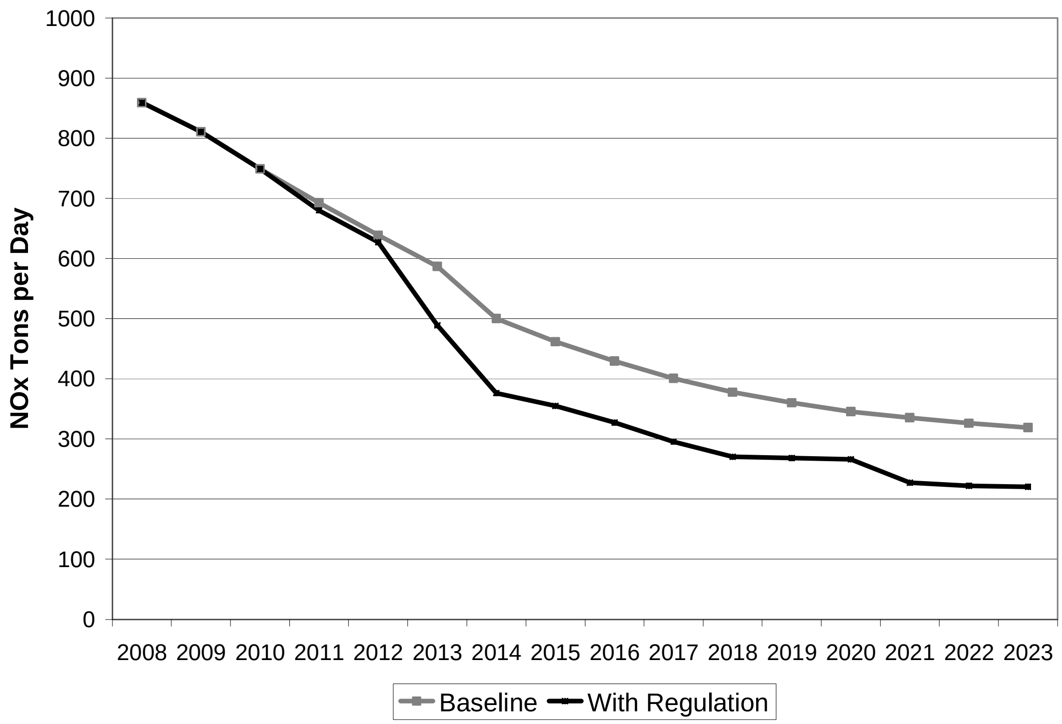
The projected NOx emissions reductions from the proposed regulation are 124 tpd and 98 tpd, for 2014 and 2023, respectively. NOx emissions would be 25 percent lower in

2014 and 31 percent lower in 2023 than they would be in the absence of the proposed regulation.

Table XII-3: Statewide NOx Emissions Reductions from the Proposed Regulation

Calendar Year	NOx Emissions (tons per day)		Projected Reductions	
	Baseline	With the Regulation	(tons per day)	Percent from Baseline
2010	749	749	—	—
2014	500	377	124	25%
2017	401	296	105	26%
2020	346	266	79	23%
2023	319	221	98	31%

Figure XII-2: Projected NOx Emissions With and Without the Regulation



Overall, staff estimates that California registered trucks, which account for 57 percent of statewide truck and bus VMT, will provide roughly 91 percent of total NOx benefit, because those trucks tend to be older than trucks entering California from other states. In addition, staff found that small fleets of three trucks or fewer comprise 35 percent of VMT but provide nealry 50 percent of NOx benefits achieved through this regulation. This is because smaller fleets tend to be older than larger fleets, across all inventory categories.

2. *Impact on the State Implementation Plan*

The 2007 SIP was based on the applicable version of ARB's on-road motor vehicle emissions model, EMFAC2007. Staff, in support of this rulemaking, has undertaken comprehensive efforts to update and improve the truck inventory since the SIP was adopted. New data not available at the time of SIP development was used in assessing the costs and benefits of this statewide rulemaking. However, assessing the proposed regulation benefits in terms of meeting the regional SIP targets must be done with the SIP inventory, since the SIP inventory is the official inventory for judging SIP compliance.

The 2007 SIP truck measure envisioned modernizing truck fleets operating in California to the equivalent of the cleanest adopted new engine (2010) standards. This proposed regulation meets that goal on the pace necessary to meet all the SIP target dates. While the quantification of benefits with the new inventory is different than with the SIP inventory, the difference is in accounting not rule effectiveness. A primary reason for the difference is that new data shows there is more travel by newer, cleaner out-of-state trucks than previously estimated in EMFAC2007. As a result, fewer benefits can be attributed to the proposed regulation for out-of-state trucks because they will already employ 2010 compliant engines. The proposed regulation benefits are primarily attributed to the modernization of in state fleets that are older and dirtier. In short, the proposed regulation accomplishes the modernization of truck fleets as envisioned in the SIP.

Table XII-4 and Table XII-5 show, using the regional SIP inventories, the proposed regulation benefits compared to the expected reductions. The SIP targets in these tables refer to the fleet modernization portion of the truck SIP measure. The second part of the SIP measure for trucks, a program to address excess emissions, will be developed separately. The proposed regulation meets or exceeds the combined NOx and PM2.5 SIP fleet proposed regulation targets in both the South Coast and San Joaquin Valley for all years. In 2014, in the South Coast, the SIP target is met with slightly more PM2.5 reductions and slightly less NOx than expected. The PM2.5 modeling used in the South Coast Air Quality Management District SIP shows that direct PM2.5 emission reductions are relatively more effective in reducing ambient particulate levels than are NOx reductions. As shown in Table XII-4 the proposed regulation achieves 60 tons per day of NOx in 2014 and the equivalent of six tons per day of NOx from the extra PM2.5 reductions that exceed the PM2.5 SIP target. The SIP also included reductions in 2020 to support attainment in regions downwind of South Coast and the San Joaquin Valley. These 2020 goals are met for both regions.

Table XII-4: South Coast SIP Emission Reduction Targets for Trucks

Calendar Year	NOx (tpd in SIP inventory)		PM2.5 (tpd in SIP inventory)	
	SIP Target for Rule[1]	Rule	SIP Target for Rule[1]	Rule
2014	66[2]	60[3] plus 6 equivalent tons	2.3	3.5[3]
2020	23	27	--	--
2023	15	22	--	--

[1] The truck measure reductions estimated in the SIP include the benefits of programs to reduce excess emissions. The numbers presented here are the SIP goals for the modernization rule only.
[2] This target represents expected benefits from the enhanced truck measure designed to provide additional reductions in 2014 for South Coast PM2.5 attainment and to accelerate ozone attainment in the San Joaquin Valley.
[3] SIP compliance assessment includes agricultural truck compliance option.

Table XII-5: San Joaquin SIP Emission Reduction Targets for Trucks

Calendar Year	NOx (tpd in SIP inventory)		PM2.5 (tpd in SIP inventory)	
	SIP Target for Rule[1]	Rule	SIP Target for Rule[1]	Rule
2014	48	66	2.5	4.3
2017	49[2]	49[3]	--	--
2020	17	29	--	--
2023	8	23	--	--

[1] The truck measure reductions estimated in the SIP include the benefits of programs to reduce excess emissions. The numbers presented here are the SIP goals for the modernization rule only.
[2] This target represents expected benefits from the enhanced truck measure designed to provide additional reductions in 2014 for South Coast PM2.5 attainment and to accelerate ozone attainment in the San Joaquin Valley.
[3] SIP compliance assessment includes agricultural truck compliance option.

3. Potential Negative Impacts

Staff has identified two potential negative impacts resulting from the potential use of catalyzed DPFs to comply with the proposed regulation. They are: 1) increased NO_2 emissions resulting in increased NO_2 exposure, and 2) the need to manage the hazardous ash that accumulates on the filter.

a) Increased Nitrogen Dioxide Emissions with Passive Catalyzed Diesel Particulate Filters

Unlike active diesel particulate filters, most catalyzed diesel particulate filters (CDPF) form NOx as part of their normal operation. The CDPF works by mechanical filtration of PM from the exhaust through a ceramic or metallic filter followed by oxidation of the captured PM – mostly elemental carbon particles – to CO_2 which is released to the atmosphere. The oxidizing agent for this process (filter regeneration) is NO_2 which is produced through the catalytic oxidation of the nitric oxide (NO) formed in the engine combustion process.

Typically, more NO_2 is created than is actually used during the regeneration process, and the excess is emitted. Emissions measurements have shown an increase in the NO_2 fraction of NOx emissions (NO plus NO_2) from heavy-duty diesel vehicles equipped with passive catalyzed diesel particulate filters even though total NOx emissions remain approximately the same. The NO_2 to NOx ratios downstream from a CDPF could range from 20 to 70 percent, depending on factors such as the DPF systems, the sulfur level in the diesel fuel, and the duty cycle (DaMassa, 2002). On average, for diesel engines not equipped with a CDPF, about 7 percent of the emitted NOx is in the form of NO_2 (ARB, 2006).

The ARB's Verification Procedure sets limits for secondary emissions from verified diesel emission control systems. The limit on NO_2 emissions is intended to limit increases in ambient NO_2, secondary nitrate PM, and ozone, and adverse public health impacts. The regulation allows a maximum NO_2 increase equivalent to 30 percent of the total baseline NOx. Beginning January 1, 2009, the maximum increase will be reduced to 20 percent. Chapter VII discusses the impact of this new limit on currently verified DECS.

Higher NO_2 emissions will result in a very small increase in ambient levels of NO_2 and ozone – pollutants associated with adverse health effects including respiratory symptoms, cardio-respiratory hospital admissions, and reduced lung function (ARB, 2007a). Currently, all of California is in compliance with the State 1 hour ambient NO_2 air quality standard, often by a wide margin. Staff analyzed the impact on micro-scale exposures such as at schools where school buses idle and on freeways with heavy diesel traffic. The analysis showed no violations of the 1 hour standard (ARB 2006). The anticipated reductions in NOx, and associated ozone and ambient NO_2 from the proposed regulation, are expected to more than offset any increases in ozone formation from increased NO_2 emissions from CDPFs.

b) Ash Management

The PM trapped by a DPF includes solid carbonaceous material or soot, semi-volatile organic matter (SOF), and inorganic solid particles. During the regeneration of the DPF, the captured soot and other combustible organic matter are oxidized to carbon dioxide and water, but the inorganic material is not typically combusted. Instead, it accumulates in the DPF as an ash. The DPF provides an environmental benefit by filtering metallic ash from the exhaust, but for effective operation of the DPF, the accumulated ash, which could be classified as a hazardous waste, must be periodically removed from the filter.

The principal sources of ash are fuel additives, engine lubricating oil, salts from environmental air, and motor wear. It primarily consists of oxides, sulfates and phosphates of iron, calcium, and zinc. Depending on the concentration of zinc, the ash may be classified as a hazardous waste. Title 22, CCR, section 66261.24, establishes two limits for zinc in a waste: 250 milligrams per liter for the Soluble Threshold Limit Concentration and 5,000 milligrams per kilogram for the Total Threshold Limit Concentration. The presence of zinc at or above these levels would cause a sample of ash to be characterized as a hazardous waste.

According to California law, it is the generator's responsibility to determine whether or not their waste is hazardous. This, in general, would require a chemical analysis of the collected ash sample to determine the zinc content. Applicable California regulations concerning the management and disposal of hazardous waste are contained in title 22 of the California Code of Regulations and are enforced by the Department of Toxic Substances Control (DTSC). Owners planning to dispose of ash from a DPF should contact both the manufacturer of the DPF and DTSC for advice on waste management. They should also consult with local environmental agencies to determine acceptable disposal methods. Diesel fuel ash is not listed as a hazardous waste by EPA in the Code of Federal Regulations (40 CFR Part 261). Federal regulations also conditionally exempt small quantity generators who generate less than 220 pounds per month of solid waste from federal hazardous waste regulations.

The amount of ash collected from a filter during a typical cleaning procedure is relatively small. For example, ARB reports that the amount of material collected from a single filter in a single cleaning procedure is in the range of 10-20 grams of ash. ARB extrapolated this ash collection amount to 10-20 kg (22-44 pounds) of ash collected per year for a fleet of 1,000 transit buses (ARB, 2002).

Most of the ash is formed from the inorganic materials in engine oil, particularly from zinc-containing additives necessary to control acidification of engine oil – due in part to sulfuric acid derived from sulfur in diesel fuel. The need for acid neutralizing additives in engine oil has decreased as the sulfur content of diesel fuel has decreased. American Petroleum Institute (API) CJ-4, which was introduced in October 2006, limits the oil's sulfated ash, phosphorus, and the amount of zinc dithiophosphate-containing detergent in the diesel engine oil to insure adequate service life of the DPF. It reduces ash accumulation rates in DPFs and prevents premature plugging

4. 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. Chapter III of this Staff Report gave an overview of ARB's commitment to integrating environmental justice in all its activities.

With implementation of the proposed regulation, PM and NOx emissions as well as associated cancer risks and other health impacts will decrease over time as on-road vehicle fleets become cleaner. 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. Although vehicles would be cleaned up on different schedules, staff expects emissions to decline in all areas.

C. Health Benefits Analysis

The emissions reductions obtained with implementation of this proposed regulation will result in lower ambient PM and ozone levels and reductions in public exposure to these pollutants. The potential health impacts of PM and NOx emissions from on-road engines and the consequent need for emissions reductions were discussed in Chapter IV. This section describes the statewide health benefits and the benefits to the targeted southern California urban study area of reducing emissions of PM and NOx from engines subject to the proposed regulation. It also provides the societal cost savings of the proposed regulations.

1. Reduced PM and NOx Emissions

a) Statewide Non-Cancer Health Benefits

The proposed regulation is projected to reduce PM2.5 emissions from heavy-duty diesel vehicles statewide by approximately 34,600 tons between 2010 and 2025. The projected NOx emission reduction over the same time period is 480,000 tons. The effect of reducing these emissions would be a reduction in the prevalence of the diseases attributed to diesel PM, reduced incidences of hospitalizations, and prevention of premature deaths.

Staff quantified the statewide cumulative impact of the total emissions removed from 2010 through 2025 through the implementation of the proposed regulation. The analysis used the same non-cancer health endpoints reported in Chapter IV for the impact of the 2008 baseline emissions. Appendix E provides a description of the methodology used to estimate the health benefits.

The estimates reported in Table XII-6 demonstrate that the health benefits of implementing the proposed regulation are substantial. Staff estimates that the cumulative emissions reductions from 2010 to 2025 would result in approximately 9,400 fewer premature deaths, 1,100 fewer hospital admissions due to respiratory causes, 1,200 fewer hospital admissions due to cardiovascular causes, 150,000 fewer cases of asthma-related and other lower respiratory symptoms, 12,000 fewer cases of acute bronchitis, 950,000 fewer work loss days, and 5,400,000 fewer minor restricted activity days. Table XII-6 also shows the range for each estimated benefit.

The analysis of the impact of the regulation includes the benefits of reductions of direct diesel PM and indirect diesel PM – nitrates formed from precursor NOx emitted by diesel engines. The impacts of direct and indirect sources of PM are listed separately in Table XII-6. The health benefits of reducing NOx as a precursor to ozone are not included in the estimates. Because only a subset of health outcomes was considered, the estimates are conservative.

Table XII-6: Total Health Benefits Associated with Reductions in Emissions from the Implementation of the On-Road Truck and Bus Regulation (2010-2025)*

Endpoint	Pollutant	Number of Cases (Mean)	Range (95% C.I.)
Premature Mortality	PM	3,300	990 – 6,000
	NOx	6,100	1,800 – 11,000
	Total	9,400	2,800 – 17,000
Hospital admissions (Respiratory)	PM	64	23 – 110
	NOx	1,000	580 – 1,500
	Total	1,100	600 – 1,600
Hospital admissions (Cardiovascular)	PM	270	140 – 400
	NOx	960	590 -1,400
	Total	1,200	730 – 1,800
Asthma & Lower Respiratory Symptoms	PM	53,000	20,000 – 85,000
	NOx	96,000	39,000 – 150,000
	Total	150,000	59,000 – 240,000
Acute Bronchitis	PM	4,400	0 – 9,600
	NOx	7,600	0 – 16,000
	Total	12,000	0 – 26,000
Work Loss Days	PM	330,000	280,000 – 380,000
	NOx	620,000	520,000 – 710,000
	Total	950,000	800,000 – 1,100,000
Minor Restricted Activity Days	PM	1,900,000	1,600,000 – 2,300,000
	NOx	3,500,000	2,900,000 – 4,200,000
	Total	5,400,000	4,500,000 – 6,500,000

* Health effects from primary and secondary PM are labeled PM and NOx, respectively. The sum of PM and NOx impacts may not equal the total given due to rounding. Estimates for premature deaths are based on an updated relative risk of 10% per 10 µg/m3 change in long term PM2.5 exposure, with a confidence interval of 3% - 20% (ARB, 2008).

b) Local Non-Cancer Health Benefits

On a local level, as part of the Commerce Study, staff also estimated these same health benefits between 2010 through 2020. Such benefits would be a subset of the statewide numbers reported above; that is, these benefits are due only to the reduction in emissions expected from implementation of the proposed regulation within the Commerce study area. Statewide, much greater benefits are expected to be realized as reported above. The anticipated benefits in and around the City of Commerce are:

- 78 avoided premature deaths (20 to 130, 95 percent CI)
- 60 avoided hospital admissions – respiratory and cardiovascular (24 to 90, 95 percent CI)
- 2,600 avoided asthma attacks (1,000 to 4,000, 95 percent CI)

- 220 avoided acute bronchitis (0 to 48, 95 percent CI)
- 14,700 avoided work loss days (11,500 to 16,500, 95 percent CI)
- 80,000 avoided minor restricted activity days (70,000 to 93,000, 95 percent CI)

2. Potential Localize Cancer Risk Reduction

On a local level, using the results from the Commerce study, staff's analysis estimates that risk levels in and around the city of Commerce will be reduced by over 80 percent, to less than 70 in a million, by 2015. However, localized cancer risks will begin to increase as growth begins to surpass the reductions realized by the regulations, with the predicted remaining cancer risk in the 2020 timeframe rising to about 75 in a million in and around the city of Commerce. As vehicle miles traveled in the future continues, this increase in cancer risk will continue, albeit at a significantly lower rate of increase than would occur in the absence of the proposed regulation. Appendix E provides a more detailed description of the methodology and results.

3. Benefits of Reduced Ambient Ozone Levels

Emissions of NOx and ROG are precursors to the formation of ozone in the lower atmosphere. On-road diesel engines contribute a substantial fraction of ozone precursors, particularly NOx, statewide. Therefore, reductions in NOx from on-road diesel engines are a considerable contribution to California's efforts to reduce exposure to ambient ozone. Controlling emissions of ozone precursors reduces the prevalence of the health effects associated with ozone exposure, such as coughing, chest tightness, inflammation and irritation of the respiratory tract, worsening of wheezing and other asthma symptoms, and reduced lung function, and would reduce hospital admissions and emergency visits for respiratory problems.

4. Economic Benefit

The proposed regulation would provide significant economic benefits as well. During the 2010 to 2025 period, the estimated statewide cumulative economic benefits from the proposed regulation is $69 billion using a 3 percent discount rate or $48 billion using a 7 percent discount rate. ARB follows U.S. EPA practice in reporting results using both 3 percent and 7 percent discount rates. A large portion of the monetized benefits results from avoiding premature death. The estimated benefits from avoided morbidity are approximately $510 million with a 3 percent discount rate and nearly $350 million with a 7 percent discount rate. Approximately 68 percent of the benefits are associated with reduced PM from NOx emissions, and the remaining 32 percent from direct PM emissions. Appendix E discusses the methodology staff used to monetize the value of avoiding the adverse health impacts using valuations compiled from ARB and U.S.EPA publications, updated to 2007 dollars.

D. Climate Change Impacts

This section provides a general discussion of the impact of the projected emissions reductions on climate change and provides an estimate of the impact based on changes in CO_2 emissions with implementation of this regulation.

1. Greenhouse Gases

The most important class of climate forcing agents responsible for global warming are greenhouse gases (GHG) which are predominantly comprised of CO_2, methane (CH4) and nitrous oxide (N_2O). Other GHGs include water (H_2O), CO and ozone. These gases are known as GHGs, due to their transparency to high frequency solar radiation and their opacity to low frequency infrared radiation emitted from the Earth's surface. The gases differ in their atmospheric warming potential, and as a result, the contribution of each gas is determined as equivalent CO_2 emissions using conversion factors approved by the Intergovernmental Panel on Climate Change. For example, methane has 21 times the warming potential of carbon dioxide and N_2O has 310 times the warming potential of CO_2.

In evaluating the potential GHG emissions changes and their impacts on climate change, it is relevant to examine changes in CO_2 emissions associated with fuel economy impacts, as well as impacts of particle and aerosol formation and emissions.

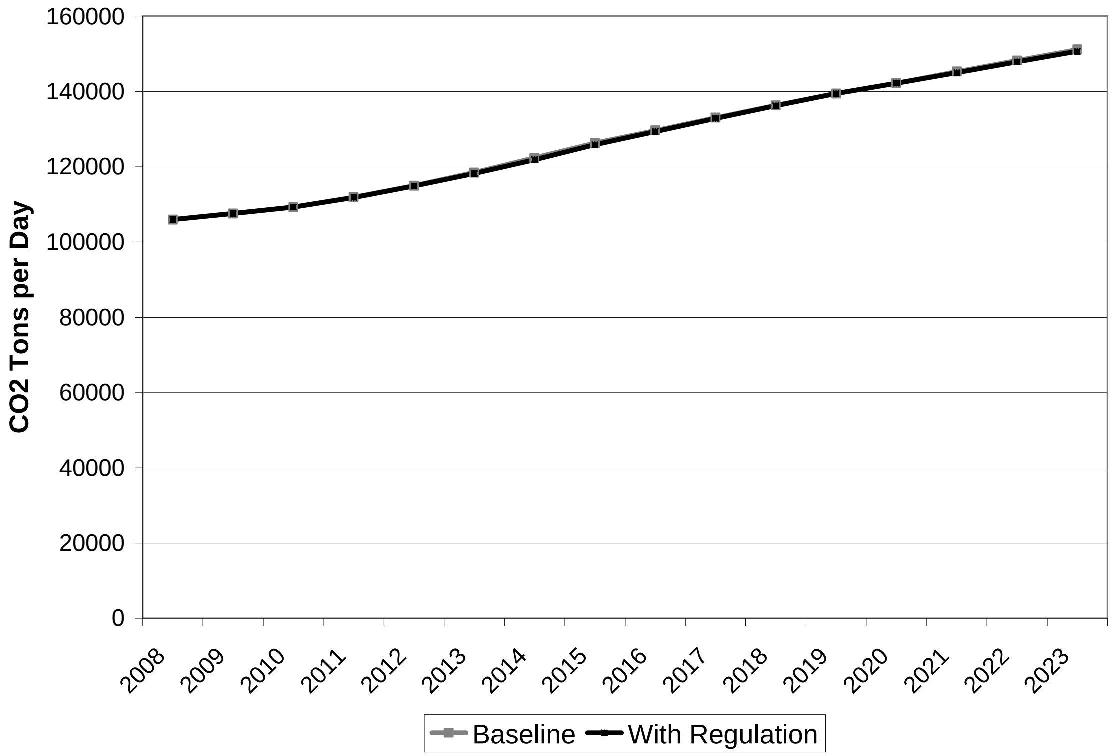
a) Fuel Economy

A vehicle owner who complies with the regulation by retrofitting the vehicle with a DPF could potentially experience a decrease in the vehicle's fuel economy of about 2 percent. However, as the fleet is modernized to comply with the regulation, SCR is expected to replace EGR as the primary NOx emissions control technology. SCR for 2010 model year engines permits operation of the engine at more optimal combustion temperatures to provide better power and fuel efficiency improvements, as well as lower PM generation.

The expected improvements in fuel economy from the use of SCR, estimated 3 to 5 percent, would offset the potential climate change impacts of the widespread installation of DPFs on the overall fuel economy of the fleet.

Staff expects fuel economy to improve over time with the introduction of engines meeting the 2010 emission standard and as a result, CO_2 emissions will increase at a slower rate than the predicted increase in VMT. Staff does not anticipate a significant reduction of CO_2 emissions as a result of the proposed regulation (Figure XII-3).

Figure XII-3: Statewide CO_2 Baseline and With Regulation Emissions



The proposed regulation would also reduce emissions of black carbon – a component of diesel PM and a likely contributor to global warming – which would further reduce climate change impacts attributed to the overall impact on fuel economy.

b) Net Effect on Greenhouse Gases

The overall impact of the regulation on climate change would be negligible. Staff expects a negligible decrease in CO_2 emissions of less than one percent after taking into account the fuel economy benefit of SCR for 2010 and later model year engines, and the relatively small CO_2 increase associated with the fuel economy penalty for DECS installed to comply with the regulation.

In assessing the climate change impact of the proposed regulation, staff examined only the direct emissions from operation of the vehicles. In addition to CO_2, on-road diesel engines emit significant amounts of at least two pollutants associated with climate change – black carbon and ozone-forming NOx. However, it is difficult at this time to estimate the impacts of reductions of these pollutants on climate change since there is no global warming potential yet assigned to black carbon.

2. Aerosols

Particles, especially those with diameters smaller than 1 micron (µm), can affect the earth's temperature and climate by altering the radiative properties of the atmosphere.

“Reflective aerosols” will scatter solar radiation so that a substantial portion of the radiation incident to the Earth’s troposphere is returned to space, thereby cooling the climate. Examples of these are sulfates, nitrates, and organic carbon particles.

“Absorbing aerosols” will absorb solar radiation, transfer the energy to the atmosphere, and prevent sunlight from reaching the ground. These aerosols warm the atmosphere, but cool the surface. Black carbon aerosols, or soot, formed by incomplete combustion are absorbing aerosols and cause a positive climate forcing of uncertain magnitude. Current investigations indicate that black carbon and associated organic matter play a major role in climate change, but this role has not been quantified reliably. Modeled estimates for radiative forcing by black-carbon-containing aerosols range widely. It may be the second or third largest individual warming agent, following CO_2 and perhaps methane (Bond and Sun, 2005).

Since diesel PM is composed largely of black carbon and associated organic matter, the diesel PM emissions reduction obtained with the proposed regulation would have a positive climate change impact by reducing the black carbon component of global warming. Also, because the lifetime in the atmosphere for most black carbon is short compared to CO_2, the control of black carbon emissions can bring an immediate environmental benefit compared to the slower response to CO_2 emissions controls.

3. Ozone Precursors

It is estimated that tropospheric ozone has had the third largest impact on radiative forcing (1750 to present) of all GHGs. Changes in tropospheric ozone are due to anthropogenic increases in the emissions of ozone precursors – NOx and VOCs. However, the effect of reducing these precursors is still uncertain, as there are no agreed-upon methods for estimating the Global Warming Potential of ozone precursors. Also, ozone production leads to the formation of particulate nitrate and secondary organics which enhance cooling. However, there are no methods for accounting for the indirect effects of changes in tropospheric chemistry. Ozone is short lived in the troposphere (an average lifetime on the order of weeks) and is typically treated as a regional pollutant with direct and indirect climate effects that vary considerably by location.

4. Alternative Fuels

The proposed regulation gives credit for the use of hybrid electric and alternative fuel vehicles and systems to replace diesel vehicles. This provision of the rule could have a positive impact on climate change to the extent that it is effective in encouraging owners to purchase low-GHG vehicles or use low GHG fuels where they are cost effective alternatives to conventional diesel vehicles or fuel. This will result in a clear GHG advantage from the need for reduced power generation and fuel production.

For electric vehicles, there are greenhouse gas implications in battery manufacturing, replacement and disposal. However, on a lifecycle basis, electric vehicles have lower associated emissions than diesel vehicles (Delucchi, 2005). Over the longer term, expanding the use of electric vehicles would provide the benefit of zero tailpipe emissions, and reduced climate change impacts.

E. Welfare Impacts

In addition to the public health effects of fine particulate pollution, fine particulates including sulfates, nitrates, organics, soot, and soil dust contribute to regional haze that impairs visibility.

In 1999, the U.S. EPA promulgated a regional haze regulation that calls for states to establish goals and emission reduction strategies for improving visibility in 156 mandatory Class I national parks and wilderness areas. California has 29 of these national parks and wilderness areas, including Yosemite, Redwood, and Joshua Tree National Parks. Reducing diesel PM from diesel-fueled on-road vehicles would help improve visibility in these Class I areas.

F. Reasonably Foreseeable Mitigation Measures

ARB staff has concluded that no significant adverse environmental impacts should occur from adoption of and compliance with the proposed regulation. Therefore, no mitigation measures would be necessary.

G. Alternative Means of Compliance with the Proposed Regulation

Alternatives to the proposed regulation are discussed in Chapter XVIII of this report. ARB staff has concluded that the proposed regulation provides the most effective and least burdensome approach to reducing exposure of children and the general public to diesel PM and other air pollutants emitted from on-road diesel-fueled engines.

H. References

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XIII. Cost Summary and Methodology

This chapter discusses the methodology staff developed to estimate the costs associated with the proposed regulation. These costs relate to the installation and maintenance of verified DECS and the early replacement of vehicles to newer vehicles (beyond what fleets have historically done). To conduct this analysis, staff developed a cost model to estimate the capital expenditures of normal vehicle replacement compared to the capital expenditures required to comply with the proposed regulation. The cost model examines actual individual company fleet actions each year between 2009 and 2030, with and without the proposed regulation. The results for each fleet included in the cost model are then scaled up to reflect the impacts on the statewide heavy-duty diesel vehicle population, including out-of-state vehicles operating in California.

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 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. Methodology for Estimating Costs

1. Overview

The cost and economic impacts of this regulation are based on the anticipated compliance paths of the affected statewide fleets. To perform this analysis, staff estimated the cost that fleets are already incurring under their normal vehicle replacement practices. Staff then estimated the costs that fleets would incur to meet the requirements of the proposed regulation. The difference between these two numbers is the regulatory costs of staff’s proposal. These costs have been estimated for the years between 2010 and 2030.

Staff developed the ARB On-Road Compliance Model (cost model) to estimate the capital expenditures of normal vehicle replacement during the analysis period compared to the capital expenditures required to comply with the proposed regulation over the same period. Using actual fleet data reported in the ARB fleet survey on over 13,000 vehicles, the costs to the statewide fleets were calculated by predicting and evaluating the compliance paths for real individual fleets using the cost model.

Staff used the cost model to analyze over 6,700 vehicles from 688 actual individual company fleets for each calendar year from 2009 to 2030, both with the regulation and without the regulation. The fleets evaluated varied by fleet age, vehicle type and weight class, and provided a representation of in-state and out-of-state fleets operating in California. The analysis determined the costs beyond those of estimated normal vehicle replacement; all costs calculated are additional costs fleets would incur by complying with the regulation.

In addition to capital costs, various annual operational and maintenance costs are attributable to the regulation. Operational and maintenance costs associated with NOx and PM controls would include annual PM filter cleaning expenses, changes in fuel economy, urea costs for SCR systems, and costs associated with regeneration of active PM systems. Potential cost savings include fuel economy improvements with replacement of older vehicles with newer vehicles. In addition, companies would incur annual reporting costs when required to report to ARB. These annual costs were modeled separately and added to the capital cost estimates to arrive at an overall cost estimate. The cost and economic methodology is described in more detail in Appendix J.

a) Fleet Data Collection Approach

First, the cost estimate of the proposed regulation was developed through the use of a number of sources of data. Staff met with several individual companies and obtained information about their normal business practices. Staff also conducted a detailed fleet information survey with participation by fleet organizations and individual stakeholders. An ARB fleet survey collected information from fleets throughout the state regarding their company's business operations, such as the fleet's primary business use categories and number of vehicles in each fleet. The survey data also included vehicle specific information for heavy-duty diesel vehicles, including model year, weight ratings, and annual mileage data. See Appendix J for summary information obtained by the survey regarding reported counts by vehicle body type and by fleet size and age.

b) Vehicle Replacement

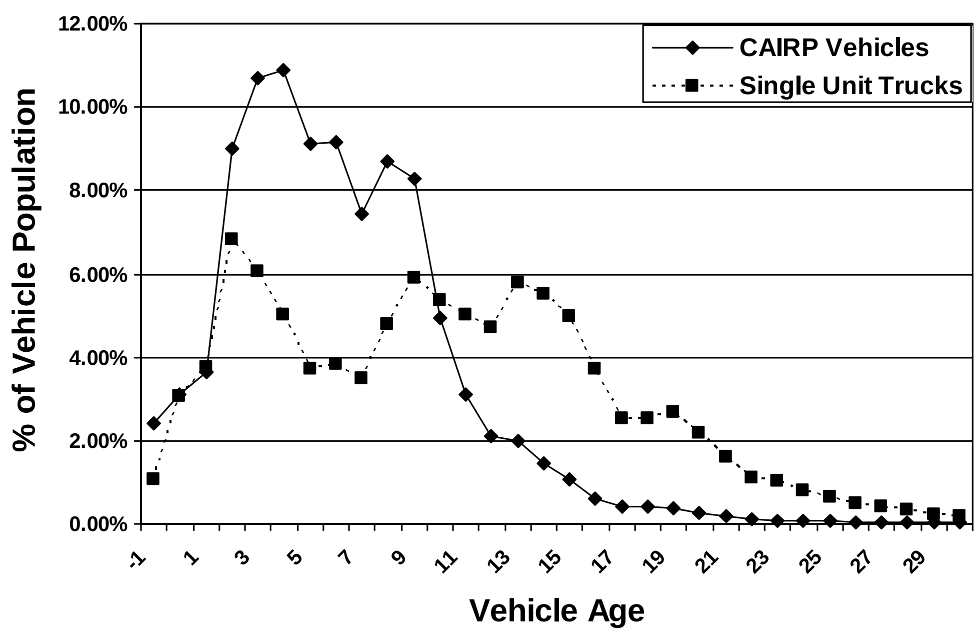
Heavy-duty diesel engines are extremely durable and can operate 750,000 to 1,000,000 miles before needing to be rebuilt. Although there are exceptions, few fleets operate vehicles significantly above 1,000,000 miles because repairs at this age often exceed the value of the vehicle and the loss in reliability adds indirect costs for most businesses.

Normal vehicle replacement practices are dependent on a number of factors, but in general are best correlated to annual miles traveled and how a vehicle is used. Fleets with vehicles travelling over 100,000 miles per year generally have vehicle replacement rates that are much higher than fleets with vehicles averaging less than 20,000 miles per year. For example, a long haul trucking operation that averages well over 120,000 miles per year may replace all of their vehicles with new vehicles in a 3 to 7 year period. In contrast, a less than truckload carrier who may average 70,000 miles per year may normally buy 3 year old vehicles and keep them for 10 years, and a local construction fleet may average 20,000 miles per year and purchase a range of new and used vehicles and will often keep them for over 20 years.

Statewide emission inventory data includes vehicle counts by model year for various fleet population groups (such as in-state vehicles, out-of-state vehicles, etc.). The age distribution of a population group provides an indication of how long vehicles remain in those groups, how they might transfer between groups and the ages at which they are retired.

As shown below in Figure XIII-1, very few heavy heavy-duty vehicles remain in the statewide fleet after 25 years; only 3.4 percent of the tractors, 2.2 percent of the single (non-tractors) and 0.23 percent of the CA IRP vehicles are expected to remain in the fleet with an age over 25 years. Staff used the capital cost model to reflect these differences in normal purchase practices to better understand the economic impacts on a wide range of businesses and industry groups.

Figure XIII-1: In-state Heavy-Heavy Duty Vehicle Age Distribution

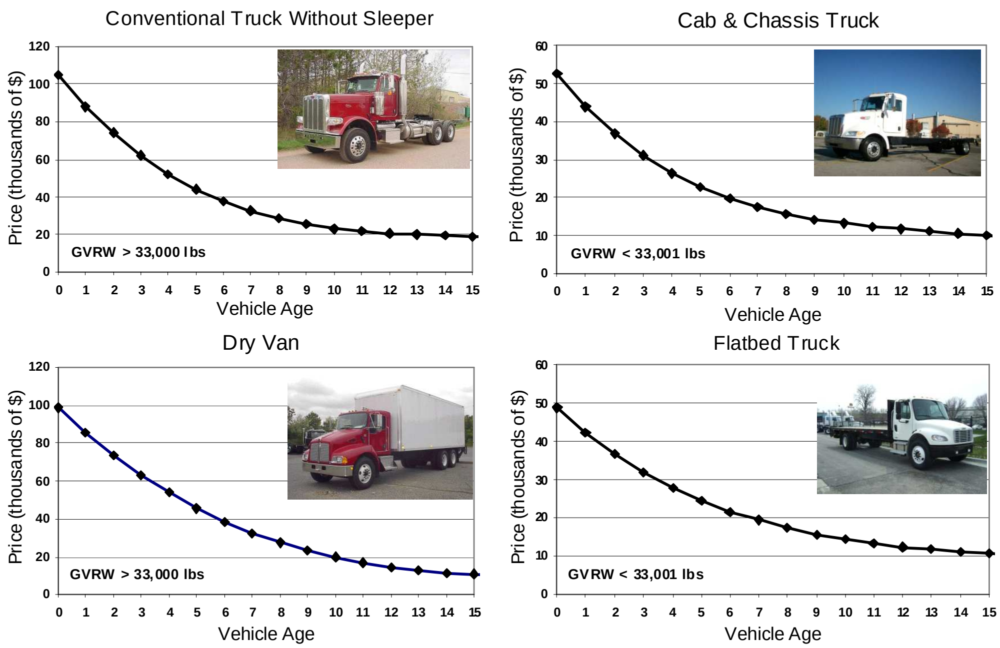


2. *Capital Cost Inputs*

a) Vehicle Prices and Replacement Costs

New and used vehicle prices were used as inputs to model company fleet operations for a range of vehicle types and ages. Staff developed price curves for over 50 vehicle body types by using for-sale vehicle price data downloaded from Truckpaper.com and other online sources. Some example price curves are shown in Figure XIII-2 below. Staff also confirmed this data with data from the National Automobile Dealers Association (NADA) that the “for sale” vehicle price information collected compared favorably for a conventional tractor. However, NADA data was not used in staff's analysis because the range of vehicle ages and body type configurations was limited, and staff believes the Truckpaper.com data is more appropriate. While heavy heavy-duty vehicles regularly cost more than most medium heavy-duty vehicles, prices for all vehicle types decline fairly quickly with vehicle age.

Figure XIII-2: Example Vehicle Prices (in thousands of dollars)



Staff also assessed whether a vehicle body type could be transferred to a new cab and chassis, and what the costs of the body transfer would be. If a body transfer is feasible and costs less than a replacement vehicle, the estimated transfer costs for the truck body was included, in addition to the cab and chassis price. If it was less costly to replace a vehicle instead of transferring the body to a new cab and chassis, the replacement vehicle cost was used. The vehicle price data and body transfer costs used in the cost model are provided in Appendix J.

b) PM Filter Capital Costs

Staff determined PM filter cost inputs for the cost model based on data received from internal and external sources, and is shown in Table XIII-1. Research included reviewing data developed for other ARB regulatory efforts, evaluating data collected through ARB's Carl Moyer program, and through discussions with local air districts, emission control installers and dealers, and various stakeholder groups (such as the non-profit organization Cascade Sierra Solutions). The cost model assumes passive filters would be used for post-1993 model year vehicles and that active filters would be used for pre-1994 model year vehicles.

Table XIII-1: PM Filter Costs

Type of Vehicle	Passive Filter	Active Filter
Medium Heavy-Duty	$11,000	$15,000
Heavy Heavy-Duty	$12,000	$15,000

Although no action would be required if a PM control device were not available for a particular vehicle, staff conservatively modeled cost assuming that PM filters would be available for all vehicles. Annual operating and maintenance costs associated with the use of exhaust after treatment devices were estimated, and are discussed later.

c) Other Capital Costs

Staff also estimated a loss in real value for vehicles covered by the proposed regulation. This estimate is dependent on a number of factors, such as the need for modifications to a vehicle and the need to transport a non-compliant vehicle out-of-state for resale. Staff estimates that, on average, this cost would not exceed $5,000 per vehicle for heavy heavy-duty vehicles, $2,000 for medium heavy-duty vehicles, and $1,000 for interstate vehicles. This estimate is conservative, as costs should be significantly lower for most tractors, as no vehicle modifications are required for most of these vehicles to be used outside of California.

In addition, new engines manufactured in 2010 will be considerably cleaner than their predecessors and are likely to cost more than those currently being produced. Staff estimates that engines manufactured after 2009 will typically have SCR, which may increase the price of new and used vehicles by up to $5,000 for heavy heavy-duty vehicles and $2,500 for medium heavy-duty vehicles. Though the majority of vehicle manufacturers will be using SCR emission control devices for engines manufactured in 2010, some manufacturers have indicated they do not plan to use SCR. Engine manufacturers that plan to include SCR in their 2010 engines have indicated an expected 3 to 9 percent fuel economy improvement which would offset any increased cost for their vehicles very quickly.

Annual operating and maintenance costs, including changes in fuel economy, urea supply, annual filter cleanings, reporting and other ongoing costs are estimated separately from the capital investment costs and are discussed later. Other costs that are included in the staff's analysis include California state sales taxes of 8 percent on used and new vehicle purchases, and federal excise taxes of 12 percent on new vehicle purchases.

3. Fleet Cost Model

The cost model uses Microsoft Access and Visual Basic to model normal vehicle replacement, compliance strategies and the resulting costs for fleets subject to the proposed regulation.

a) *Modeling Normal Vehicle Replacement*

To determine the baseline fleet costs without the regulation, the cost model calculates an average normal vehicle replacement rate for each company's fleet to reflect its normal business practice. The normal replacement rate is a function of the fleet age and the age of the replacement vehicle, and will vary for different fleets. For example, a fleet with an average age of 10 years that purchases new vehicles and keeps them for 20 years would have an average replacement rate of five percent per year. Whereas a fleet with the same average age that normally purchases 5 year old vehicles and keeps them for 10 years would have an average replacement rate of 10 percent per year. The replacement rate is calculated per Equation XIII-1 below.

Equation XIII-1: ***Replacement Rate = 1 / ((2*Fleet Average Age) - Vehicle Purchase Age)***

Staff used the fleet survey responses to determine the normal vehicle replacement ages for 688 fleets. An average replacement vehicle age was calculated for each average fleet age group, by fleet population group, as shown in Table XIII-2 below.

Table XIII-2: Average Vehicle Replacement Age by Average Fleet Age Group

Average Fleet Age Group (Years)	Average Vehicle Replacement Age (Year)			
	CA IRP	In-state Tractor HHD	In-state NonTractor HHD	In-state MHD
0 to 3	N/A	(0.92)	0.00	0.00
>3 to 6	1.05	(0.22)	1.00	0.01
>6 to 10	1.50	1.88	1.79	1.57
>10 to 13	2.93	3.33	2.00	1.39
>13 to 16	5.97	8.02	6.20	5.02
>16 to 20	N/A	8.19	9.71	8.21
>20	N/A	14.36	11.94	7.14

Because new model year vehicles can be purchased in the prior year, a new vehicle can have a purchase age of -1 (for example, a 2010 model year vehicle can be purchased in 2009). The CA IRP fleets tend to replace vehicles more quickly than the other in-state fleets, and in doing so will purchase newer vehicles with lower replacement ages. Fleets with an older average vehicle ages tend to purchase older used vehicles.

Data reported in the ARB fleet survey was used regarding the year each vehicle was purchased and the year each vehicle would have been replaced, as shown in Table XIII-3. The cost model assigns a replacement vehicle age based on the average age of the individual fleet.

Table XIII-3: Statewide Weighted Average Vehicle Replacement Age

Fleet Average Age	Replacement Vehicle Age
0 to 3	0
>3 to 6	0
>7 to 10	1
>11 to 13	2
>14 to 16	5
>17 to 20	8
>20	10

As the average age of a fleet increases, the average replacement vehicle age increases. For example, if an individual company fleet has an average age of 8 years, then the cost model would select a 1 year old vehicle as the normal replacement for the vehicles in that individual company's fleet. This, on average, represents the practice of buying some new vehicles and some used vehicles. For a company with an average vehicle age of 15 years, the replacement vehicle age would be five years old.

The data collected by staff indicates that certain vehicles are kept longer than others. To account for this, the model establishes the likelihood that a particular vehicle would be replaced based on the vehicle age characteristics and vehicle category reflected in the emissions inventory. For example, a fleet with interstate registered tractors and in-state heavy-duty vehicles is more likely to replace their interstate tractors more frequently because interstate vehicles generally travel more miles and are newer than other types of vehicles. This likelihood is identified as the vehicle's relative age. A vehicle's relative age takes into account the useful life of the fleet category and sequences that vehicle for replacement based on the amount of useful life it has left. For example, a CA IRP vehicle that accumulates high annual miles may have a short life of 7 years while an in-state tractor that travels moderate miles each year may have a longer life of 14 years. A vehicle that is 7 years old would have a higher relative age if it is in a CA IRP fleet that would replace vehicles at 7 years of age, than if it was in an in-state tractor fleet that would not be replaced until 14 years of age. For each calendar year, vehicles in an individual company's fleet are sequenced for replacement based on the vehicle's "relative age". The relative age is computed by taking the ratio of the age of the vehicle compared to the half-life for the vehicle category most representative from the statewide emissions inventory.

The cost model evaluates one company at a time and each year replaces vehicles at the normal historical rate of vehicle replacement as indicated from the fleet survey data. The cost model continues this process from 2009 to 2030. Then, as described below, the model evaluates the actions taken to comply with the proposed regulation, using the same normal replacement rate and replacement vehicle age.

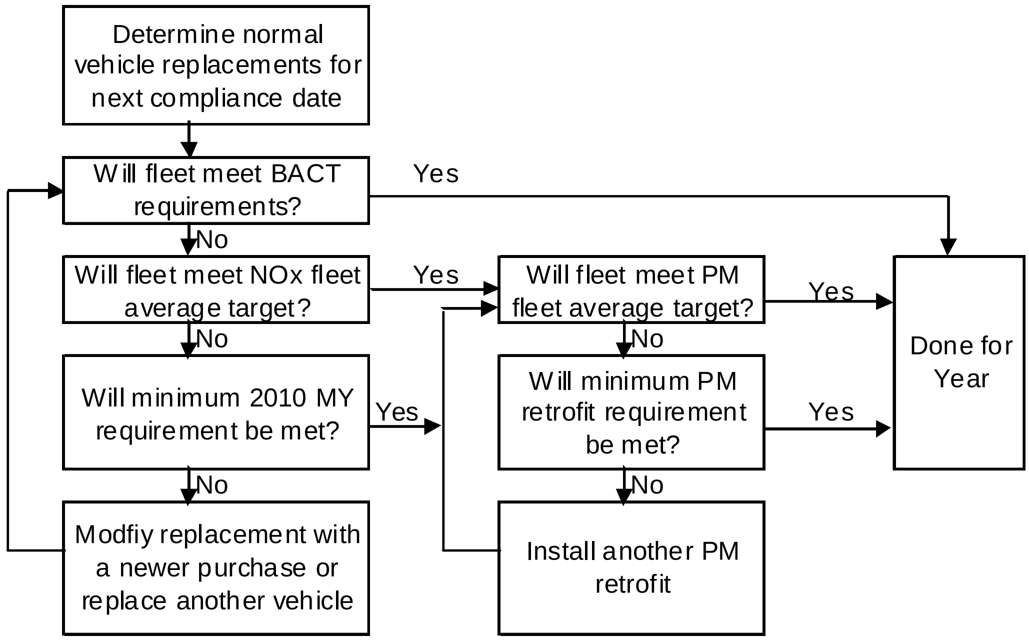
b) Modeling Compliance with the Proposed Regulation

As shown in Figure XIII-3, for each year, the cost model determines if the normal actions taken by the fleet would comply with the proposed regulation. If not, the cost model will first replace one vehicle at a time until the NOx criteria are met, and then will apply PM exhaust retrofits until the PM criteria are met. Staff programmed the model to replace the vehicle with the oldest relative age first, while vehicles with the newest relative age would be the first to receive verified DECS. This reflects the likelihood that fleet owners would install verified DECS on vehicles they intend to keep longer and would replace the vehicles that are closest to the end of their useful life.

The entire procedure is then repeated for each year from 2009 to 2030 for each fleet. Due to accelerated replacement from the requirements of the proposed regulation, an individual company fleet may be newer than normal and no actions may be needed for a number of years. After 2023, the model steps through each year using each company's normal fleet average replacement rate and average vehicle replacement age. The cost associated with the "regulation run" is compared with the "baseline run" cost to determine any increased cost due to the proposed regulation. This is needed to ensure that the baseline costs and costs with the regulation are compared for actions taken over the same period. This is also important in evaluating the vehicle age distribution and resulting impact on emissions in the years after the regulation period.

The replacement sequence is not optimized to reduce costs, and vehicles are not purchased older than normal to lower the estimated cost of compliance. In actuality, many fleets will be required to purchase newer than normal vehicles between 2012 and 2023 in order to meet the proposed regulatory requirements. Staff also modeled that fleets would purchase 2007 model year or newer vehicles through calendar year 2013 and then starting in 2014 would not buy vehicles older than one with a 2010 model year. This assumption only changed the vehicle purchase age if the fleet being modeled would normally buy older vehicles in the given year. This conservatively reflects that fleet owners would buy newer than normal when a vehicle needed to be replaced even before the regulation would require it. Also, most fleet owners indicated they would minimize the purchase of aftermarket verified DECS and would rather purchase vehicles with OEM equipped filters.

Figure XIII-3: Annual Compliance Flowchart



4. Model Results

The costs for each fleet are then determined by comparing the modeled costs for normal vehicle replacement with that required under the proposed regulation. The increased cost is then divided by the number of vehicles to determine the average increased cost per vehicle. This information is then input into the statewide analysis where the increased per vehicle costs for each individual company are grouped by fleet age and fleet size. These average increased costs reflect that companies with newer fleets will have little or no increased costs, while companies with older fleets will have more substantial increased costs due to the proposed regulation. As shown in Figure XIII-4, Figure XIII-5 and Figure XIII-6, the average increased cost per vehicle associated with the proposed regulation varies by the average age of the fleet.

Figure XIII-4: Average Increased Cost for In-state Heavy-Heavy Duty Vehicles in Fleets with 4 or more Vehicles (excluding special provisions)

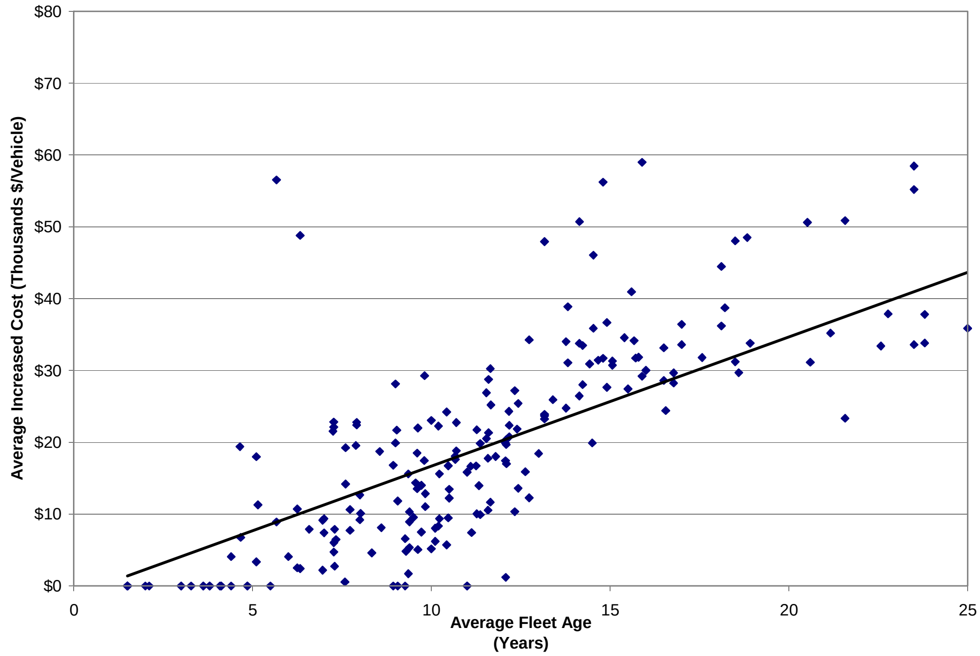


Figure XIII-5: Average Increased Cost for In-state Medium-Heavy Duty Vehicles in Fleets with 4 or more Vehicles (excluding special provisions)

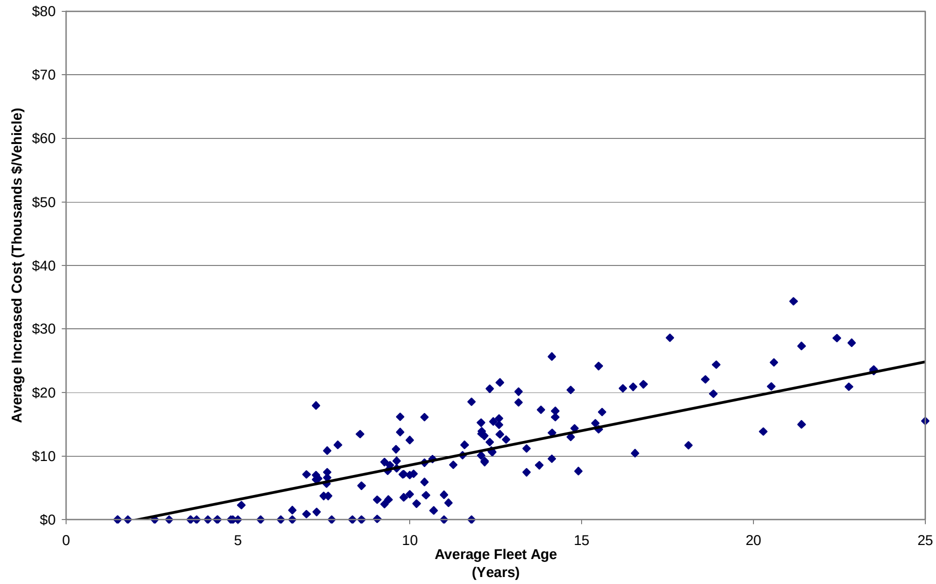
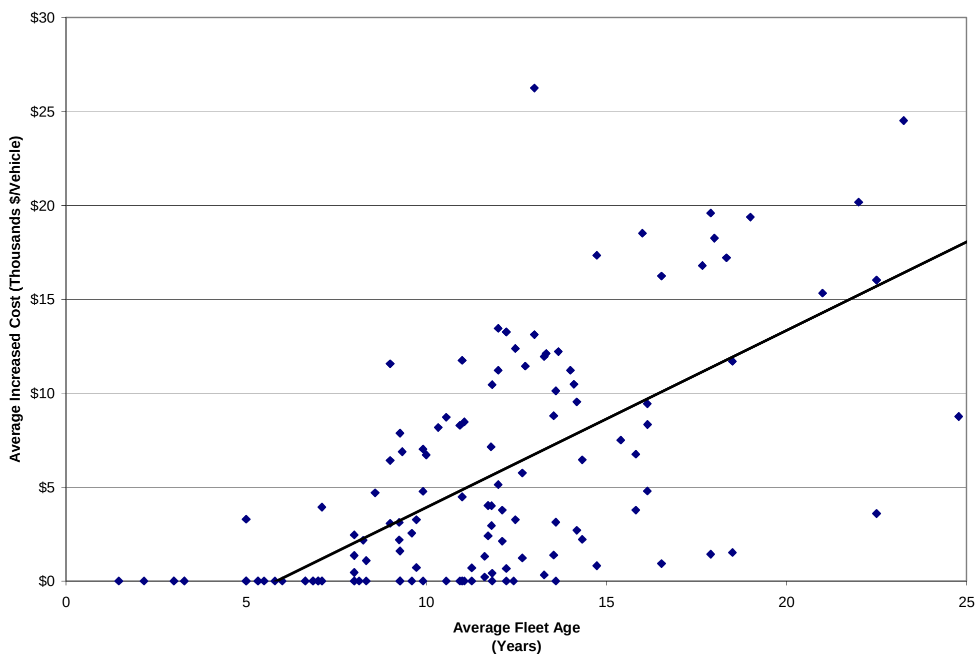


Figure XIII-6: Average Increased Cost for In-state Heavy-Heavy Duty Low Use NOx Exempt Vehicles (<7500 Miles)



5. Scaling to Statewide Results

The following table shows sample results from staff's modeling of heavy heavy-duty vehicles that would not qualify for any of the proposed special provisions of the regulation. Registration data from the DMV provides the weighting percentages (based on vehicle age) that are applied to the total statewide vehicle population to get the number of vehicles in each fleet age group. The DMV weighting percentages in the table below do not match the percentages in Table XIII-5, as the vehicle population for Table XIII-4 excludes small fleets (less than 4 vehicles).

Table XIII-4: In-state Heavy-Heavy Duty Vehicles by Fleet Age for Fleets with more than 3 vehicles (excluding fleets qualifying for special provisions)

Fleet Age	Number of Vehicles	Percentage of Vehicle Population	Average Increased Cost $/Vehicle (Per Model Output)	Statewide Cost (millions of dollar)
0 to 3	5,772	12.3%	$0	$ 0
>3 to 6	7,933	17.0%	$7,688	$61
>6 to 10	13,567	29.0%	$13,981	$190
>10 to 13	8,765	18.8%	$20,274	$178
>13 to 16	6,126	13.1%	$25,668	$157
>16 to 20	3,003	6.4%	$31,961	$96
>20	1,372	2.9%	$40,052	$55
Unknown	209	0.4%	$15,756	$3
TOTALS	46,750	100.0%		$740
Overall Average Increased $/Vehicle				$15,827

The statewide cost estimate for these vehicles can then be estimated by multiplying the number of these vehicles in the state by the increased cost per vehicle ($/vehicle in Table XIII-4) for each age group, and then summing the statewide cost (statewide cost in Table XIII-4) for each fleet age. In this example, the highest increased costs due to the regulation are found in "the over 20 years" (>20) fleet age category, with an average cost per vehicle of $40,052. The least cost impact due to the proposed regulation is found in the 0 to 3 fleet age category with no average increased costs. Medium heavy-duty vehicles and vehicles qualifying for the special provisions, including low use vehicles, would have separate population counts and lower costs.

The cost model output provides the average increased costs per vehicle by fleet age and fleet size for individual company fleets (see Appendix J for more information). For determining the statewide costs, staff matched vehicle types from real fleets who responded to the ARB survey to the emission inventory. Staff used DMV and IRP data to determine the distribution of medium duty vehicles, heavy duty vehicles, fleet size, and fleet age distributions. The vehicle population counts were derived from statewide emissions inventory database and include the following population categories:

- Intrastate
  - o Heavy Heavy-Duty Vehicles (HHD) – Tractors
  - o Heavy Heavy-Duty Vehicles – Non Tractors
  - o Medium Heavy-Duty (MHD) Vehicles
  - o Ag vehicles

- Interstate
  - o California International Registration Plan (CA IRP) Vehicles
  - o Out-of-state neighboring vehicles (AZ, BC, ID, NV, OR, WA)
  - o Out-of-state non-neighboring vehicles

In addition to the statewide vehicle population groups, there are some additional sub-group vehicle counts needed because the regulatory requirements differ, such as for:

- Low Mileage (<7500 for HHD & <5000 for MHD) Vehicles
- Small Fleets (1-3 Vehicles)
- Exempted Vehicles

The characteristics of the fleet and vehicle information were used to match each vehicle to the emissions inventory categories. For example, a company may have some vehicles that are registered in the CA IRP, and also some that are medium and heavy heavy-duty vehicles that are registered instate. Based on DMV instate and CA IRP data, weighting percentages were developed by fleet age and size group to apply to the statewide emissions inventory populations to get the vehicle counts by fleet age and size groups. The statewide cost can be calculated for each fleet age group by multiplying the increased average cost per vehicle by the population vehicle counts. The number of vehicles by average fleet age used in staff's analysis is shown in Table XIII-5.

Table XIII-5: Vehicles by Fleet Average Age

	Vehicle Counts by Fleet Average Age				
Fleet Age	In-state* pop. HHD	In-state* pop. MHD	CA IRP* pop. HHD	Neighboring* pop. HHD	Non-Neighboring IRP** pop. HHD
0 to 3	12,263	41,864	9,244	6,394	327,572
>3 to 6	18,693	42,183	19,368	13,396	31,636
>6 to 10	38,245	57,594	20,028	13,853	38,844
>10 to 13	27,054	26,049	4,182	2,892	2,002
>13 to 16	18,044	19,137	935	647	400
>16 to 20	13,455	13,593	660	457	-
>20	10,224	9,625	550	381	-
Unknown	763	447	55	38	-
Totals	138,741	210,492	55,022	38,057	400,455

Sources: *DMV 2006 age distribution
**IRP 2006 age distribution based on data from 12 states

In general, newer fleets that normally replace their vehicles in a short period would incur little to no increased costs to comply with the proposed regulation, while older fleets that buy older vehicles and keep them longer would incur higher increased costs to comply.

Finally, as shown in Table XIII-6 below, the estimated statewide capital costs for vehicle replacements is $2.3 billion for in-state vehicles and $700 million for out-of-state vehicles. Similarly, the estimated statewide capital costs for installation of verified DECS are $1.4 billion for in-state vehicles and $200 million for out-of-state vehicles. The total regulatory capital costs of the proposed regulation are $4.6 billion.

Table XIII-6: Summary of Average Increased Capital Costs

	Vehicle Replacements	Verified DECS	Totals
In-state	2.3	1.4	3.7
Out-of-state	0.7	0.2	0.9
Totals	3.0	1.6	4.6

Additional information on the anticipated number of retrofit needed for compliance with the proposed regulations is provided in the next section of this chapter.

6. Annual Costs

In addition to capital costs of the proposed regulation, various annual operational and maintenance costs will also be incurred. In determining the total regulatory costs of staff's proposal, these annual costs are added to the total statewide capital cost estimates. Operational and maintenance costs associated with verified DECS include annual filter cleaning expenses, fuel economy losses and costs associated with regeneration of active systems. Other costs or savings include fuel economy improvements with replacement of older vehicles with newer vehicles and urea costs for SCR. At this time, staff has not included anticipated cost savings associated with lower maintenance and less down time with newer vehicles compared to older vehicles.

The operating and maintenance costs associated with the use of verified DECS are determined using the anticipated population of vehicles equipped with aftermarket PM controls, as well as the population of 2007 and newer engines. The number of PM controls in each calendar year was estimated by extrapolating the results of the capital cost model to the affected vehicle population.

Operating and maintenance costs attributable to the proposed regulation were broken into four main categories: regeneration cost for active DPFs, changes in fuel economy, urea usage, and annual maintenance. Regeneration costs for active filters are incurred for electricity or fuel usage for a vehicle to regenerate the filters on a regular basis. Annual maintenance costs for vehicles with PM control devices are for the cleaning servicing of the filters by external parties. Engines manufactured after 2009 with SCR would also have annual costs associated with the use of urea. Also, there is likely to be a fuel economy improvement and associated cost savings through the use of 2004-2006 MY engines utilizing EGR.

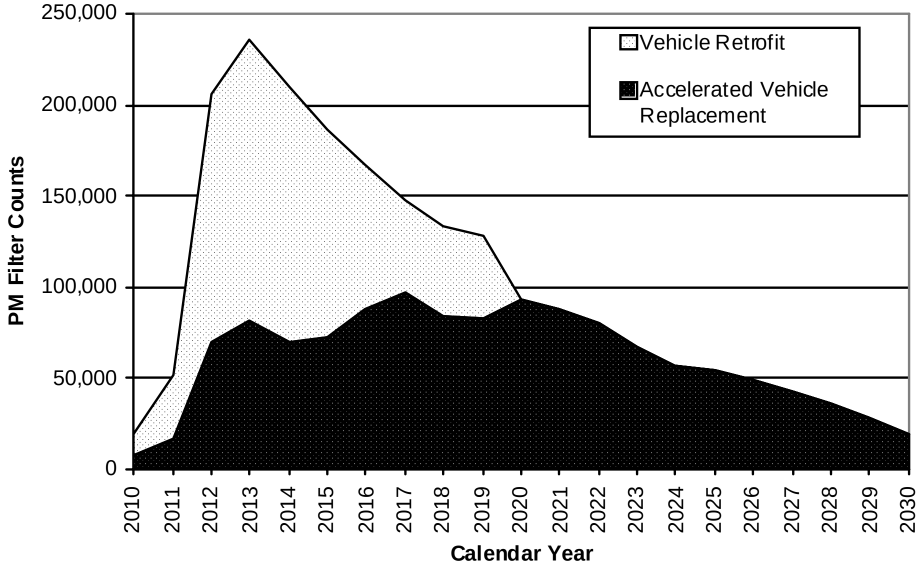
a) Annual DPF Costs

When calculating the statewide costs, additional costs due to DPFs were also incorporated. These include the costs associated with regeneration of active PM exhaust retrofits on pre-1994 vehicles, the expected number regenerations per week, and the cost of electricity or fuel used per regeneration. In addition, PM exhaust retrofits are expected to decrease fuel economy by 2 percent. The total statewide fuel costs associated with DPFs are estimated by the average fuel economy and annual miles traveled by vehicles with aftermarket PM controls. Finally, annual maintenance includes an estimated average filter cleaning cost of $400.

i. Estimated Number of Retrofits

The estimated incremental number of DPFs that will need to be installed because of the proposed regulation in the statewide fleet is shown in Figure XIII-7. The filter retrofits begin in 2010 and are completed by the end of 2013. Also displayed are the estimated number of increased vehicles with OEM installed DPFs as a result of the proposed regulation. It is expected that after 2021, the incremental number of vehicles having DPFs because of the accelerated vehicle replacement required with the proposed regulation will slowly decrease as these vehicles are replaced and the statewide fleet goes back to normal vehicle age distribution.

Figure XIII-7: Number of DPFs in Statewide Fleet Resulting from Proposed Regulation



ii. Regeneration Costs

Staff expects the majority of vehicles needing to be retrofit will use passive DPFs. However, because of temperature requirements with passive DPFs, active fuel-based systems, will also be needed. Staff believes that active fuel-based systems may be preferable for fleets so that they may avoid the need to plug in electrically regenerated DPFs because many vehicles (dump trucks, being a good example) may not have on the job access to electricity nor the extended time for a full electricity-based regeneration cycle, which can take as long as 8 hours. Electricity-based regeneration should remain commonplace in day-use applications where the vehicle returns to the same facility each night, such as shuttle bus and local delivery fleets.

Given the similarity in regeneration costs between the two technologies, staff estimated these costs by using fuel-based DPFs exclusively in the analysis. To estimate the number of active DPFs expected to be installed as a result of the proposed regulation, the retrofit population was scaled by the weighted in-state percentage of pre-1994 medium heavy-duty and heavy heavy-duty vehicles, which is 15 percent of the population. The staff estimates is based on two regenerations per week and 0.2 gallons of diesel fuel consumed per regeneration, and one half hour of employee time to plug-in or wait for the system to regenerate. A vast majority of the cost is attributed to the down time and the total cost is insensitive to fuel price. The total cost to the statewide fleet was estimated to be $181.7 million at a diesel fuel price of $3.69 per gallon. At $4.00 per gallon of diesel, the cost would increase to $182.3 million; and at $5.00 per gallon, this cost would further increase to $184.2 million.

iii. Maintenance Costs

Between 2010 through 2013, the proposed regulation would require the retrofit installation of DPFs on existing vehicles that do not already have them. After 2013, the incremental population of vehicles having retrofit filters will decrease because of the replacement of these vehicles with vehicles meeting the NOx and PM performance standards of the proposed regulation. The proposed regulation will also accelerate the replacement of vehicles to vehicles that have a DPF installed by OEM engine manufacturers. This will result in an increased number of vehicles in the statewide fleet with their DPFs relative to what would occur without the proposed regulation. The total estimated number of retrofits in the statewide fleet, by year, was previously shown Figure XIII-7.

Staff has estimated that each retrofit will result in maintenance costs of about $250 per year for pre-installed OEM Devices and about $400 per year for post-installed PM retrofits. Using their estimate, the total statewide costs due to retrofit maintenance was calculated using *Equation XIII-2*.

Equation XIII-2: Total Maintenance Costs = Σ (maintenance cost/year per vehicle x # of vehicles in the state retrofitted)

The total increased in maintenance costs for the statewide fleet from 2010 to 2030 is estimated at $430 million (in 2008 equivalent dollars), as shown in Table XIII-7 below.

Table XIII-7: Cumulative Increased Retrofit Maintenance Costs ($2008)

Per Filter Costs	Cumulative Costs (millions)
OEM equipped DPFs	$ 190
Aftermarket DPFs	$ 240
Total	$ 430

iv. Changes in Fuel Economy

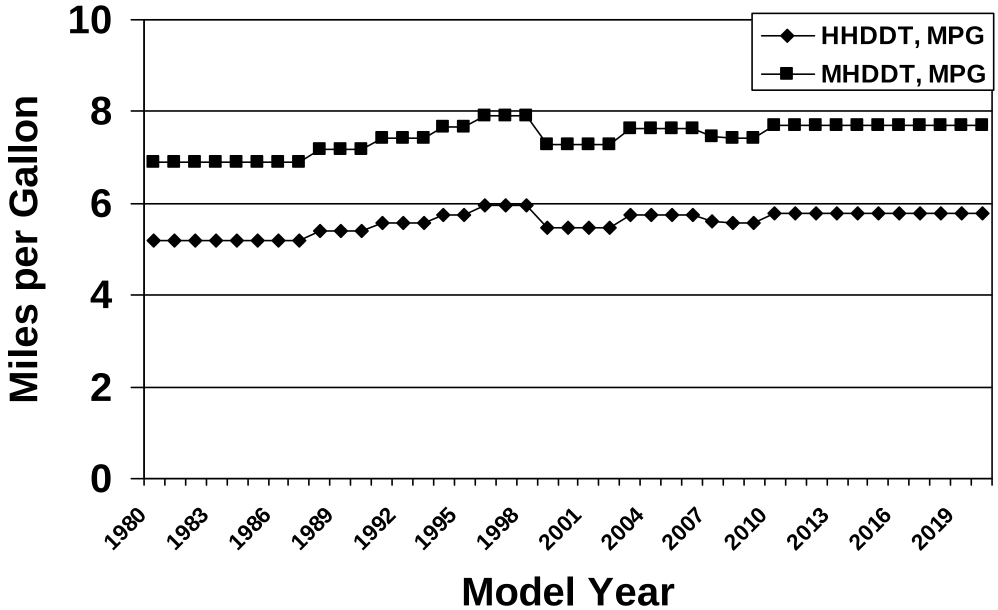
Statewide fleets with vehicles subject to the proposed regulation use over 3 billion gallons of diesel fuel per year (for their California miles traveled) at an average cost of approximately $4.00[21] per gallon (California Energy Commission, September 2008). The use of retrofit DPFs can result in a small loss of fuel efficiency (about 2 percent), resulting in increased fuel costs.

As part of the ARB fleet survey, fleets reported vehicle fuel usage and miles traveled. Data used in the development of the statewide emission inventory (including vehicle miles traveled) was then used to compute the costs associated with fuel economy penalty DPFs. Figure XIII-8 shows the estimated fuel economy of medium and heavy heavy-duty diesel vehicles without DPFs. The fuel usage for statewide vehicles was calculated both with and without the proposed regulation using the estimated fuel

[21] Price of California No 2 Diesel in September 2008 (http://energyalmanac.ca.gov/gasoline/).

economy shown in Figure XIII-8. Overall, replacing older vehicles with newer vehicles results in a net savings from increased fuel efficiencies. However, most of the fuel efficiency savings are offset by a two percent fuel penalty for vehicles with PM filter retrofits.

Figure XIII-8: Estimated Fuel Economy of Diesel Vehicles by Vehicle Model Year



The total statewide fuel economy penalty costs between 2010 and 2030 due from DPF retrofits is estimated to be approximately $113 million ($2008). The total statewide cost benefit in 2010 to 2030 due to decreased fuel consumption from the accelerated introduction of more fuel efficient vehicles is about $126 million (2008 dollars). Thus, there is a net reduction in costs of approximately $13 million at a fuel price of $4.00 per gallon. At a price of $3.69 per gallon, the net reduction in costs would be about $12 million and at a price of $5.00 per gallon the net reduction in costs would be about $17 million.

b) Selective Catalytic Reduction Costs

The proposed regulation will also accelerate the replacement of existing vehicles to newer vehicles that utilize SCR technology. The result is an increased number of vehicles in the statewide fleet that have SCR relative to what would occur without the proposed regulation. SCR technology utilizes urea to reduce NOx emissions, so an additional cost will be realized. It is expected that after 2023, the increased number of vehicles having SCR because of the accelerated vehicle replacement requirement will slowly decrease as the statewide fleet returns to normal vehicle replacement cycles. Projecting in 2008 equivalent dollars, and considering urea costs of $4.00 per gallon and that urea consumption in SCR is expected to be about 3 percent of the diesel fuel used, the estimated cost is approximately $240 million.

C. Reporting Cost

For small fleets, staff estimates that the initial reporting will cost between $0 and $100 (for up to 2 hours needed to compile fleet data). This assumes a cost of $50 per hour for either work time lost, or to hire a consultant. For larger fleets, the cost was estimated to vary between $200 and $400 (assuming an average of 4 to 8 hours to compile larger fleet data).

For estimating the total statewide costs, the number of fleets present in the state was estimated using 2006 DMV and CA IRP data with the number of registered vehicles grouped by fleet size bins. The number of fleets was calculated using *Equation XIII-3*.

Equation XIII-3: Fleets in State = Σ [Registered Vehicles / Fleet Size]

Using 2006 DMV data for in-state heavy heavy-duty, medium heavy-duty and CA IRP vehicle populations, staff estimates there are approximately 171,500 fleets in California subject to the proposed regulation. Approximately 156,000 of these fleets are small fleets (having three or fewer vehicles) and approximately 15,500 are larger fleets. To estimate the reporting costs, staff used *Equation XIII-4.*

Equation XIII-4: Fleet initial reporting costs = # of fleets x 75% x average initial reporting costs

In $2008 dollars, the anticipated statewide cost for fleets to comply with initial reporting requirements in 2010 is shown below in Table XIII-8.

Table XIII-8: Initial Reporting Costs (2010)

Fleet Type	Cost ($2008) (millions)
Small fleet	$11
Larger fleet	$ 5
Total cost for initial reporting	$16

Staff estimated the on-going annual reporting costs for small fleets to be approximately $50 per fleet per year, assuming an average of one hour is needed to update the fleet information in the ARB reporting system. For a larger fleet, this cost is estimated to be $200 per fleet per year, assuming that, on average, 4 hours is needed to update the fleet information in the ARB reporting system. The 4 hours for larger fleets is based on a weighted average using 1.5 hours for fleets with 4 to 5 vehicles, 2 hours for fleets with 6 to 10 vehicles, 4 hours for fleets with 11 to 20 vehicles and 20 hours for fleets with over 20 vehicles. The total annual cost for small fleet reporting will be 75 percent of the estimated number of fleets multiplied by $50, or $5 million per year. For larger fleets, the cost per year will be 75 percent of the number of fleets multiplied by $200, or $2 million per year.

The reporting costs over the life of the regulation were calculated using *Equation XIII-5*, assuming that for all fleets reporting ends in 2022.

Equation XIII-5: Total annual reporting cost = Σ (Annual reporting cost for every year of reporting)

The total annual reporting cost over the life of the regulation is shown in Table XIII-9.

Table XIII-9: Total Annual Reporting Costs

Fleet Type	Cost ($2008) (millions)
Small fleet	$42
Larger fleet	$19
Total cost for annual reporting	$61

The total reporting costs for the proposed regulation are the sum of initial and annual reporting costs (in 2008 dollars). This is shown below in Table XIII-10.

Table XIII-10: Total Reporting Costs

Fleet Type	Cost ($2008) (millions)
Small fleet	$53
Larger fleet	$24
Total cost for reporting	$77

D. Total Statewide Costs

The total increased cost due to the proposed regulation (in 2008 dollars) for fleets operating in California is estimated to be $5.5 billion, as shown in Table XIII-11. About $4.5 billion of the cost would be incurred by fleets with vehicles based in California and $1.0 billion would be incurred by out-of-state fleets. A detailed explanation of the methodology and input costs used to make the estimates are discussed in Appendix J.

Table XIII-11: Summary of Average Increased by Statewide Fleet Groups

Fleet/Population Type	Capital Cost (millions)	Annual Costs (millions)	Total Cost (millions)	# Vehicles
In-state MHD*	$1,194	$450	$1,643	219,392
In-state HHD	$1,559	$302	$1,861	147,074
Interstate CA IRP	$498	$118	$616	57,399
Interstate Neighboring/Non-Neighboring	$858	$81	$939	490,359
Motorcoach & School Buses	$348	$54	$402	26,443
Totals	$4,457	$1,005	$5,461	940,667

*Includes about 9,000 CA IRP and out-of-state vehicles.

E. Cost Effectiveness of the Proposed Regulation

Cost-effectiveness is expressed as control costs in dollars per unit of pollutant emissions reduced in pounds ($/lb). The cost-effectiveness for the proposed regulation is determined by dividing the total capital costs plus the annual costs by the total pounds of diesel PM and NOx reduced during the years 2010 to 2030. The expected cost effectiveness of this regulation is $1.76/lb for NOx and $46/lb for PM. All costs are in $2008.

In considering the cost effectiveness of the regulation relative to premature mortality avoided, a PM cost effectiveness of $46/lb of PM is about 5.5 times lower than the U.S. EPA's benchmark for value of avoided death (which equates to about $248/lb). Therefore, proposed regulation is a cost-effective mechanism to reduce premature deaths that would otherwise be caused by diesel PM emissions without this regulation relative to that benchmark.

Table XIII-12 below compares the estimated cost-effectiveness of the proposed regulation to the estimated cost-effectiveness of other recently adopted diesel regulations. For comparison purposes, all cost-effectiveness estimates shown in Table XIII-12 attribute part of the total regulation cost to PM reductions and part to NOx reductions. Regulations are ranked from lowest $/lb PM cost to highest.

Table XIII-12: Comparison of the Average Cost-Effectiveness of the Proposed Regulation to Average Cost Effectiveness of Recently Adopted Air Toxic Control Measures

Regulation	$2008 /lb NOx Cost-effectiveness	$2008 /lb PM Cost-effectiveness	Source of Estimate
Stationary Compression Ignition Engine ATCM	0.92/lb HC+NOx	$7.70/lb PM	(ARB, 2003b)
Portable Engine ATCM	<$2/lb NOx	$8-10/lb PM	(ARB, 2004)
Cargo Handling ATCM	$1/lb NOx	$21/lb diesel PM	(ARB, 2005a)
Solid Waste Collection Vehicle ATCM	1.79/lb HC+NOx	$32/lb PM	(ARB, 2003a)
In-Use Off-Road Diesel Vehicle Rule	$2.1 - 2.5/lb NOx	$37 - 43/lb PM	(ARB, 2007)
Proposed Regulation	$1.4 – 1.9/lb NOx	$42 – 48/lb PM	See Chapter XIII
Public Fleets Rule	$10.9/lb HC+NOx	$160/lb PM	(ARB, 2005b)

F. Cost Model Methodology for Industry Sectors

1. Overview

Staff used fleet vehicle data reported in the fleet survey to proportion the in-state vehicle population by weight class and fleet age group for a number of industry sectors. These included transportation, construction, agriculture, retail and wholesale, and other services. U.S. Census Bureau 2002 Vehicle Inventory and Use Survey (National 2002 VIUS) truck data was used to allocate the total number of in-state vehicles to each industry group by weight class, as discussed below. Proportions of vehicles by weight class and fleet age groups in the National 2002 VIUS truck data were reviewed for context; however the cost model relied on the proportions derived from the more current California fleet survey to be consistent with the method used for the statewide fleet groupings.

The increased costs per vehicle by weight class were based on prior analyses for statewide fleet groupings. The percentage of vehicles in each fleet age group was multiplied by the allocated number of in-state vehicles to get the estimated number of vehicles for each age group by industry sector. These counts by age group were then multiplied by the increased cost per vehicle and summed across all age groups to estimate the statewide capital costs for each industry sector.

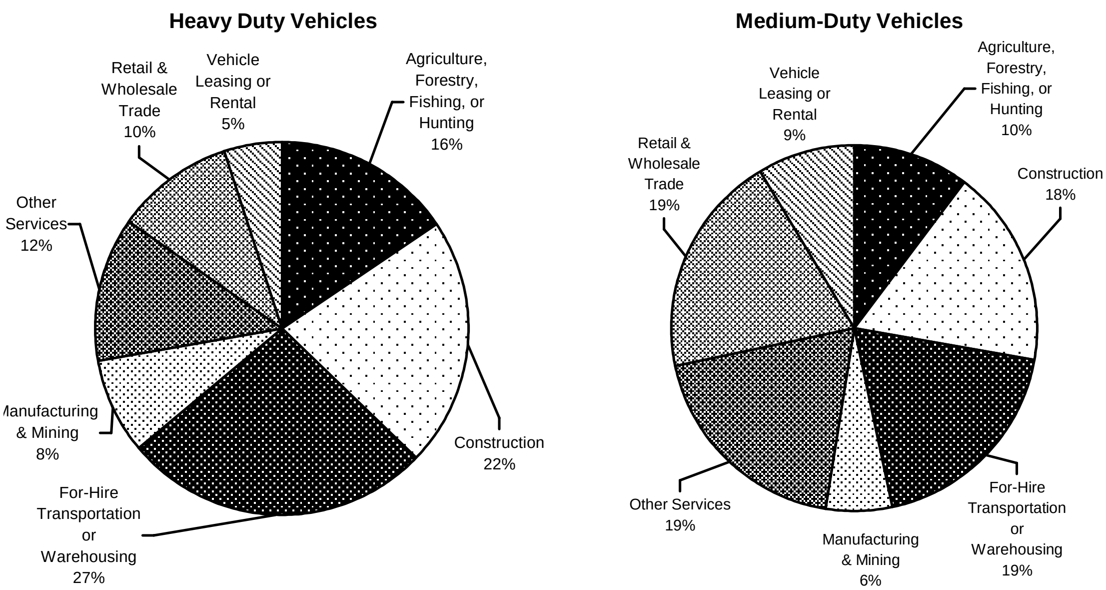
The costs for motor coach bus lines, school districts, and utilities were calculated separately using emissions inventory vehicle count data and modeling the specific rule provisions. ARB staff computed the increased capital costs over the period from 2010-2030 and also calculated the maximum year costs for each industry.

More detail on the analysis of the economic impacts on business sectors can be found in Appendix J.

2. *Vehicles by Business Type*

The impact of the proposed regulation on each business sector will depend on the number and types of vehicles that are impacted and the fleet ages for each business sector. Figure XIII-9 summarizes the National 2002 VIUS data by the percent of the vehicle population to business type for heavy heavy-duty and medium heavy-duty diesel vehicles.

Figure XIII-9: Percentage of Vehicle Population by Business Sector from National 2002 VIUS Data



The total in-state heavy heavy-duty and medium heavy-duty inventory vehicle population's were multiplied by the appropriate National 2002 VIUS vehicle percentages for each industry sector type to get the total number of vehicles allocated to each industry by weight class. The in-state annual operating and reporting costs were apportioned to each industry sector based on the annual miles travelled for each industry sector, as per the 2002 VIUS national data. The increased costs by sector are summarized below in Table XIII-13.

Table XIII-13: Increased Costs by Business Sector

Business Sector	Increased Capital Costs (in millions of $2008)	Annual Costs (in millions of $2008)	Total Increased Costs (in millions of $2008)
Accommodation or Food Services	$ 83.5	$ 14.7	$ 98.2
Agriculture, Forestry, Fishing, or Hunting	$ 197.7	$ 68.0	$ 265.7
Arts, Entertainment or Recreation Services	$ 14.0	$ 0.9	$ 14.9
Construction	$ 960.1	$ 100.4	$1,060.5
For-Hire Transportation or Warehousing	$1,359.0	$ 486.2	$1,845.2
Manufacturing	$ 124.9	$ 43.3	$ 168.2
Mining	$ 117.1	$ 20.1	$ 137.2
Other Services	$ 84.6	$ 48.5	$ 133.1
Retail & Wholesale Trade	$ 401.3	$ 105.5	$ 506.8
Utilities	$ 3.9	$ 10.2	$ 14.1
Vehicle Leasing or Rental	$ 207.9	$ 71.1	$ 279.0
TOTALS	$3,554.0	$ 968.9	$4,522.9

This industry sector cost analysis computes the increased capital costs for vehicles registered in-state and does not include costs to out-of-state operators. However, staff expects the majority of costs to out-of-state fleets to be borne by the transportation and warehousing sector.

G. Sensitivities in Estimating Statewide Costs

The total economic costs imposed by this regulation on the statewide fleet would depend on the compliance path chosen by each business and the compliance options available to them.

1. Retrofit

a) Retrofit SCR

Staff examined the possibility of requiring verified NOx DECS in addition to verified PM DECS, however high level verified NOx DECS are not yet commercially available and are expected to have substantial cost. As such, while the proposed regulation maintains flexibility to meet emission targets with verified NOx DECS should they become available, it does not require them.

To evaluate how the use of verified NOx DECS could impact staff's cost estimate, the cost model was run with 119 sample fleets containing 1,440 vehicles, to examine the difference of Level 3 DECS versus installing SCRs. The vehicles modeled use model year 1994 and newer, and SCR retrofit was estimated to cost $25,000 and provides a 70 percent NOx reduction. As summarized in Table XIII-14, the overall average cost was reduced by almost 17 percent across all of the sample fleets. The additional NOx emission reductions realized through the use of the SCR retrofit decreased the number of replacements needed. Fleets with newer vehicles would have no cost differences because they already would be replacing vehicles faster than the regulation would require and would not need to install SCR systems. Fleets with the oldest vehicles would not see any reduction in costs because they would likely travel fewer miles and would have several vehicles exempt from the NOx criteria or because staff modeled that older fleets would purchase older used vehicles and the SCR system may not cost less than replacing the vehicle and selling the retired vehicle.

Table XIII-14: Cost Sensitivity Analysis for Use of NOx Retrofits

Average Age of Sample Fleet	Change in Costs
Less than 8 years	No Change
8 to 18 years	Decreased
More than 18 years	No Change
All Fleets	17% Decrease

b) Increased PM Retrofit Costs

The cost model assigned passive exhaust retrofit costs of $11,000 for medium heavy-duty and $12,000 for heavy heavy-duty vehicles, and a cost of $15,000 for all active retrofits. Staff examined the impact an increased retrofit cost of $5,000 for all size vehicles would have by modeling 119 sample fleets with 1,440 vehicles. As summarized in Table XIII-15, the overall average increased cost was 20 percent across all of the sample fleets. Newer fleets would have no significant costs because they would have a higher proportion of vehicles with OEM equipped DPFs and would not need to install many aftermarket PM retrofits. In contrast, fleets with an older average age would have more vehicles without OEM equipped filters and would need to install a higher number of PM retrofits; therefore, the costs would increase for these fleets.

Table XIII-15: Cost Sensitivity Analysis for Increased Retrofit Costs

Fleet Average Age	Change in Costs
>9 Years	Increased
<10 Years	No Change
All Fleets	20% Increase

2. Optimization Strategies

Individual fleets will be able to assess the options that are available to them in meeting the proposed regulation and can examine strategies for optimized results. For example, mixed medium and heavy heavy-duty vehicle fleets could sequence their replacements such that the medium heavy-duty vehicles with lower costs would be replaced first and delay heavy heavy-duty vehicle replacements so they would occur closer to the normal replacement cycle. Fleets with older vehicles that would require installation of higher cost active filters might find the costs to purchase used vehicles with pre-installed filters to be less costly than to install the active filters. In addition, these used vehicles can remain in the fleet much longer than the older vehicles with the post-installed filters and the replacement costs for a model year 2010 vehicle could be delayed. Overall, staff believes that as fleets optimize their compliance activities, the overall estimated costs of the proposed regulation are likely conservative.

H. References

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XIV. ECONOMIC IMPACTS

As presented in the Chapter XIII, the total statewide costs of the proposed regulation are estimated to be about $5.5 billion. About $4.5 billion is attributable to in-state vehicles and about $1 billion is attributable to out-of-state vehicles. In this chapter, a discussion of the economic impacts of these costs on the economy of the state, and on affected business sectors, is discussed.

A. Background

1. Estimating Economic Impacts

Developing control cost estimates provides a means to estimate the direct expenditures that would be incurred by California businesses, governments, and individuals to meet the requirements in the proposed regulation. Depending on the significance of these costs, they could in turn bring about additional (indirect) changes in the California economy. Increased control costs for all on-road vehicles, for example, may result in higher prices to perform certain services. California firms may respond by cutting back production and decreasing employment. On other hand, the requirements in the proposed regulation may also increase demand for retrofitting, repowering, and new vehicles, thus inducing firms supplying those products and services to expand their production and increase their hiring of workers.

This change in economics could in turn affect other industries both negatively and positively. The net effect on the California economy of these activities hinges on the extent to which products and services are obtained locally. Using a new version of the E-DRAM model (a macroeconomic model of the California economy), staff estimated the net effects of these activities on affected industries and the overall economy. The California industries affected most are those engaged in the use of heavy-duty vehicles, such as the transportation and warehousing industry. Also affected are industries that are engaged in installing retrofits, maintaining vehicles, or selling them.

The economic model used for this analysis does not account for the significant health benefits to California businesses and citizens that this regulation would bring. Actions to improve air quality reduce illness and premature death, and increase natural resources and work force productivity thereby providing significant societal cost savings. This regulation is also likely to induce significant advancement of clean diesel engine technologies by California based companies. ARB staff estimates that the benefits to California of currently adopted air pollution control measures exceed their costs by about 10 to 1. That is, each dollar spent on clean air generates on average ten dollars in social benefits that improve the quality of life.

2. Environmental-Dynamic Revenue Analysis Model (E-DRAM)

The overall impact of all direct and indirect economic effects associated with the proposed regulation is estimated using a computable general equilibrium (CGE) model of the California economy. A CGE model simulates various economic relationships in a market economy where prices and production adjust in response to changes in behavior resulting from regulatory changes. More specifically, it describes the relationships among producers, consumers, government, and the rest of the world. The CGE model used for this analysis is the latest updated version of the E-DRAM. E-DRAM was first developed as DRAM for the California Department of Finance[22]. The model can be used to measure the total impact of a change caused by a regulation in one industry on all other industries within California. The economic impact results are measured in terms of changes in the State output, personal income, and employment.

The new model is based on a revised database called a social accounting matrix (SAM). The revisions to SAM include a calibration of the base year in the model to calendar year 2003 from fiscal year 1998-1999, an updating of energy data, and a more detailed sectoring of the California economy. The new E-DRAM divides the California economy into 174 distinct sectors, consisting of 108 industrial sectors, 2 factor sectors (labor and capital), 8 household sectors (classified by income level), 9 composite goods sectors, 1 investment sector, and 45 government sectors (7 federal, 27 State, and 11 local), and 1 sector that represents the rest of the world.

Data for the industrial sectors originated with the Bureau of Economic Analysis of the U.S. Department of Commerce, based on the Census of Business – a detailed survey of companies conducted in the U.S. every five years. The conversion of national data to updated California data is accomplished by Impact Analysis for Planning (IMPLAN), a program that primarily utilizes state-level employment data to scale national-level industrial data down to the size of a state.

In much the same way as firms, households are also aggregated. California households were divided into categories based upon their taxable income. There are seven such categories in the model, each one corresponding to a California personal income tax marginal tax rate (0, 1, 2, 4, 6, 8, and 9.3 percent). Thus, the income for the "one-percent" household is calculated by adding up the income from all households in the one-percent bracket.

Similarly, the expenditure of the one-percent household on agricultural goods is calculated by adding up all expenditure on agricultural goods for these households. The total expenditure on agricultural goods is found by adding the expenditure of all households together.

B. Economic Impacts on the California Economy

1. Direct Costs

The proposed regulation imposes capital costs on a number of industries; the most costly year of the regulation was used for this analysis ($566 million in 2013). Estimates of the maximum annual costs for each affected industry are provided in Table XIV-1. As shown in the table, the transportation and warehousing sector has the highest increased

[22] For a complete description of DRAM, see Berck, Peter, E. Golan and B. Smith, "Dynamic Revenue Analysis for California, California Department of Finance, Summer 1996.

capital cost in 2013 at 51 percent of the total. The construction industry has the second highest increased capital cost in 2013 at almost 21 percent of the total.

Table XIV-1: Estimates of Total Capital Costs of Proposed Regulation by Affected Industries in 2013 (Millions of 2008 Dollars)

Industry	Capital Costs	Percentage
Accommodation and Food Services	$15.1	2.7
Agriculture, Forestry, Fishing	$41.4	7.3
Arts, Entertainment or Recreation Services	$2.0	0.3
Construction	$117.1	20.7
Transportation and Warehousing	$288.5	51.0
Manufacturing	$18.9	3.3
Mining	$17.7	3.1
Other Services	$9.4	1.7
Wholesale and Retail Trade	$55.7	9.8
Total	$565.8	100

2. Overall Statewide Economic Impact

Increased capital costs of the proposed regulation would affect the California economy through many complex interactions. E-DRAM was developed to simulate many of these complex interactions. Using the model, staff in consultation with U.C. Berkeley researchers conducted an assessment of the economic impacts of the proposed regulation on the California economy.

Table XIV-2 summarizes the impact of the proposed regulation on the California economy in the year 2013, when the annual capital costs to the affected industries were the highest. Staff projects the capital costs of the proposed regulation would reduce California economic output by roughly $1.3 billion (0.04 percent) and California employment by approximately 4,600 to 13,600 jobs (less than 0.08 percent) in 2013. Personal income projections would also decline by roughly $500 to $600 million (-0.02 percent) in 2013.

Table XIV-2: Impact on the California Economy of Proposed Regulation in the Year 2013 (Billions of 2006 Dollars)

California Economy	Without Regulation	With Regulation	Difference (Impact)	Difference (Percent)
Output	3,104	3,103	-1.3	-0.04
Personal Income	1,800	1,799	-0.6	-0.02 to 0.02
Employment (thousands)	17,630	17,620 to 17,630	0 to 10	-0.03 to -0.08

3. Conclusion

Total annual fleet capital costs associated with the proposed regulation are estimated to be approximately $566 million in 2013. Accounting for indirect costs, the proposed regulation is expected to reduce California economic output by about $1.3 billion, personal income by about $0.5 to $0.6 billion, and employment by as many as 13,600 from their projected levels in 2013. In the context of the State's economy ($3.1 trillions), the economic impact of the proposed regulation is minor and is not expected to impose a noticeable impact. Additional details on staff's analysis can be found in Appendix J.

C. Economic Impact on Individual Business Sectors

Although there are considerable differences in types of vehicles and how they are used among various industry sectors, there are some commonalities. Heavy-duty engines are designed to operate up to 1,000,000 miles. In general, few companies will operate vehicles significantly beyond this point because the cost of repairs will often exceed the value of keeping the vehicle, and in most operations reduced vehicle reliability presents additional business risks and costs. As a vehicle ages it is more likely to be placed in local service or in an application where high reliability is less critical. As the vehicle nears the end of its useful life, it is often placed in a back-up service or in low use application.

In this section, staff provides information on the economic impacts of a number of business sectors impacted by the proposed regulation. These include the:

- Transportation sector, including various subsectors;
- Agricultural sector;
- Construction sector;
- Manufacturing sector;
- Retail and wholesale trade sector;
- Schools, and;
- Federal fleets.

Within the discussion of each business sector, staff provides an overview, including a description of the typical make-up of fleets and their vehicle replacement practices. Staff also provides an assessment of the economic impact of the proposed regulation on the sector, the cumulative costs of the proposed regulation and other ARB regulations, and the ability of fleets to pass through their compliance costs. As part of staff's analysis a number of industry case studies were performed. A number of these are provided in this chapter, and the remainder are in Appendix J.

1. Transportation Sector

The Transportation and Warehousing sector includes air, pipeline, rail, water, truck, transit and ground passenger transportation. Truck transportation is the largest subgroup in this sector, including busses and motor coaches used in local transportation and tourism. The gross domestic product for this sector from the 2006 California Statistical Abstract for 2004 was $35 billion. Within the sector, truck transportation, passenger transportation and other support activities represent about $24 billion of the total.

For comparative purpose, staff also evaluated California specific transportation sector data from FleetSeek. FleetSeek is part of Fleet Owner Magazine, and provides data on the trucking industry for fleet operators. This data contained information for 21,487 individual companies with a total of 259,000 vehicles in various sections and allocates number of vehicles and revenues by Standard Industrial Classification (SIC) code for hire carriers, private carriers and other companies with trucks. The data also identifies characteristics about the vehicle weight class and vehicle configuration important for understanding the cost impacts of the proposed regulation. For the trucking sector FleetSeek reports about $19 billion in gross revenue for 2006. However, because it is not a complete data set for all companies in California, the total figures should be considered a lower bound estimate. As such, staff believes the data from the 2006 California statistical abstract for 2004 provides a more appropriate measure of the economic output of this sector.

a) Industry characteristics of the Transportation Industry

(1) Trucking Companies

Trucking companies primarily utilizing heavy-duty, truck-tractor trailer combinations, that travel relatively high miles compared to other sectors, generally have newer vehicles. Within trucking there are a number of categories that characterize different vehicle usage patterns and business models. Interstate vehicles tend to travel the highest annual miles, and in-state truck-tractors tend to be purchased used and travel fewer miles.

Many trucking companies specialize in certain freight types and compete with other companies having similar equipment. For example, companies may specialize in refrigerated freight, bulk materials, liquids, hazardous waste, dry goods or other items. Most of these transportation businesses will have several tractor-trailer combinations with similar design or function, maximizing their flexibility in moving various goods locally, throughout the state, and across the country.

Few trucking companies will operate Class 8 trucks significantly beyond 1,000,000 miles. Long haul trucks that operate 100,000 to 200,000 miles per year are commonly purchased new and sold within 3 to 7 years. This maximizes the fleet reliability while the resale value of the vehicle remains relatively high. In the secondary market, these used vehicles are often purchased by fleets that may operate their vehicles regionally or locally and do fewer annual miles. After another 5 to 10 years the vehicle is often sold to a fleet that operates the vehicle for the remainder of its useful life. Fleets that operate their vehicles fewer miles per year generally do not need high reliability, and because they are operated fewer miles, any repair costs are more spread out over time.

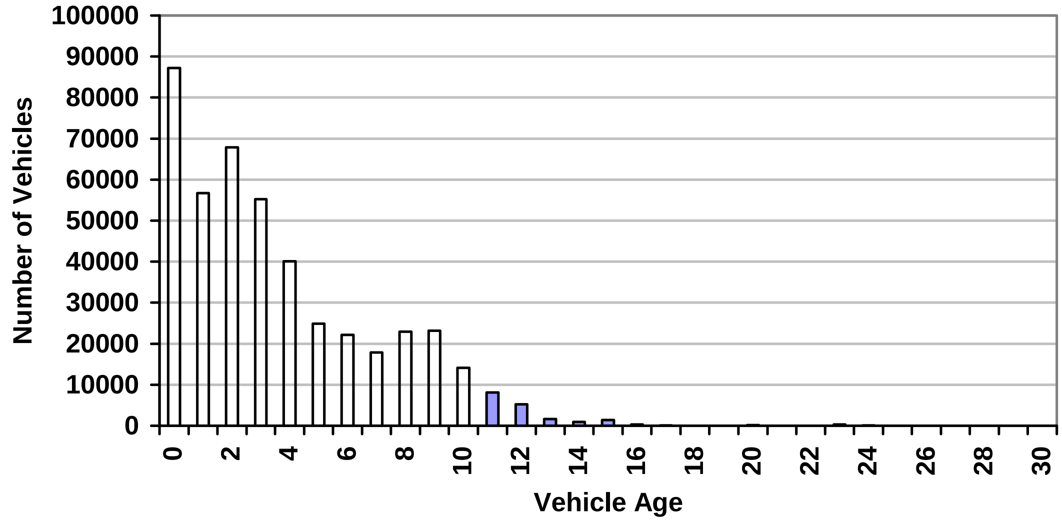
(2) Motorcoach and Bus Industry

There are generally three types of motorcoach services: point to point service, fixed route and fixed schedule service, and intercity or special event service. Shuttle buses are typically used in point to point service, such as transporting passengers to, from, or between airports or other points of destination. Shuttle buses are typically light- to medium heavy-duty buses and can be powered by gasoline or diesel. Motorcoaches are heavy heavy-duty buses designed for long distance travel. They are frequently used as charter buses for intercity travel or special event services and do not operate on fixed routes or schedules. As these vehicles age, their use tends to change such that they are used for shorter trips.

b) Out-of-state Trucks and Buses

Staff estimates there are about 490,000 different vehicles operating in California over the course of a year. Fleets that come in from out-of-state will vary in age, but have the newest vehicles of any other category of vehicles. Most vehicles coming in from outside California travel well over 100,000 miles per year. Most of these vehicles would reach 1,000,000 miles in seven to ten years. Those from neighboring states will also travel relatively high miles, but are not as new. Staff did not include the costs attributable to out-of-state vehicles in the E-DRAM model analysis because the model does not address the impacts of costs occurring outside California.

Figure XIV-1: Vehicles from Non-Neighboring States



As Figure XIV-1 shows, the vehicles registered in non-neighboring states have mostly newer vehicles. About 80 percent are less than 7 years old and would normally have 2007 and newer engines by January 1, 2014, thus meeting the proposed PM and BACT requirements until 2021. The remaining 20 percent would need to have a verified DECS installed or would potentially be replaced earlier than normal. Small fleets from non-neighboring states are estimated to represent only about 2 percent of the non-neighboring truck population but typically have the same age distribution as larger fleets because of the high number of miles travelled. By 2021, more than 94 percent of these vehicles would normally have 2010 emissions engines or newer. Consequently, the cost impact of the proposed regulation would be the lowest compared to vehicles in other truck categories.

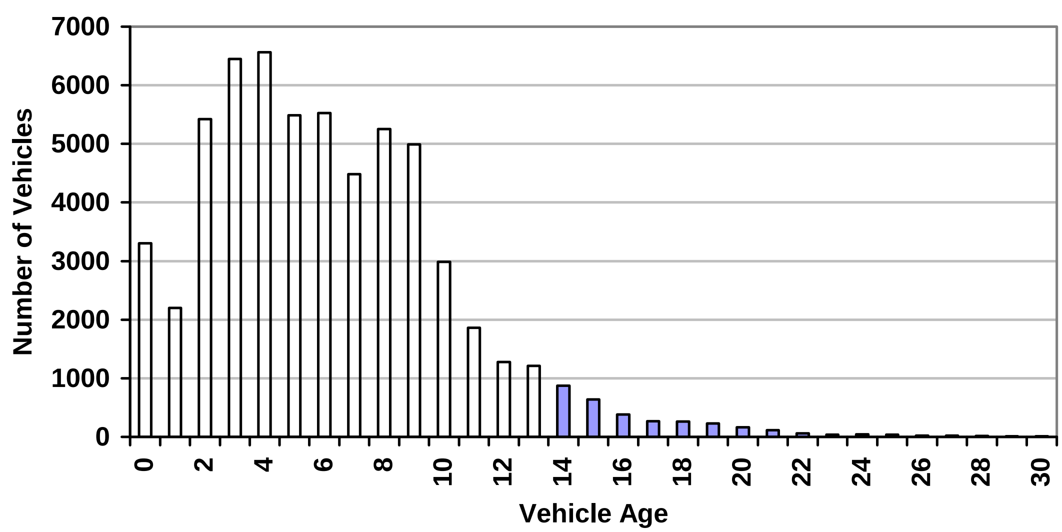
Staff analyzed IRP registration data from various non-neighboring states in the midwest and eastern United States. Staff's analysis of fleets that reported traveling in California showed that about half of the vehicles were in fleets that operated less than 1,000 miles per truck in California. Under the proposed regulation, those that operate less than 1,000 miles per year in California would be exempt from any of the proposed performance requirements and would subsequently have no costs. For the remaining, vehicles staff estimated that the total increased cost for non-neighboring vehicles would be about $471 million. Staff believes this estimate is conservative because larger out-of-state fleets have the ability to direct their cleaner vehicles (about 83 percent of the vehicles) to California, resulting in no increased cost of operation.

There are an estimated 40,000 trucks operating in California from neighboring states (Arizona, Nevada, Idaho and Oregon. Trucks from neighboring states have nearly identical vehicle age distributions to California registered interstate trucks. About 58 percent of the vehicles are less than 7 years old. Staff estimates that, through normal attrition, these vehicles would typically have 2007 and newer engines by January 1, 2014, thus meeting the proposed PM and BACT requirements until 2021. However, to meet the proposed NOx and PM performance standards, the remaining 42 percent would need to have a verified DECS installed and/or would potentially be replaced earlier than normal. But by 2021, staff estimates that more than 90 percent of these truck tractors would normally have 2010 emissions engines or newer. Again, in many cases like non-neighboring state operators, neighboring out-of-state fleets can direct their cleaner vehicles to California to minimize their costs.

c) California Based Interstate Trucks and Buses

As Figure XIV-2 shows, the California tractors that are registered in the IRP tend to be relatively new. About 58 percent of the vehicles are less than 7 years old. Staff estimates that, through normal attrition, these vehicles would typically have 2007 and newer engines by January 1, 2014, thus meeting the proposed PM and BACT requirements until 2021. However, to meet the proposed NOx and PM performance standards, the remaining 42 percent would need to have a verified DECS installed and/or would potentially be replaced earlier than normal. By 2021, staff estimates that more than 90 percent of these truck-tractors would normally have 2010 emissions engines or newer. Consequently, the average cost per truck in this timeframe would be lower compared to other truck categories.

Figure XIV-2: California IRP

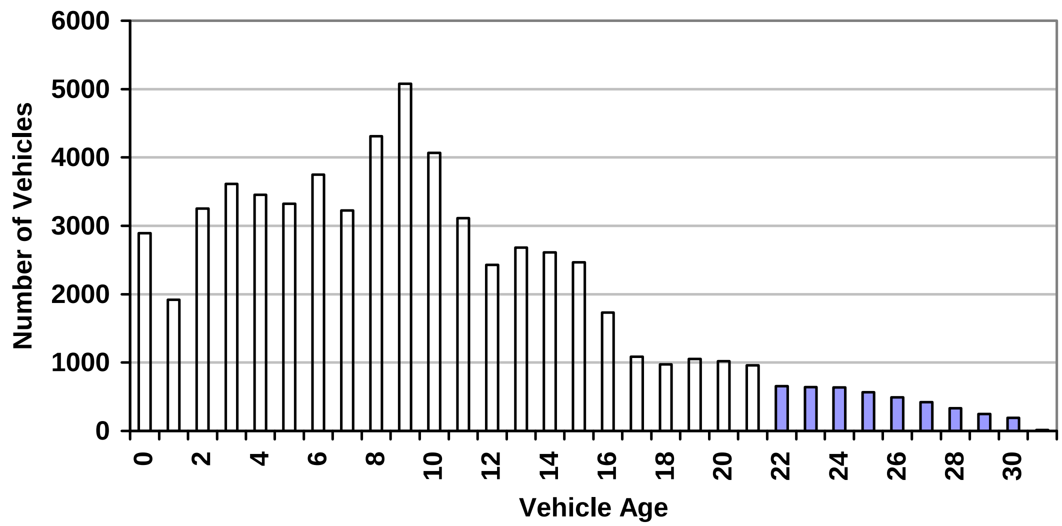


d) In-state Registered Tractors

In-state registered tractors operate regionally or locally. There is significant variety in the type of vehicles used, including smaller beverage delivery tractors, two axle tractors pulling double trailers, or larger three axle tractors. Newer tractors registered to operate in-state average about 75,000 miles per year, while 20 year old tractors average about 30,000 miles per year. Because in-state tractors operate fewer miles than interstate registered tractors, it takes longer for them to reach 1,000,000 miles (the estimated end of their useful lives).

As Figure XIV-3 shows, in-state registered tractors have a broad age distribution. About 35 percent of the vehicles are less than 7 years old. Staff estimates that, through normal attrition, these vehicles would typically have 2007 and newer engines by January 1, 2014, thus, meeting the proposed PM and BACT requirements until 2021. However, to meet the proposed NOx and PM performance standards, the remaining 65 percent would need to have a verified DECS installed and/or would need be replaced earlier than normal. But by 2021, staff estimates that more than 60 percent of these truck-tractors would normally have 2010 emissions engines or newer.

Figure XIV-3: California In-state Registered Tractors



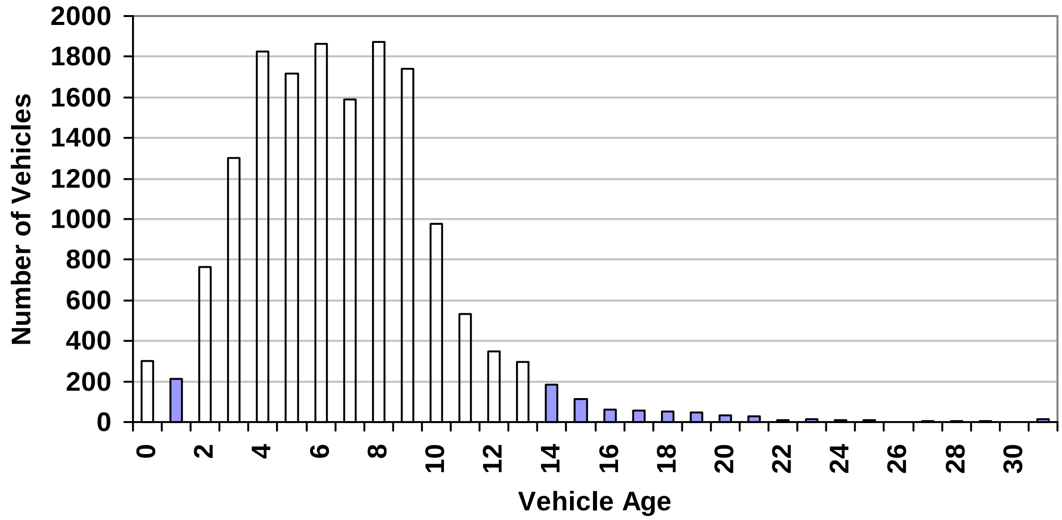
e) Small Fleets

Based on 2006 DMV data, fleets with three or fewer vehicles represent almost 90 percent of the fleets and approximately 48 percent of the trucks registered in California. Of these same vehicles, single owner operator fleets represent almost 75 percent of the fleets and approximately 32 percent of all trucks registered in California. However, it is unclear from the DMV data what proportion of the small fleets are in the transportation sector or in other sectors. FleetSeek data identifies owner operators as having about 14 percent of the revenues and number of trucks within the trucking sector.

While smaller in-state fleets, in general, tend to have older vehicles compared to larger fleets, overall they have similar age characteristics depending on annual miles travelled. Similar to larger interstate fleets, California IRP registered owner operators travelling higher annual miles have newer vehicles than large fleets operating in state.

As shown in Figure XIV-4, California IRP registered trucks operated by owner operators tend to be fairly new. About 50 percent are less than 7 years old and would normally have 2007 and newer engines by January 1, 2014. These vehicles would already meet the proposed PM and NOx BACT requirements until 2021. By 2021, about 90 percent would have 2010 emissions engines or newer. The age distribution for these fleets suggests that it is fairly common to purchase 2 to 4 year old vehicles and to operate them until they are about 10 years old.

Figure XIV-4: California Interstate Registered Owner Operators

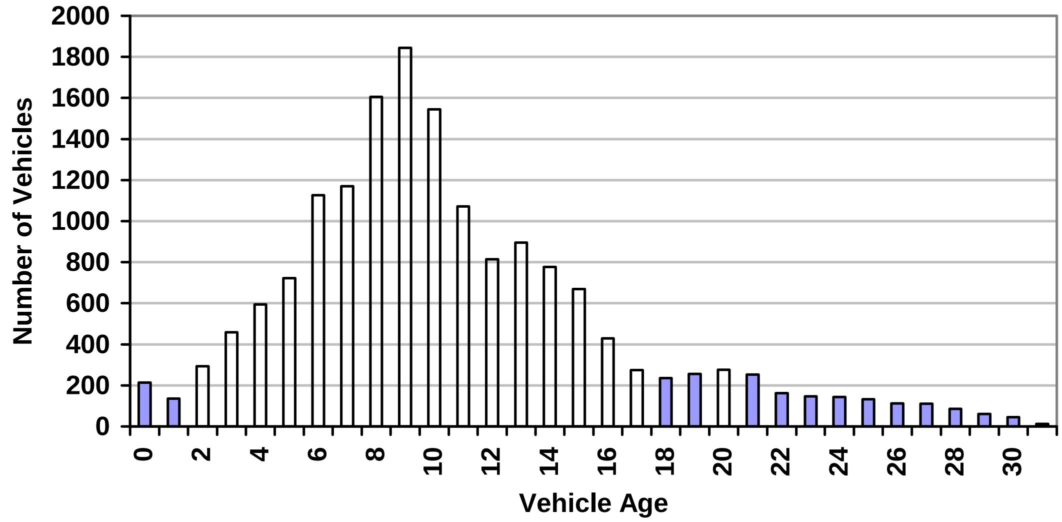


Similar information from the Owner-Operator Independent Drivers Association (OOIDA), which primarily represents owner operators and small long-haul trucking companies that travel across the country, support these findings. Results of the 2008 Land Line Reader Survey, published by OOIDA, show that more than one third of the respondents bought their truck new, 65 percent have not owned their truck longer than 6 years and over 80 percent have not owned their trucks more than 10 years. These results appear consistent with the characteristics of the California registered interstate operators. In terms of the revenue generated by interstate owner-operators, national surveys of interstate independent owner operators who primarily operate in long-haul trucking indicate that most independent owner operators generally gross more than $1.50 per mile. This is consistent with the reported per mile revenue generated by larger fleets. The results are show in the Land Line Reader Survey response shown in Table XIV-3.

Table XIV-3: 2008 Land Line Reader Survey Results on Gross Income per Mile

Gross Income per Mile	% of Respondents
Less than $0.90	5.8
$0.91 to $0.99	7.0
$1.00 to $1.24	19.6
$1.25 to $1.49	29.0
More than $1.50	33.3
Blank	5.2

Figure XIV-5: In-state Registered Owner Operator Tractors (Excluding Low Mileage Vehicles)



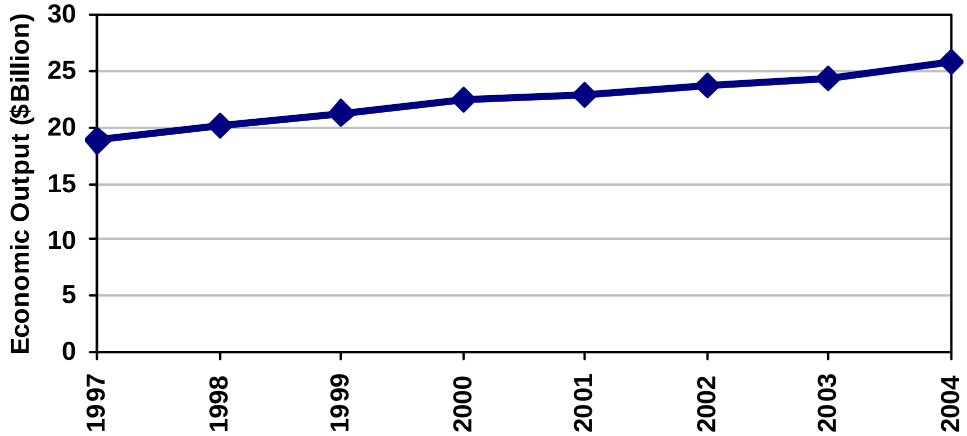
While interstate owner-operators tend to have newer vehicles in-state registered tractors owned by owner operators are older, with a median age of about 10 years. The age distribution for these fleets is shown in Figure XIV-5 and suggests that it is fairly common to purchase 5 to 8 year old vehicles and to operate them until they are about 16 years old. About 28 percent of the vehicles would normally have 2004 to 2006 model year engines by January 1, 2013, and would be required to install a verified DECS under the proposed regulation. An additional 21 percent would be expected to have 2007 or newer engines that would already meet the PM and BACT requirements until 2021. The remaining 51 percent would need to replace their engines or vehicles with one having a 2004-2006 engine and install the highest level verified DECS, or to replace it with one having an engine meeting the 2007 engine emissions or newer. By 2021, staff estimates that about 65 percent of the vehicles would normally have 2010 emissions engines or newer.

f) Economic Impact on Transportation Sector

As was shown in Table XIII-13, the Transportation industry has the highest proportion of costs of all the impacted business sectors representing over 50 percent of the estimated regulatory costs. Staff estimates the transportation industry would have increased regulatory costs of approximately $1.8 billion.

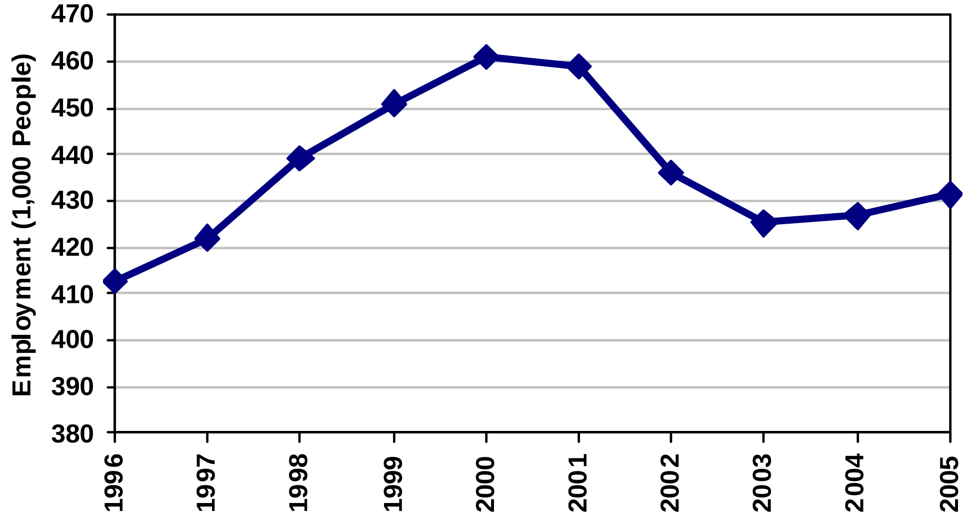
In evaluating the impacts of these costs, the results of the E-DRAM analysis indicated the economic output for the transportation and warehousing sector would be reduced by about 0.2 to 0.4 percent in 2013, the highest capital cost year. To put this cost in context, the historic California gross domestic product for truck transportation, passenger transportation and other support activities is shown in Figure XIV-6. Relative to the economic output of this sector, the increased regulatory costs of the proposed regulation represents less than 0.1 percent of the cumulative projected gross domestic product over the years 2010-2025.

Figure XIV-6: California Gross Domestic Product: Truck Transportation



As shown in Figure XIV-7, California employment in transportation and warehousing grew significantly over the last decade, from about 380,000 jobs in 1994 to over 430,000 jobs in 2005. More detailed data on jobs within segments of the transportation and warehousing sector are not available. The E-DRAM analysis indicates that the proposed regulation could reduce California employment in this sector by as many as 12,000 jobs, or -2.5 percent in 2013, the highest capital cost year. This represents the majority of the potential job impacts from the proposed regulation. However, employment trends in this industry sector have continued to increase, and staff believe such growth can be expected to continue as population in the state continues to grow. Therefore, the projected impact on employment would result in slower growth, and would not necessarily result in a loss in jobs.

Figure XIV-7: California Employment: Transportation and Warehousing



g) Cumulative Costs and Ability to Pass on Costs

To evaluate potential cumulative costs, as part of the ARB Heavy Duty Vehicle survey, staff requested information about off-road diesel vehicles, portable engines, and information about the truck and trailer. The truck and trailer information allowed staff to determine whether a fleet owner would have equipment that may be subject to an existing regulation.

Out of a total of 682 transportation companies that responded to the ARB Survey, there were 105 transportation companies that indicated they were subject to the In-Use Off-Road Vehicle Regulation, the Portable Equipment Regulation or PERP. These companies reported the ranges of equipment horsepower that would be subject to the other rules as shown in Table XIV-4.

Of the 105 fleets shown in Table XIV-4 that are subject to multiple regulations, almost all of them had less than 2,500 horsepower (hp) of off-road equipment. Under the off-road regulation, such fleets are considered small fleets, meaning they are not subject to the replacement requirements, and do not need to meet the PM retrofit requirements until 2015. Also, few fleets overall reported having equipment subject to the Portable Equipment Regulation. For those that are subject to that regulation, they would have to replace their unregulated Tier 0 portable engines by January 1, 2010, which is before most fleets subject to the proposed regulation would have to take significant action. Since the regulatory compliance timelines do not overlap between these two regulations and the proposed regulation, and since few fleets are impacted by these multiple regulations, staff does not believe that, overall, many fleets in the transportation sector will have to address the issue of cumulative costs with these regulations.

Table XIV-4: Percentage of Transportation Fleets Reporting Equipment HP Subject to Other Rules

Off-Road Engine Horsepower	Off-Road Vehicles	Portable Engines
<2,500 hp	12%	8%
2,500 to <5,000 hp	0%	0%
>=5,000 hp	1%	0%

The trucking sector is a competitive industry local, regional and interstate markets. Within these markets, trucking companies tend to specialize with certain equipment and product transportation for a variety of reasons. These include filling niche demands, improved efficiency, customer satisfaction, reliability and expertise required to transport various products. In many cases, larger companies depend on owner operators to support seasonal needs, variations in work load and a variety of other reasons. However, the requirements to install verified DECS or to operate newer trucks will have an impact on companies who travel fewer miles and keep their trucks longer. Staff believes that, in general, companies will be able to pass through their costs, as the incremental increase in revenue per mile is small relative to existing gross revenue levels. This is shown below in several actual fleet case studies. Additional case studies for other fleets are provided in Appendix J.

In addition, to the extent fleets subject to the proposed regulation would qualify for incentive funding (as discussed in Chapter XV), the anticipated compliance costs would be even lower, further reducing the need to pass on costs.

(i) ***Refrigerated Transport Case Study***

As a case study, staff analyzed the economic impact of the proposed regulations and the existing transportation refrigeration unit regulation for a refrigerated transport company that owns 228 tractors and 270 refrigerated trailers used in long haul operations. The average tractor age was 7 years and the average trailer age was about 6 years old. This particular company normally purchases refrigerated trailers new and maintains a mix of new to three year old trucks.

For this company, staff estimates the increased costs to comply with the proposed regulation would be about $1.5 million in 2008 equivalent dollars over the calendar years of 2010-2025. This compares to about $16.8 million that would normally be spent for capital upgrades of trucks over this time period. Annual revenues for this company are approximately $47.8 million, which are cumulatively projected to be $583 million in 2008 equivalent dollars over the same time period. To offset the increased capital costs of the regulation, this fleet would need to increase revenue by about 0.25 percent, or $0.0031 per mile, during 2010 to 2030.

This company would also be subject to the transport refrigeration unit (TRU) regulation. Staff estimate increased TRU costs of $2.1 million in 2008 equivalent dollars would be incurred over 2008-2018 to meet the TRU requirements. Thus, the increased costs of both rules would be approximately $3.6 million in 2008 equivalent dollars over the calendar years of 2010-2025. To offset the increased capital costs of these combined regulations, this fleet would need to increase revenue by about 0.61 percent, or $0.0074 per mile, during 2010 to 2030.

(ii) Motorcoach Case Study

A California bus company comprised of 138 diesel buses with an average fleet age of 6.4 years had a 2007 net income of approximately $800,000 out of about $9.8 million in gross receipts. This company operates a range of bus types including small shuttle buses and motorcoaches. The shuttle buses are primarily operated locally and the motorcoaches are used for both local trips and longer trips. On average, this company would spend about $1.7 million annually for normal replacements of 11 to 12 vehicles.

For this company, staff estimates the increased costs to comply with the proposed regulation would be about $900,000 in 2008 equivalent dollars over the calendar years of 2010-2025. This compares to about $20.1 million that would normally be spent for capital upgrades over this time period. Annual revenue for this company is approximately $9.8 million, which is cumulatively projected to be $120 million in 2008 equivalent dollars over the same time period. To offset the increased capital costs of these regulations, this fleet would need to increase revenue by about 0.8 percent from 2010 to 2025.

2. Agricultural Sector

The Agricultural sector includes farms and ranches, forestry, farm service providers and agricultural processing centers. The gross domestic product data for the agricultural sector from the 2006 California Statistical Abstract for 2004 was $26 billion per year. In its applicability, the proposed regulation would include agriculture transport vehicles, and specific certain others that are owned by chemical supply companies. Agricultural services are estimated to add about $1 billion to the gross domestic product of this sector.

As reported August 28, 2008, by the USDA’s National Agricultural Statistics Service and Economic Research Service, California agriculture saw a 15 percent increase in the sales value of its products in 2007. The state’s 75,000 farms and ranches received $36.6 billion for their output in 2007, a 15 percent increase from 2006.

a) Fleet Characteristics

ARB staff worked with agricultural stakeholder groups and farmers to develop an agricultural fleet specific survey based on the broader statewide survey. Based on the results of the agricultural fleet survey, staff estimates that there are about 22,000 vehicles engaged in agricultural operation in California. However, most farms do not own vehicles within the scope of the proposed regulation. Vehicles in this industry sector are typically older and drive fewer miles than most other sectors.

While many farms and ranches do not own vehicles that would be subject to the proposed regulation because they contract much of their needed transportation services, they still own vehicles to support their farm activities and/or to deliver products to market. In either case, vehicles used on farms and ranches range from single unit vehicles with bodies designed for uses specific to farming operations, to tractor trailer combinations for transporting harvested commodities for processing.

Farm operators, especially those that do not own their own vehicles, depend on custom service (for hire) providers for supplies, soil preparation, crop harvesting, and other services. Also, most farm operators contract with custom harvesters, farm labor contractors, co-operatives, trucking companies that transport commodities to processing centers, and often depending on seasonal operators to perform this work.

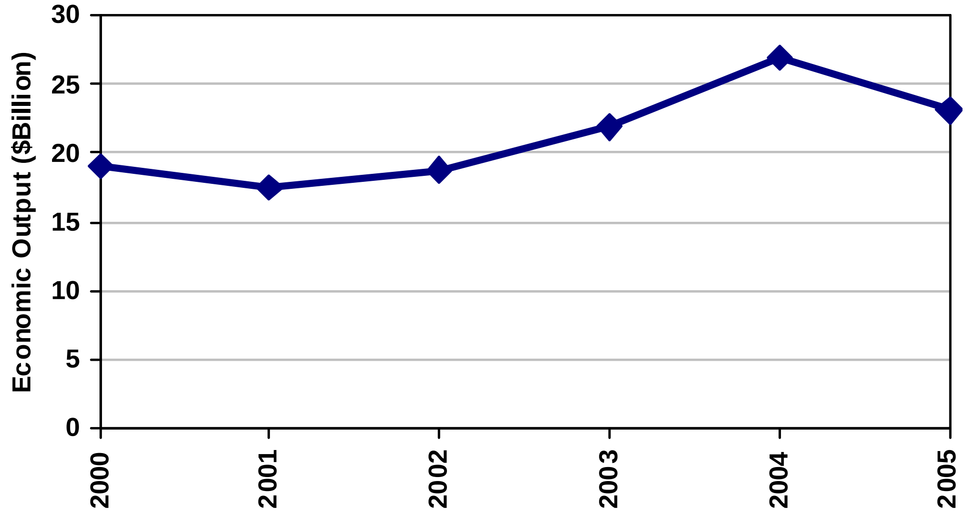
While many of the truck bodies installed on trucks used in agricultural operations are also available in trailer configurations that can be pulled behind a farm tractor, trucks are typically used where farm land is not contiguous and incidental travel on the highway is required. There are a number of truck body types that are used in agricultural operations for feeding livestock, land conditioning, crop protection chemical application, fertilizer spreading, dust control, harvesting and transporting.

Data for the agricultural industry from the agricultural fleet survey showed an average vehicle fleet age of about 16 years. Of the vehicles reported, about 55 percent were heavy heavy-duty vehicles and the remainder were medium heavy-duty vehicles. Staff compared the results to the 2002 National VIUS survey data, and found that medium-duty California agricultural vehicles appear to be older than the national average, while the heavy heavy-duty vehicles are of similar age.

b) Economic Impact on Agricultural Sector

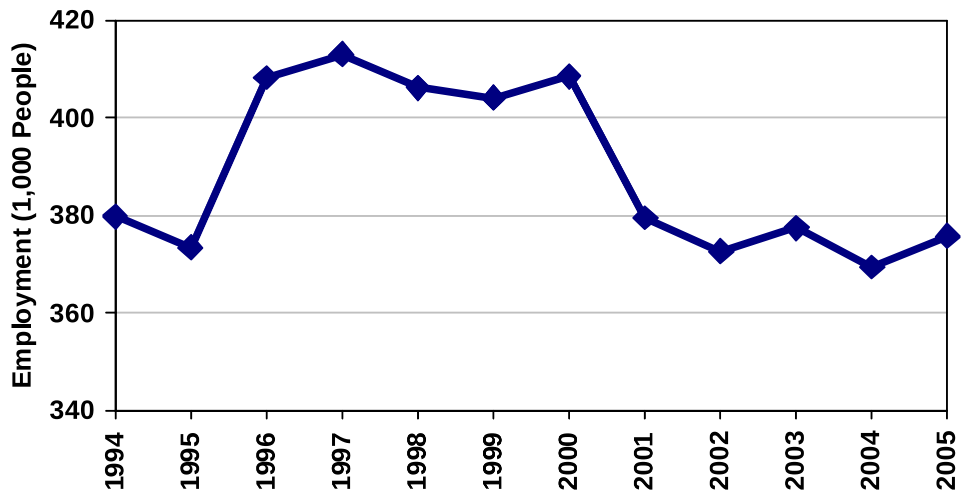
As was shown in Table XIII-13 in Chapter XIII, staff estimates the Agricultural Sector would have an increased regulatory cost of approximately $265 million. In evaluating the impacts of these costs, the results of E-DRAM analysis indicate the economic output for the agriculture, forestry, and fishing sector would be reduced by about 0.1 percent in 2013, the highest capital cost year. To put this cost in context, the historic California gross domestic product for the agricultural sector is shown in Figure XIV-8. Relative to the economic output of this sector, the increased regulatory costs of the proposed regulation represents less than 0.1 percent of the cumulative gross domestic product over the years 2010-2025.

Figure XIV-8: California Gross Domestic Product: Agriculture



As shown in Figure XIV-9, employment in agriculture has varied significantly over the last decade, from about 380,000 jobs in 1994 to over 400,000 jobs in 1997, and subsequently reduced to less than 380,000 jobs in 2005. The E-DRAM analysis indicates that the proposed regulation would reduce California employment in this sector by about 0.1 percent, or 430 jobs in the highest cost year. With the variable nature of employment in this sector, staff does not believe the proposed regulation will have a noticeable impact on agricultural employment.

Figure XIV-9: California Employment: Agriculture



c) Cumulative Costs and the Ability to Pass on Costs

Out of a total of 504 agricultural companies that responded to the ARB heavy-duty vehicle survey, most had filled out an abbreviated version of the survey which did not have detailed vehicle information to determine if there fleets are subject to multiple ARB regulations for instance, its unclear if some of the trucks reported had refrigeration units, questions remain as to address whether some farms also had portable engines or non-farm use off-road equipment. Staff has committed to addressing emissions from in-use off-road agricultural tractors and other equipment in 2010, and plans to evaluate cumulative regulatory cost impacts as part of that rulemaking effort.

Farming is an diverse and complex industry. Various commodities are traded on a world market and prices are establish by supply and consumer demand. Supply is often affected by weather and other factors. Lower cost commodities produced in other parts of the U.S. or in other countries limit the commodity price and the ability to pass through costs. However, farmers have historically had the ability to switch to other higher value crops as margins and profits for particular commodities decline. This practice is expected to continue as market conditions continue to change and the potential need to generate additional revenue arises.

When considering these impacts, it is important to note that California is one of the leading agricultural states in the country for exporting high value crops such as nuts, flowers and fresh fruit throughout the world. In addition, while many crops are grown in other parts of the world, direct competition from the Southern hemisphere is limited because of the differing seasons. Staff believes that for some commodities, and in particular for high value crops, some ability to pass through or absorb costs exists, but likely would vary year to year.

In addition, to the extent fleets subject to the proposed rule would qualify for incentive funding (as discussed in Chapter XV), the anticipated compliance costs would be even lower, further reducing the need to pass on costs.

(i) ***Almond Farm Case Study***

Staff did not receive financial information from any farms or ranches. Therefore, to evaluate specific costs, staff used an economic study from the University of California (UC), Davis of a typical almond orchard (UC, 2008). The example almond orchard had typical gross returns of $4,200 per acre. The study indicates that a single truck-tractor would be needed for an orchard of approximately 125 acres.

Survey data from an Almond Board survey suggests that a typical farm vehicle would be 16 years old (a 1992 model year) vehicle and would be driven about 13,000 miles (Almond, 2007). If this vehicle would be normally replaced when it was 25 years old it would need to be replaced in 2017. Under the agricultural provisions of the proposed regulation, this vehicle would be required to be replaced by January 1, 2017. Using the same assumptions from the cost model, it is assumed the farmer would normally buy a ten year old replacement vehicle. Therefore, if the farmer chose to purchase a vehicle with a 2010 model year engine, the farmer would buy a 7 year old vehicle rather than a 10 year old vehicle. Staff estimates that he would pay about $12,000 more than normal to replace this vehicle after accounting for resale value and a potential loss in value of the older vehicle. For a farm of this size, the total amount of almonds harvested from

2010 to 2025 would be about 7,350,000 pounds, valued at $6,400,000 in $2008. The increased capital costs to comply with the proposed regulation represents about 0.025 percent of the gross revenue received. To offset the increased cost to replace this vehicle, the farmer would need to increase prices by $0.001 per pound of almonds. Further, if the farmer operated the vehicle less than 10,000 miles, the vehicle would not be required to be replaced until 2022.

3. Construction Sector

The construction sector in the 2006 California Statistical Abstract is comprised of businesses engaged in the construction of buildings, highways and utility systems. In addition, many of these businesses are also engaged in the preparation of sites for new construction, subdividing land for sale, and building sites. The reported gross domestic product for 2004 was $70 billion.

a) Fleet Characteristics

The construction sector is a broad sector that contains a wide variety of business types. Staff estimates there are about 76,000 vehicles owned by construction firms and construction contractors. Construction companies range from a special trade contractor with one truck and no off-road equipment, to large road construction and earthmoving companies with hundreds of trucks and pieces of off-road vehicles and equipment. Vehicle types owned by construction companies range from small service trucks and water trucks, to larger tractor trailer combinations to transport aggregate, materials, debris, and equipment. Construction companies may also have more specialized equipment such as sweepers, drill rigs, and cranes. Companies in this sector also include cement truck companies.

While most construction companies and contractors have trucks, many have little or no off-road equipment. For those fleets that do have off-road vehicles, in the ARB 2005 off-road equipment survey, it was reported that the majority of fleets are small fleets (i.e., fleets with very few off-road vehicles), and that the majority of off-road vehicles were owned by large fleets (ARB, 2005). Table XIV-5 shows the total off-road vehicle horsepower, number of vehicles, and number of off-road fleets by fleet size (small, medium and large off-road fleets), as defined in the off-road regulation.

As Table XIV-5 shows, while over 70 percent of the fleets reported to have 2,500 or less horsepower (hp), such small fleets have just over five percent of the total hp of affected vehicles. Conversely, less than 15 percent of fleets have total maximum power over 5,000 hp, but these very large fleets have over 80 percent of the total hp of affected vehicles.

Table XIV-5: Total Off-Road Vehicle Fleet Characteristics

Size Category	Fleet Size (hp)*	Reported Survey Results		
		Percent of Total hp	Percentage of Off-Road Vehicles	Percentage of Fleets
Large	over 5,000	81	72	13
Medium	2,501-5,000	12	16	16
Small	under 2,500	6	12	71

* As defined in the in-use off-road vehicles regulations

Staff used FleetSeek to better understand the impacts of the proposed regulation, and to determine the percentage of trucks owned by fleets of different sizes within the construction sector. Table XIV-6 shows that special trade contractors have the highest number of trucks, while another third are owned by heavy construction companies, which staff believes are likely to qualify as large off-road fleets under the in-use off-road vehicle regulation. Special trade contractors include roofers, plumbers, drywall installers and electricians that are expected have few or no off-road vehicles.

Table XIV-6: Percent of Vehicles in Construction by Category

Construction Categories	Vehicles
Special trade contractors	46%
Heavy construction, except building	33%
Stone, clay, and glass products	13%
General building contractors	7%
All Other	1%

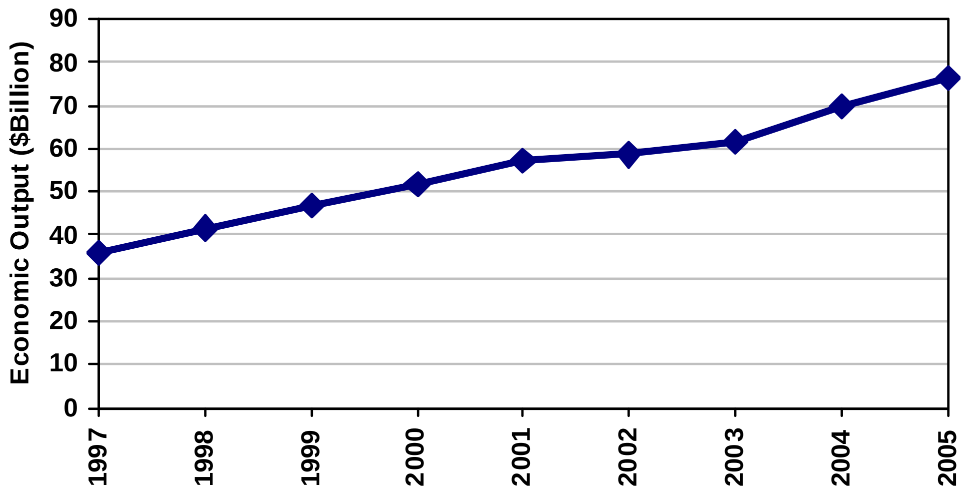
Source: FleetSeek

To verify this data, staff also evaluated available data for large companies with known off-road equipment to estimate the number of vehicles in large fleets. Staff analyzed data from large fleets with 733 vehicles and a total of 596,000 total off-road vehicle hp. Staff estimates there are 27.7 million total off-road vehicle hp in the construction and mining sector, with 81 percent of it in fleets with more than 5,000 hp. Using the ratio of vehicles to total fleet horsepower, staff estimates that there are less than 23,000 vehicles, or about a third, are owned by companies that would be considered to be large fleets in the off-road regulation. The remaining 53,000 vehicles would be in fleets that either would be small fleets or medium fleets in the off-road regulation or have no off-road equipment. Under the off-road regulation, small fleets only have to meet the PM filters requirements, and not until starting 2015.

b) Economic Impact on Construction

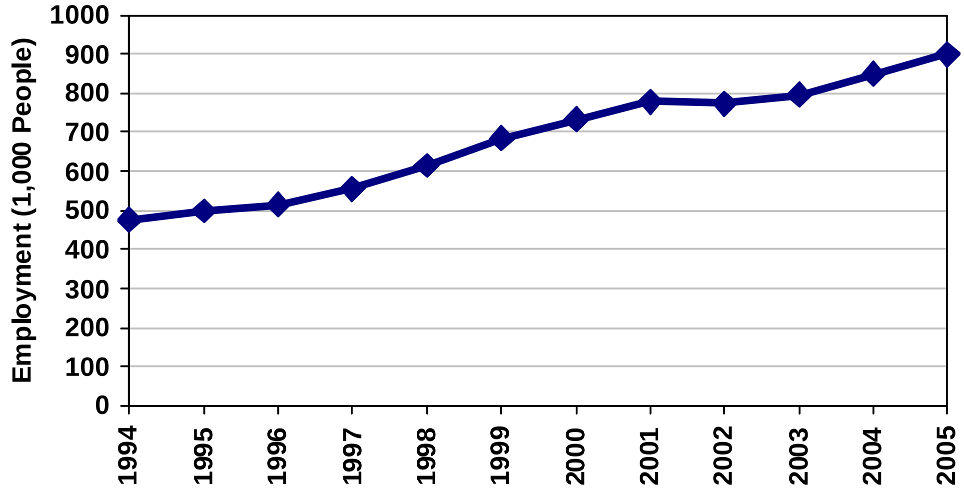
Staff estimates the construction industry would have increased regulatory costs of approximately $1 billion in $2008 as a result of the proposed regulation. In evaluating the impacts of these costs, the results of E-DRAM analysis indicate the economic output for the construction sector would be reduced by about 0.15 percent in 2013, the highest capital cost year. For the California construction sector, staff estimates that the increased regulatory costs of the proposed regulation represent 0.13 percent of the gross domestic product over the years 2010-2025. The historical California cumulative projected gross domestic product for the construction sector is shown in Figure XIV-10.

Figure XIV-10: California Gross Domestic Product: Construction



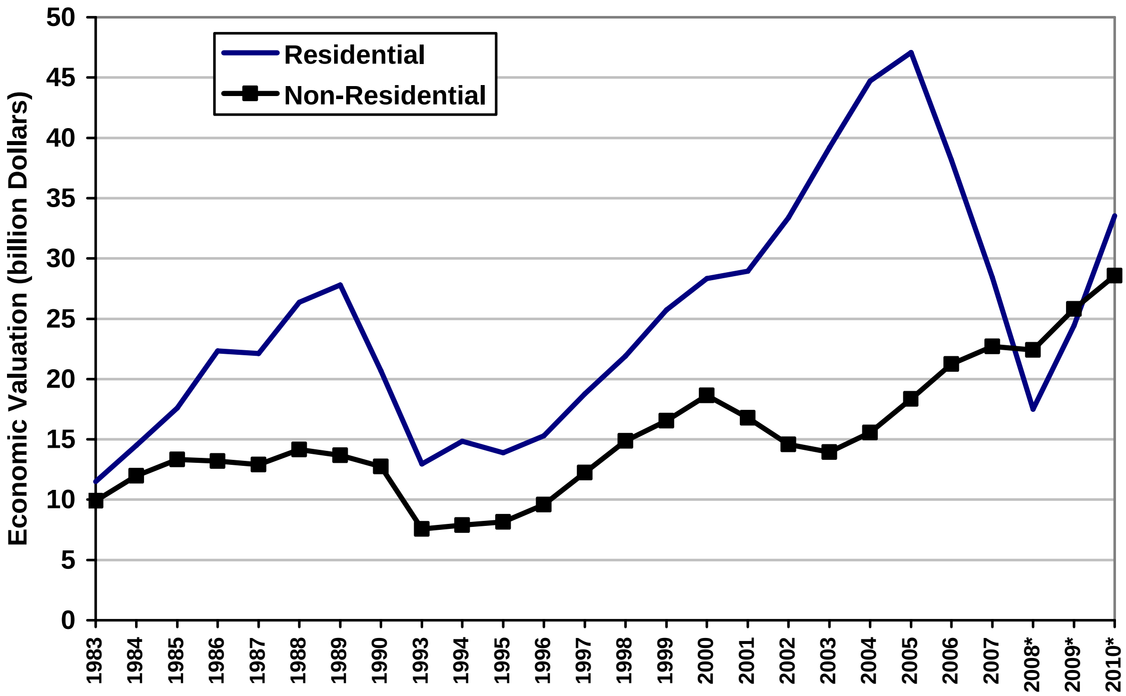
While not reflected in recent data, staff expects that some of this growth has been lost in recent years due to poor economic conditions in the industry. While staff expects the market will grow in the long term, with the current economic climate, it is less certain when the construction economy will recover. The residential construction sector, in particular, has been significantly impacted with the recent downturn in the economy. The E-DRAM analysis indicates that the proposed regulation would reduce California employment by about 0.15 percent, or 1,300 jobs in 2013, the highest capital cost year. As shown in Figure XIV-11, employment in construction grew from about 500,000 jobs in 1994 to over 900,000 in 2005. However, while not reflected in recent data, staff expects that some of this growth has been lost in recent years due to poor economic conditions in the industry. While staff expects the market will grow in the long term, with the current economic climate, it is less certain when the construction economy will recover. The residential construction sector, in particular, has been significantly impacted with the recent downturn in the economy.

Figure XIV-11: California Employment: Construction



Staff also evaluated sources of recent construction valuation trends to determine if there are differences in growth patterns within construction. Shown in Figure XIV-12 is the construction valuation projection made by the Economic Research Unit of the California Department of Finance for residential versus non residential construction in a report released on April 2008. While quite variable over time, the residential construction sector overall is currently experiencing a substantial slowdown. However, the non-residential sector has not shown a similar decline. For the industry as a whole, the forecast projects a recovery for residential construction in 2009 and 2010, and a continued upward trend in the non-residential sector.

Figure XIV-12: California Construction Total Valuation Dollars (in billions)



Source: Economic Research Unit of the California Department of Finance, April 2008 Data

c) Cumulative Costs and Ability to Pass on Cost

Out of a total of 357 construction companies that responded to the ARB on-road survey, 63 companies indicated they had off-road vehicles or portable engines or both. However, the survey responses did not include many large construction companies, and therefore staff does not believe the data provided are representative of large companies as a whole. Therefore, staff has used alternative means to estimate the anticipated cumulative costs of the proposed regulation and existing ARB regulations.

In evaluating the cumulative impacts of the proposed regulation on the construction sector, staff segregated its analysis into large fleets and small fleets. While the construction industry sector as a whole could have compliance costs associated with a number of in-use regulations, large fleets are expected to have the greatest cumulative costs, as they will typically would have the highest compliance costs associated with the proposed regulation and recently adopted the off-road regulation. In developing its regulatory cost estimates for the in-use off-road vehicle regulation, it was estimated that $1.7 billion (about 50 percent of the total costs) was attributed to the construction and mining industries.

In proposing the In-Use Off-Road Diesel Regulation, staff concluded that most businesses would be able to pass through or absorb the costs of that regulation. As discussed above, in evaluating the cumulative costs of this regulation and the in-use off-road vehicle regulation, staff has concluded that overall, the cumulative impact of the two regulations is small, increasing the anticipated regulatory costs for affected fleets by no more than about 6 percent. As such, staff does not believe that these additional costs will change the industry's ability to pass through the costs of both regulations in the form of higher bids.

In addition, to the extent fleets subject to both rules would qualify for incentive funding (as discussed in Chapter XV), the anticipated compliance costs would be even lower, further reducing cumulative cost impacts and the need to pass on costs.

(i) ***Large Off-Road Fleets***

As noted above, staff did not receive the on-road truck and off-road vehicle information from many construction companies necessary to be able to perform a detailed analysis on the cumulative industry impacts of multiple regulations. To address this, staff used 2006 DMV data to find the model year and body type of vehicles owned by individual large off-road vehicle fleets for which staff already had off-road equipment information. Staff then analyzed the combined compliance costs associated with the off-road regulation and the on-road regulation for 10 large construction companies with more than 5,000 hp of off-road vehicles each.

Because staff did not have information about the annual miles traveled by the on-road vehicles in these fleets, staff used a conservative estimate by assuming all vehicles did not qualify for any of the low-use flexibility provisions in the proposed regulation. The companies analyzed had 733 vehicles and a total of 596,000 total hp. Based on this analysis, staff has concluded that the combined cumulative costs for large off-road fleets to comply with both the proposed regulation and the in-use off-road vehicle regulation is about 6 percent higher than the anticipated compliance costs of the in-use off-road vehicle regulation alone.

(ii) ***Small and Medium Off-Road Fleets***

Small and medium fleets in the in-use off-road vehicle regulation are defined as those having less than 5,000 total cumulative off-road vehicle hp. This means, for example, a company might have a small fleet of backhoes, or wheel loaders or motor graders. Under the off-road regulation, these fleets are not subject to any clean-up requirements until 2013 for medium fleets, and 2015 for small fleets. In addition, for small fleets, the clean up requirements are less stringent than for higher hp medium and large fleets.

As noted above, staff did not receive the on-road truck and off-road vehicle information from many construction companies necessary to be able to perform a detailed analysis on the cumulative impacts of multiple regulations. Despite this, staff evaluated the potential cumulative costs of the proposed regulation for small fleets, and does not expect that the proposed regulation will impose any significant over lapping costs on small fleets. This is because these fleets would not incur any capital costs under the off-road regulation prior to 2015, when they would have to begin installing verified

DECS on their off-road vehicles. Because this is later than when these small fleets would have to clean up under the proposed regulation, staff believes it is unlikely that small fleets would be required to make capital investments in the same year to comply with both regulations. In addition, for contractors not subject to the in-use off-road regulation at all (estimated to be as much as 60 percent of the fleet), there are no cumulative costs at all.

Like other small fleets, the costs attributable to the proposed regulation depend on when a fleet would normally replace its vehicle. Those that purchase newer vehicles may experience no cost at all, while those with older vehicles would be required to either install verified DECS or to replace their engines or vehicles prior to 2012 or 2013. Also, a fleet that purchases a 2007 to 2009 model year engine would not have any additional requirements until January 2021.

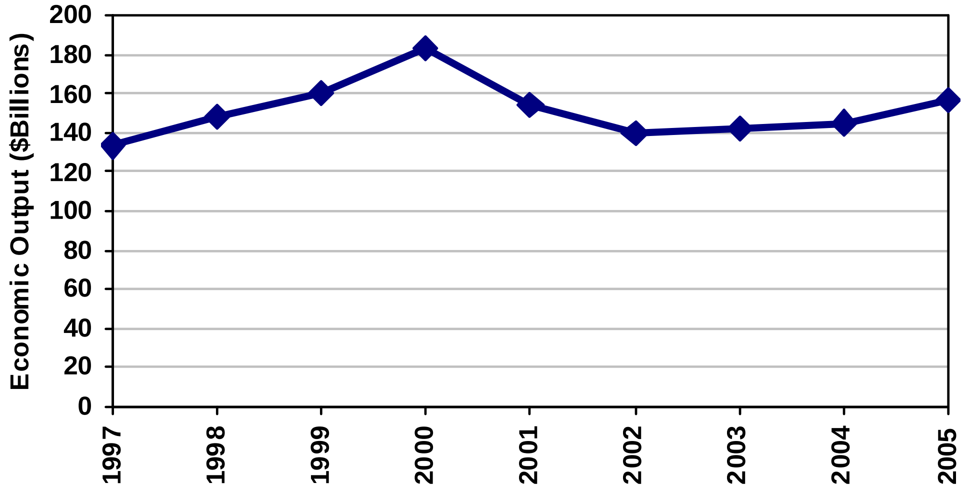
4. Manufacturing Sector

The manufacturing sector is engaged in making new products from raw material or assembling parts. This sector includes plants, factories, or mills used to make food products, machinery, furniture, equipment and other items. The reported gross domestic product for manufacturing in California was $145 billion in 2004.

a) Economic Impact on Manufacturing

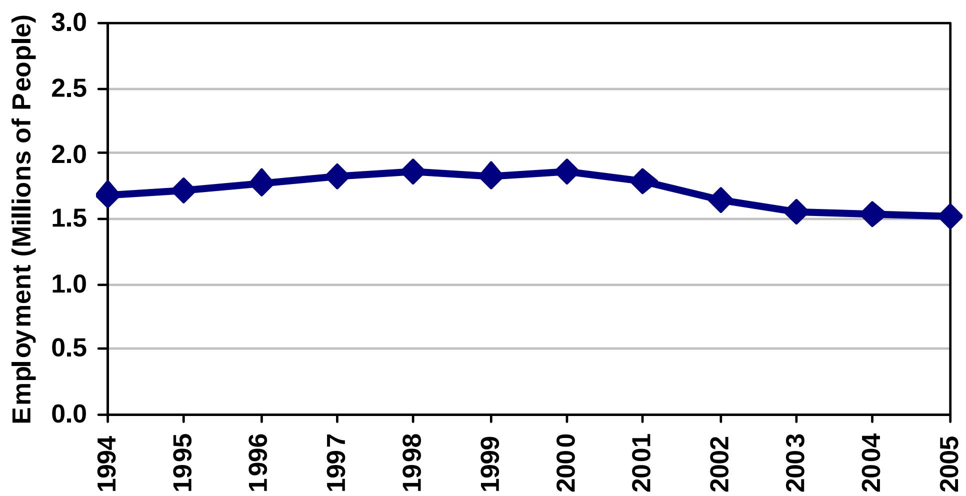
Staff estimates the manufacturing sector would have a increased capital costs of approximately $168 million as a result of the proposed regulation. The results of the E-DRAM analysis indicate the output off California manufacturing would be reduced by about 0.05 percent in 2013, the highest cost year. The historic California gross domestic product for manufacturing sector is shown in Figure XIV-13. Overall, staff estimates that the increased total costs of the proposed regulation represent 0.0008 percent of cumulative projected gross domestic product over the years 2010-2025.

Figure XIV-13: California Gross Domestic Product: Manufacturing



As shown in Figure XIV-14 employment in manufacturing has declined from about 1.7 million jobs in 1994 to about 1.5 million in 2005. The E-DRAM analysis indicates that the proposed regulation could reduce California employment in the manufacturing sector by about 0.05 percent, or 1,000 jobs in the highest cost year.

Figure XIV-14: California Employment: Manufacturing



b) Ability to Pass on Costs

The manufacturing sector has local, regional, and international markets. The ability to pass on costs will be determined by a number of factors including the market region, uniqueness of a product, supply and consumer demand. Because the use of vehicles subject to this regulation in this sector is generally necessary not to generate revenue, but to support other revenue generating activities, staff believes these fleets should be able to pass on the costs of the proposed regulation through higher prices for the products they manufacturer. In addition, to the extent fleets subject to the proposed regulation would qualify for incentive funding (as discussed in Chapter XV), the anticipated compliance costs would be even lower, further reducing the need to pass on costs.

5. Retail and Wholesale Trade Sector

The retail and wholesale trade sector primarily sells products to individuals or businesses. Retail generally refers to the sale of merchandise in small quantities, such as grocery, department, specialty, and apparel stores among other venues. Wholesale mainly refers to sales of goods in large quantities to distributors, manufacturers and retailers. The California gross domestic product for the retail and wholesale trade sector in California was $194 billion in 2004.

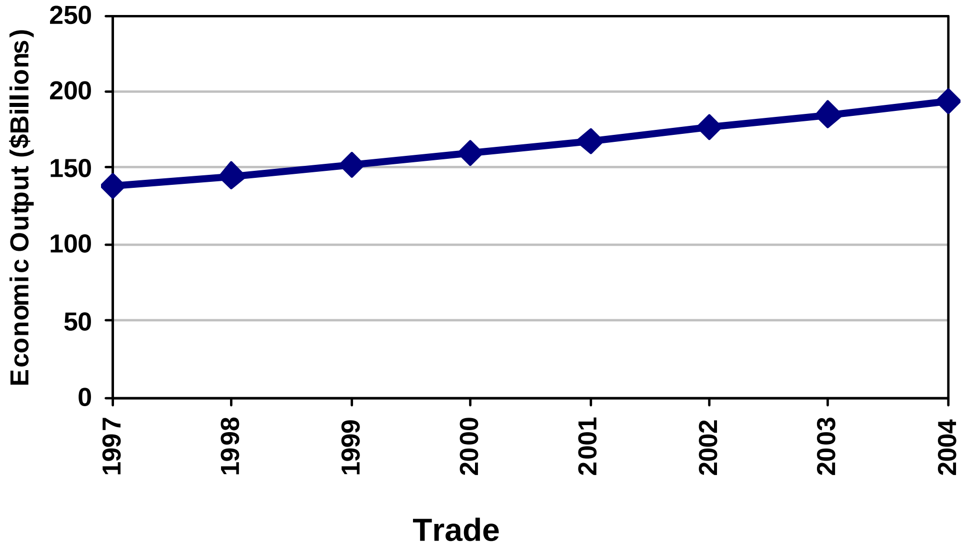
a) Fleet Characteristics

Goods are either transported using the vehicles owned and operated by the retailer or wholesalers, or through the service of a trucking company. Goods are generally transported to distributors using tractor trailer combinations and singe unit box trucks. For perishable goods, tractors with a refrigerated trailer and tractor, or a single unit refrigerated box truck are used. Shipments of raw materials to other manufacturers for refinement are typically transported using tractor trailer combinations, flatbed, box trucks, tank trucks and others. Some retail stores also own vehicles to provide home delivery services.

b) Economic Impact on Retail and Wholesale Trade

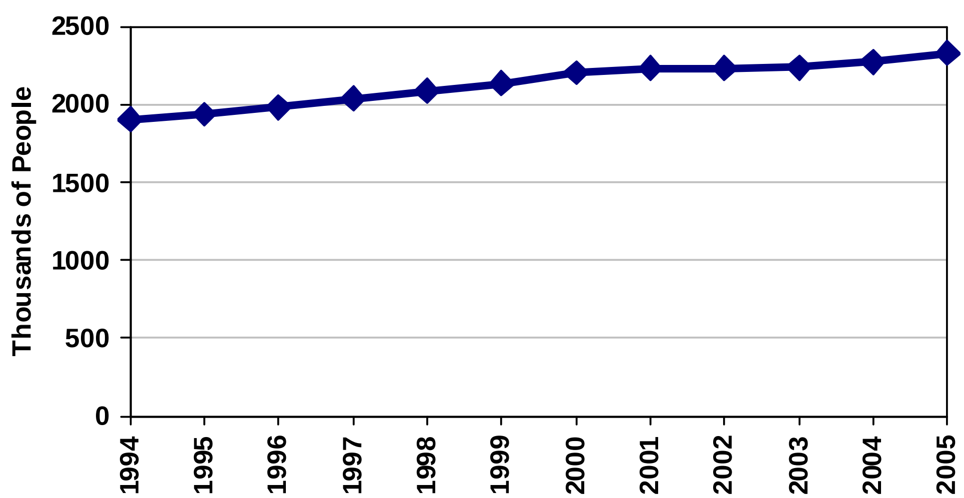
Staff estimates the retail and wholesale trade sector would have an increased regulatory cost of approximately $510 million. In evaluating the impacts of these costs, the results of the E-DRAM analysis indicate the economic output for retail and wholesale trade would be reduced by about 0.01 to 0.03 percent in 2013, the highest capital cost year. To put this cost in context, the historic California gross domestic product for the retail and wholesale trade sector is shown in Figure XIV-15. Relative to the economic output of this sector, the increased regulatory costs of the proposed regulation represents less than 0.1 percent of the cumulative projected gross domestic product from 2010-2025.

Figure XIV-15: California Gross Domestic Product: Retail and Wholesale



As shown in Figure XIV-16, employment in retail and wholesale trade grew significantly over the last decade, from about 1.9 million jobs in 1994 to over 2.3 million jobs in 2005. The E-DRAM analysis indicates that the proposed regulation could reduce California employment in this sector by about 0.02 percent, or 500 jobs, in 2013, the highest cost year.

Figure XIV-16: California Employment: Retail and Wholesale Trade



c) Ability to Pass On Costs

Fleets in the retail and wholesale industry sector are not as significantly affected with other ARB regulations as other industries. Because the use of vehicles subject to this regulation in this sector is generally necessary not to generate revenue, but to support other revenue generating activities, staff believes these fleets should be able to pass through the costs of the proposed regulation through higher prices for the products they market and sell.

In addition, to the extent fleets subject to the proposed regulation would qualify for incentive funding (as discussed in Chapter XV), the anticipated compliance costs would be even lower, further reducing the need to pass on costs.

6. Schools Districts and School Transportation Providers

School districts are generally responsible for providing school transportation. While many school districts purchase buses and hire their own drivers, many others engage the service of school transportation providers (such as Laidlaw) to perform this function. Districts operating their own school bus system may charge fees for school bus ridership. In some urban locations, students may utilize public transit services.

In the United States, the school bus is a vehicle which is built and equipped according to federal and state laws that are required to be painted yellow. Most school buses made in recent years have been diesel-powered or hybrid. Full-size school buses can seat 59 to 90 passengers, but in many districts smaller vehicles are also used. Such smaller vehicles are often used for low-density routes associated with private schools and for magnet programs, as well as those for developmentally-challenged students.

Today there are about 3,700 verified DECS currently installed on both public and private school buses in California and an additional number that are equipped with OEM equipped DPFs. However, staff estimates that there are about 3,500 publicly-owned and over 3,900 privately-owned school buses needing to be retrofit to comply with the proposed regulation.

About $200 million is available in the Lower Emission School Bus program for bus replacement and retrofit. The program provides up to $20,000 for a verified DECS, including 10 years of maintenance cost for 1987 and newer buses. This money is available to both school districts and private school transportation providers. Up to $140,000 is also available for replacement of pre-1987 buses, but only for the purchase of public school buses. Also, up to 10 percent of the award amount is available for infrastructure improvements for alternative-fueled buses. Local air pollution control districts administer the funds, and the availability of incentive funding is dependent on funding choices made by school districts and program administrators.

a) Economic Impact on School Districts

Staff does not expect the proposed provisions for school buses to have a significant impact on school districts or school transportation providers. Taking into consideration $200 million that are available through the Lower Emission School Bus program for bus replacement and retrofit, the remaining regulatory costs only total about $27 million over

8 years (2010-2017). Staff believes affected school districts and transportation providers should be able to absorb these costs into their existing budgets.

7. Federal Fleets

The federal government is the largest public truck/bus fleet operator in California. According to the 2006 Federal Fleet Report, the federal government owned and operated over 18,900 heavy-duty vehicles and buses nationwide, excluding military vehicles. About 12 percent of these vehicles are estimated to operate in California. The U.S. Postal Service (USPS) accounted for over 28 percent of these vehicles, and the Department of Interior operated over 23 percent (GSA, 2007). The remaining vehicles were operated by various other agencies. The average ages of the medium- and heavy-duty vehicles are 6 and 9 years respectively (GSA, 2007).

The federal government operates a wide range of vehicle types based on the needs of each individual agency. For example, the USPS operates vehicles such as tractor trailers and dry vans for transporting letters and packages between distribution centers, and smaller vans for delivering packages to business and residences. The U.S. Forest service, an agency of the Department of the Interior, operates larger heavy haul vehicles for transporting forestry equipment, and smaller chipper trucks for clearing trees and bushes. In addition, for scenic locations such as in national parks, tour buses may be used for transporting visitors. In support of all of the federal governments' operations, a wide range of vehicles are used for transporting personnel, site maintenance and for general operations.

a) Economic Impact on Federal Fleets

Staff met with representatives of the General Services Administration (GSA) to discuss the proposed regulation and to discuss compliance options. GSA representatives indicated they would likely allocate 2007 and newer vehicles in the federal fleet to California to meet the PM requirements from 2011 to 2014 rather than installing verified DECS. After 2014 they would resume their normal vehicle replacement cycles and would meet the 2021 PM and NOx requirements without any accelerated replacements. The anticipated costs to the federal government are expected to be negligible.

D. Economic Impact on California Consumers

To estimate the economic impact of the proposed regulation on consumers, staff estimated a high and low range cost based on the total economic impact in the state. While the actual costs could be higher or lower for a given product, the estimate provides a reasonable indicator of the average cost impacts. For the low end cost range, staff estimated the consumer impact by calculating the average increase in cost compared to the total gross domestic product for California from 2010 to 2025. For the high end cost range, staff compared the annual gross domestic product for the highest cost year.

Overall, in the context of the State's $3.1 trillion economy, the economic impact of the proposed regulation is minor and is not expected to impose a noticeable impact on consumers. However, if all of the regulatory costs were passed through to consumers, staff estimates this could result in an increase in consumer goods of about 0.04 percent in the highest cost year (2013), and about 0.014 percent on average over the life of the proposed regulation. To put this into context, this equates to about a 1 to 2 cent increase for a pair of shoes, less than one one-hundredth of a cent increase per pound of produce, or an increase of from $3 to $10 for a new car.

E. References

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XV. AVAILABILITY OF INCENTIVE FUNDING

The role of incentive funding will be an important element for many fleets as they consider how to comply with the proposed regulation. While staff recognizes the demand for incentive funding greatly outweighs the availability of funds, several potential state, federal and local funding programs exist that could assist with offsetting the cost of the proposed regulation to affected fleets that move quickly to take advantage of these funding opportunities.

A. State Sources of Funding

State incentive funding programs have historically played a complementary role to the state's regulatory emission reduction programs towards meeting the state's SIP requirements and achieving California's air quality goals. California's funding programs typically require participation prior to established regulatory deadlines; thus to qualify, fleets affected by the proposed regulation will need to act quickly if they are interested in pursuing available state incentive funding.

1. Proposition 1B Funding

In 2006, California voters approved the Highway Safety, Traffic Reduction, Air Quality, and Port Security Bond Act of 2006 (Proposition 1B). This measure authorized the California Legislature to appropriate $1 billion for emission reductions in the State's good movement corridors. Proposition 1B funds are used to pay for projects that are completed in advance of or go beyond what is required by any regulation or law.

a) Overview

The ARB's Proposition 1B: Goods Movement Emission Reduction Program (Prop. 1B Program) implements Senate Bill 88 (Chapter 181, Statutes of 2007) as amended by Assembly Bill 201 (Chapter 187, Statutes of 2007), which directs ARB to quickly reduce emissions and public health risk associated with freight movement along California's trade corridors – the Bay Area, Central Valley, Los Angeles/Inland Empire, and San Diego/Border area.

In approving the Prop. 1B Program, the Board has targeted $360 million to provide incentives to clean-up heavy-duty vehicles (those not routinely serving seaports or intermodal rail yards). Eligible upgrades include retrofits, repowers, and replacements with funding in the form of grants for purchase or lease-to-own programs. The Proposition 1B ballot language directs ARB to fund emission reductions not otherwise required by law or regulation. Once the Board adopts a regulation, upgrades eligible for funding must result in early reductions in advance of the BACT compliance date or achieve extra reductions beyond what is required in the BACT requirements.

For most fleets, the current Prop. 1B Program requires engine repowers and vehicle replacements to be completed three years before required. However, independent owner/operators and owners of MY 1997 and older vehicles need to complete the project only two years earlier than otherwise required. The funding is currently limited to

2003 model year vehicles and older. Each vehicle then competes for funding based on the emission reductions to be achieved and the cost-effectiveness. These factors favor replacement of the oldest vehicles.

The Prop. 1B Program Guidelines for fiscal year (FY) 2007-08 funds allow up to the following:

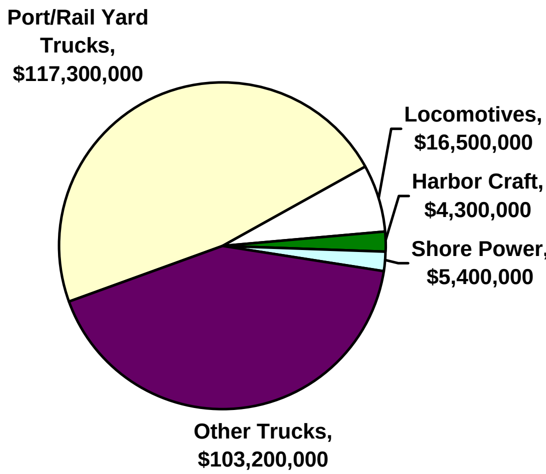
- $5,000 to retrofit a truck with a verified Level 3 DECS;
- $20,000 for an engine repower;
- $50,000 to replace a model year 2003 or older vehicle with one meeting 2007 or better new engine standards.

The current Prop. 1B Program Guidelines require vehicle replacements to be completed at least 3 years prior to a regulatory BACT requirement for that level of emissions control. For independent owner/operators and owners of MY1997 or older vehicles, replacements must be completed 2 years prior to the BACT requirement. Vehicles receiving Prop. 1B Program funding are prohibited from participating in fleet averaging programs during this advance period. The Prop. 1B Program Guidelines also require that the upgraded vehicle be able to legally operate in California for four years with retrofits to eight years for replacements and repowers to sustain the benefits of the investment.

b) Current Funding

Of the $1 billion authorized under Proposition 1B, ARB received the first installment of $250 million in the FY 2007-2008 budget, and the second $250 million installment in the FY 2008-2009 budget. The Figure XV-1 below shows the Board's allocation of FY 2007-2008 funds.

Figure XV-1: Proposition 1B Fiscal Year 2007/2008 Allocation



Local agencies have already awarded most of the $103 million in FY 2007-2008 funds allocated for other vehicles to the most competitive vehicle projects. The overwhelming majority of the applications has been for vehicle replacements, with demand for funds exceeding four times the available funds in the first year of the Prop. 1B Program.

Most of the implementing local agencies are developing lease-to-own truck programs for expenditure of FY 2007-2008 funds or subsequent cycles. These lease-to-own programs provide a mechanism for independent and small fleet owners to obtain a new vehicle for a reasonable monthly payment that covers the difference between the Program grant and the total vehicle purchase cost. Staff must approve the terms of any proposed lease-to-own programs to ensure that the payments are reasonable and appropriate.

c) Program Updates

ARB staff is currently developing updates to the Prop. 1B Program Guidelines for FY 2008-2009 funds through a public process throughout Fall, 2008. The Board is scheduled to consider the proposed guidelines during its January, 2009, meeting. After soliciting applications from local agencies and discussing funding recommendations in a public process, staff expects the Board to award the second $250 million in funding in Spring, 2009. Staff will be recommending that most of the funds again be allocated to port trucks and other trucks, in recognition of the need for funds and the expected near-term regulatory deadlines. Local agency funding for individual projects should begin later in 2009.

Staff is evaluating the updates needed to the Prop. 1B Program Guidelines, including changes to integrate Program funding options with the proposed regulation. These potential changes that staff is developing for discussion in the public process include:

- Expansion of the schedule flexibility currently provided for independent owner/operators to also include small fleets of 3 or less vehicles (ability to use bond funding 2 years prior to regulatory BACT requirement).
- Mechanism to provide an advantage to vehicles owned by small fleets of one to three trucks in the competitive process for funding.
- Option to allow some medium heavy-duty vehicles engaged in goods movement to compete for funding.
- Alternative calculation of emission reductions based on hours of operation (rather than miles traveled) to allow construction industry vehicles to compete for funding.
- Update to the funding amounts to encourage vehicle replacements with models meeting 2010 emission standards and to recognize the potential availability of more effective combined PM/NOx retrofit devices.
- Addition of a combined grant/loan guarantee program.

The changes identified above would expand the number of vehicles eligible for the Prop. 1B Program and recognize small fleets of one to three trucks as a priority for funding (along with the oldest trucks already targeted).

Based on these changes and the BACT compliance dates in the proposed regulation, truck owners could compete for bond funding to install PM filters on a 1995-2006 engine, or to replace or repower a 2003 or earlier engine. PM filters would need to be installed in the 2009-2012 timeframe, depending on engine model year. Vehicles in fleets of three or less vehicles would generally be eligible for replacement funding through the 2010-2012 timeframe, depending on the age of the vehicle. Fleets with more than three vehicles would generally be eligible for bond funding through 2012, based on the age of the old vehicle.

2. Lower Emissions School Bus Program

California's Lower-Emission School Bus Program (LESB Program) is administered by ARB and is implemented by the local air districts. The LESB Program supports the retrofit and replacement of public school buses, and the retrofit of school buses operated by private companies contracted by public schools to provide home-to-school transportation.

The LESB Program was appropriated $200 million by the Legislature in 2007, and the LESB Program guidelines were updated in early 2008. Qualifying projects are allowed up to $20,000 for a verified DECS, including 10 years of maintenance costs for 1987 and newer buses. Up to $140,000 is also available for replacement of pre-1987 buses. Up to 10 percent of the award amount is also available for infrastructure improvements for alternative-fueled buses. It is anticipated that over 1,100 replacements and 3,500 retrofits could be funded through the LESB Program.

3. Carl Moyer Program

a) Overview

Created in 1998, the Carl Moyer Program provides incentive grants to encourage the voluntary purchase of cleaner-than-required engines and equipment that provide early or extra emission reductions. Eligible projects include cleaner on-road, off-road, marine, locomotive and stationary agricultural pump engines. The program achieves near-term reductions in emissions of NOx, PM, and ROG. While regulations continue to be the primary means to reduce emissions, the Carl Moyer Program plays a complementary role by funding surplus emission reduction projects.

Over its first seven years, the Carl Moyer Program provided $170 million to clean up approximately 7,500 engines throughout California. This achieved emission reductions of about 24 tons per day of NOx and one ton per day of toxic diesel PM. Legislation in 2004 provided the Carl Moyer Program with up to $140 million per year through 2015. Though significant, this level of funding is far from sufficient to pay for all the reductions needed to provide clean air. Reductions required by regulations, and funded by owners of affected equipment, must continue to provide the majority of emission reductions.

On-road projects in the Carl Moyer Program generally consist of new alternative-fuel purchases, fleet modernization (replacing an older vehicle with a new or newer vehicle), engine repowers, and retrofits. In recent years, fewer on-road projects have been funded relative to other categories such as off-road. New purchase projects are not common because of a lack of eligible engines that are cleaner than existing standards. Repower projects are limited due to physical and technological constraints with installing a newer engine in an older chassis. Fleet modernization projects have provided significant emission reductions in some areas, but are more difficult to administer and may only be considered in air districts that have an approved ARB Fleet Modernization Plan. Currently, Fleet Modernization Plans are approved for the South Coast AQMD, Sacramento Metropolitan AQMD and San Luis Obispo APCD.

State law requires that Carl Moyer Program projects provide emission reductions early or beyond what is required by regulation. Therefore, on-road projects must be surplus to the proposed regulation, as well as existing regulations such as the Fleet Rule for Transit Agencies, the Fleet Rule for Public Agencies and Utilities, the Solid Waste Collection Vehicle Regulation, and the Port Truck Regulation.

In order for a project to be considered surplus, the 2005 and 2008 Carl Moyer Program Guidelines require a minimum three year project life which means that incentive funds can not be used to pay for equipment that is less than three years from its compliance deadline. The three year surplus requirement is a fundamental component of the Carl Moyer Program and is necessary to ensure that funds are used for early reductions rather than paying for compliance. It has only been shortened by the Board in one other regulatory proposal. However, as discussed below, staff believes it is appropriate to shorten the minimum project life from three years to two years for one component of this regulation. Also, projects must also be surplus to the assumptions in the emission benefit analysis performed to determine creditable emission reductions in the SIP. In other words, projects funded through the Carl Moyer Program can not double count emission reductions claimed by a regulation.

b) Proposed Changes to the Carl Moyer Program Guidelines

Based on the proposed regulation, future opportunities for funding on-road projects through the Carl Moyer Program will be limited. This section describes those opportunities and proposes several changes to existing Carl Moyer Program Guidelines that would maximize funding options while ensuring surplus emission reductions. These changes will be presented to the Board as part of staff's presentation of the proposed regulation.

Under the proposed changes, in general, small fleets of up to three vehicles would be eligible for incentive funding through the end of 2010 to comply with the December 31, 2012, compliance deadline. The first vehicle in a small fleet would be eligible for incentive funding for a 2010 truck through the end of 2012. Limited use agricultural vehicles would be eligible through 2013, and low use or specialty agricultural vehicles would be eligible through 2019. Large fleets with more than three vehicles have few remaining funding opportunities that are surplus to the proposed regulation.

In order to effectively integrate Carl Moyer Program funding options with the proposed regulation, as well as provide greater consistency with Prop. 1B Program funding, staff proposes several changes to the Carl Moyer Program Guidelines. These changes, shown below in Table XV-1 would primarily help small fleets purchase newer vehicles prior to the compliance deadlines while ensuring that Carl Moyer funded projects result in surplus emission reductions.

Table XV-1: Proposed Carl Moyer Program Guidelines Changes

Guideline Provision	Existing Criteria	Proposed Criteria
On-Road Fleet Modernization		
Eligible engine and chassis model year for old vehicle	1990 and older	1993 and older
Maximum eligible funding	80 percent of vehicle cost for fleets of 5 or less; 50 percent for fleets of 6 or more	80 percent up to $50,000 per vehicle with engine certified to 1.2 g/bhp-hr standard; 80 percent up to $75,000 per vehicle with engine certified to 0.2 g/bhp-hr standard.
Two vehicles to one option	not available	Replacement of two similar older vehicles with one newer vehicle
Minimum Project life	3 years	2 years for small fleets complying with 2012 deadline
On-Road Retrofit		
Eligible engine model years	no restriction	2004 or later for small fleets; 2005 or later for large fleets (requires highest level retrofit verified for specific engine)
Agricultural Vehicles		
Reporting to ARB	None	Must obtain the agricultural vehicle designation from ARB before applying
All On-Road Carl Moyer Program Funded Projects		
Funding contract restriction on proposed regulation compliance options	None	Applicant must use BACT Compliance Schedule, not BACT Percentage Limits or Fleet Averaging, for compliance during the contract term

The changes proposed above will expand eligibility for fleet modernization projects by allowing replacement of three additional model year engines, 1991-1993. However, the focus of this funding would still be on replacing the oldest vehicles. In general, since older vehicles that accumulate the most mileage are the most cost effective to replace, the most competitive on-road projects are expected to be in small fleets with relatively high mileage.

As a direct result of the anticipated oversubscription of fleet modernization funds, staff is also proposing to lower the amount of funding per vehicle to increase the number of applicants receiving funds. Similarly, adding a two vehicle to one option under fleet modernization provides greater funding options for applicants.

Changing the minimum project life from three years to two years for small fleets complying with the 2012 compliance deadline extends the window of time to fund surplus projects in fleets with the greatest need. The 2012 compliance deadline for small fleets is aggressive due to their financial conditions, but necessary to achieve the needed emission reductions. A three year project life would require project completion by the end of 2009, allowing only one funding cycle. A two year project life allows funding during two cycles, and allows districts without a Fleet Modernization Program the time to initiate one.

Staff also proposes to restrict retrofit funding to 2004 and later engines so that retrofits are not installed in vehicles destined for short term replacement.

c) Funding Opportunities under the Carl Moyer Program

As discussed above, there are limited options available for on-road Carl Moyer Program funding. However, considering the Carl Moyer Program Guideline changes proposed above, Table XV-2 below describes the future funding options expected after adoption of the proposed regulation.

Table XV-2: Future Carl Moyer Program On-Road Funding Options

Fleet Modernization - Small Fleets	Through 2010; limited for first vehicle only through 2012
Fleet Modernization - Large Fleets	None
Retrofits - Small fleets	Limited to 2004-2006 vehicles through 2009
Retrofits - Large fleets	Limited to 2005 and 2006 vehicles through 2009
Agricultural Vehicles – Low Use & Specialty (<10,000 miles per year) Agricultural Vehicles – Limited Use (>10,000 miles/year and <15,000 miles/year	Fleet modernization through 2019 Fleet modernization through 2013
Solid Waste Collection Vehicles – New Purchase of 0.84 g/bhp-hr NOx or cleaner	Through 2009

Fleet modernization funding would be available for the first, second, and third vehicle in small fleets through 2010, two years in advance of the 2012 compliance deadline. For the first vehicle only, the emission benefit calculations assume the purchase of a 2007 truck. Therefore, very limited funding is available for the purchase of a 2010 truck through the 2012 deadline. For large fleets, there are no remaining fleet modernization or repower funding options that would be surplus to the proposed regulation.

On-road retrofit options would remain available through 2009, but would be very limited because there are few currently verified DECS for 2004 and newer diesel engines. If future retrofit devices are verified to achieve NOx reductions sufficient to meet the 2004, 2007, or 2010 MY NOx Emissions Equivalent definitions in the proposed regulation, then those devices would also be eligible for Carl Moyer Program funding in some applications. For example, funding could be available through 2017 for verified DECS that achieve at least 70 percent NOx reduction on model year 2007-2009 vehicles in large fleets.

Designated agricultural vehicles that operate below 10,000 miles annually and specialty agricultural vehicles will have funding opportunities through 2019. However, due to lower usage and cost, funding for these vehicles may be limited. MY 1993 and older vehicles operating up to 15,000 miles annually will be eligible through 2013.

While not covered under the proposed regulation, funding is also available for new purchases of 2007 and newer solid waste collection vehicles, as long as the owner is in compliance with the Solid Waste Collection Vehicle Regulation. New purchases must be at least 30 percent cleaner than the current 1.2 g/bhp-hr NOx standard.

4. Assembly Bill 118 Grants

Assembly Bill (AB) 118 created two new incentive programs with potential funding for on-road heavy-duty vehicles. The first is the Alternative and Renewable Fuels and Advanced Technology Program to be administered by the California Energy Commission, and the second is the Air Quality Improvement Program (AQIP) to be administered by ARB. The Energy Commission program will have about $120 million annually beginning in FY 2008-09 and is geared toward transforming California's fuel and vehicle types to help attain California's climate change goals. The AQIP has about $50 million annually beginning in FY 2008-2009 to improve California's air quality by funding vehicle and equipment projects, air quality research, and advanced energy technology workforce training.

AB 118 provides the Energy Commission and the AQIP with over seven years of program funding. AB 118 requires that grants received pursuant to these two programs must achieve emission reductions that are early or go beyond what is required by regulation. ARB and the Energy Commission are currently developing guidelines and eligible project categories for their respective programs, with initial year project solicitations expected in mid-2009. As discussed in the next section, the State's FY 2008-2009 budget designates that the $48 million available in year one be made available for loans to aid heavy-duty vehicle owners that would be impacted by the proposed regulation.

5. Concepts for Financing Incentives

In developing the proposed regulation, staff recognizes that the proposal must be balanced in such a way that the needed emission reductions and health benefits are achieved, while the State's economy, and the businesses that support it, can continue to grow. As such, it is important that the State take a leading role in ensuring that economic assistance is available for fleets affected by the proposed regulation.

To carry out that role, ARB is developing a heavy–duty vehicle air quality loan program with funding provided from two separate but complementary legislatively-established sources: Prop. 1B and AB 118. The FY 2008-2009 state budget contains an approximate $48 million appropriation to fund a heavy-duty vehicle air quality loan program. Funding for loans from the Prop. 1B program is still to be determined.

Together, these funding sources will be leveraged to provide critical financial assistance options, including finance packages that combine grant and loan funds, to a broad range of qualifying fleets operating throughout California.

a) Applicant Profile

Just as the existing grant programs described above have their respective eligibility criteria, ARB's proposed loan program also targets a specific subset of the trucking industry. The fleets targeted by the loan program are based on the statutes that authorize the funding sources, and primarily consist of heavy-duty vehicle owners for which it is difficult to qualify for conventional financing through traditional banking avenues. That is, ARB's proposed loan program is not intended to provide lending to those that already have established a strong credit history and that could easily qualify for a conventional loan, nor is it intended to provide loans to those that have extremely poor credit with an assumed high risk of default. The program is intended for the "near bankable" -- those that have marginal credit (See Table XV-3).

It should be noted that the current economic climate has expanded the window of credit risk to now include what may have previously been considered "Good". Also, the table below is intended simply to illustrate the portion of the credit risk spectrum on which the loan program intends to focus. The actual loan evaluation process will be dependent on the respective financial institutions.

Table XV-3: Credit Risk

Credit Risks	FICO	Bankruptcy or Collection	Delinquent by 30 days	Delinquent by more than 60 days	Number of Years in Business	Loan-to-value of collateral (%)	Debt-to-income ratio (%)	Debt-to-worth ratio
GOOD	>700	N	N	N	>5	<70	<30	1:1
MARGINAL	620-680	N	Y	N	<3	71-80	31-60	3:1
POOR	<600	Y	Y	Y	<3	>80	>60	>3:1

Additional criteria also include, but are not limited to, fleet size (focusing on the smallest fleets), corridors and regions of operation, financial hardship, and cost effectiveness.

b) ARB's Proposed Loan Program

Staff is proposing that loan funds be made available for: 1) used and new vehicle purchases; 2) ARB-verified DECS; and 3) SmartWay-approved energy efficiency retrofits. The following list provides examples of possible equipment packages, and the corresponding estimated total costs of those packages, that may qualify for loans through the proposed ARB loan program:

- SmartWay packages (includes used/new trailer transactions)
    - Tractor low-rolling resistance tires (LRRT): $4,750
    - Compliant trailer retrofit (LRRT and aero kits): $6,000
    - New SmartWay-compliant trailer: $28,000

- DPFs ~ $10,000 - $25,000

- Used/New Vehicles
  - Used MY 2004 tractor: $45,000
  - Used MY 2007 tractor: $80,000
  - New SmartWay-certified MY 2010 sleeper-cab tractor: $125,000 (price estimated in 2010)
  - New Day cab tractor – MY 2010 tractor: $115,000 (price estimated in 2010)

- Any combination of the above

ARB is proposing to utilize the California Pollution Control Financing Authority's (CPCFA) California Capital Access Program (CalCAP) to leverage Proposition 1B and AB 118 funds to support affordable financing to vehicle owners to achieve early compliance with regulatory requirements. The concept is geared to the typical CalCAP borrower (near bankable) and is not intended to provide funding to high risk borrowers.

c) Potential Applicant Process

(i) ***Grant Funding Process***

Because Carl Moyer Program grants are administered by California's local air districts, and Prop. 1B Program grants are awarded by local air districts and other local agencies (such as Port Authorities), the grant application process and requirements may vary from agency to agency. Though different local air districts and local agency application processes may vary, grants are generally awarded through the Carl Moyer Program and the Prop. 1B Program on a competitive basis. After the district or agency receives funding from ARB, the district or agency announces to the public that program funds are available and issues a request for proposals. Applicants then complete and submit their applications and supplemental documentation before the close of the application period. The district or agency reviews the applications received, and scores the projects according to their established ranking criteria. Typical ranking criteria include cost effectiveness and benefits to impacted communities. The district or agency enters into contracts with the applicants whose projects were highest-ranked. The grantees agree to comply with the contract for the term of the project.

(ii) ***Loan Funding Process***

The California Pollution Control Financing Authority administers the CalCAP, which encourages banks and other financial institutions to make loans to small businesses. CalCAP is a form of "loan portfolio insurance" that provides up to 100 percent coverage on certain loan defaults. The borrower and lender each contribute a small percentage of the principle amount of the loan, which CalCAP matches and places in a "loan loss reserve account" at the lender bank. As the lender enrolls more loans, the loan loss reserve account grows. The participating financial institutions are entirely liable for loan losses, which can be reimbursed through each lender's CalCAP loan loss reserve account. From the beginning of the program in 1994 through the end of 2007, CalCAP has enrolled over 6,800 loans, with a default rate of less than 4 percent.

A small fleet owner or owner/operator may or may not receive a grant award through the competitive processes explained above. Regardless of whether they are a grant recipient, an owner/operator can apply for financing under the CalCAP program. To do so, the potential borrower would speak with a loan officer at a bank or financial institution that participates in CalCAP. Approximately 60 financial institutions, with locations across the state, currently participate in CalCAP. The most current list of lenders and their contact information is available at: http://www.treasurer.ca.gov/cpcfa/calcap/institutions.pdf.

The loan officer would assist the borrower in completing the lender's standard loan application. If the lending institution cannot offer the borrower a loan because the borrower falls just outside their traditional underwriting standards, the loan officer could then evaluate the borrower for eligibility under CalCAP by completing CalCAP's loan enrollment application and ARB's borrower eligibility criteria and certification form. If the borrower meets the CalCAP eligibility criteria, and the lender determines that the borrower qualifies for a loan with CalCAP's backing, the borrower and lender complete the lender's traditional loan issuance process and maintain the lender/borrower relationship throughout the term of the loan.

Except for the small amount of extra information for the borrower eligibility and criteria certification form, ARB staff expects very little additional effort on the borrower to participate in the CalCAP program, compared to traditional loan financing.

B. How an Integrated Grant and Loan Program Could Assist Fleets

Constraints on the availability of grant funds from ARB's traditional incentive programs due to regulatory requirements, coupled with the high demand for grant funds in general, call for the ARB to evaluate new approaches to providing financial assistance to regulated fleets. One concept for a flexible financing option within the ARB's loan program is a combined grant and loan. In this conceptual grant/loan program component, the applicant would apply for an incentive grant for a vehicle purchase through its local air district's or local agency's solicitation process. Upon receiving the grant award, the applicant would then apply for a loan through a participating lender in CalCAP. Staff will continue to pursue a mechanism to combine these programs in the future.

a) Summary of How State Financial Assistance Can Help

This section describes how available state financial assistance can be combined and integrated to assist fleet operators in meeting the requirements of the proposed regulation. The examples used below assume a new day cab, heavy-duty 3-axle truck that costs about $115,000.

Absent any State funding through a grant program to provide down payment assistance, a vehicle owner may see interest rates on qualifying bank loans in the range of 12 percent to 15 percent, on average, with terms that may run between 5 and 7 years. These monthly payments would average about $2,300 per month, ranging from $2,000 to over $2,700 per month. Under the current economic climate, many qualifying owner/operators may not have the same access to financing as they did in a more favorable economy. Similar lending trends are occurring in other financing establishments (e.g., OEM financing sectors, dealership financing, etc.) as well.

Grants from either Prop. 1B Program or the Carl Moyer Program as the sole financial assistance source will provide significant relief to the vehicle owner. As an example, an award of $50,000 from the Proposition 1B program for a new 2010 model year truck would provide a down payment that may qualify the vehicle owner for a bank loan with interest rates and terms similar to those referenced above. However, the loan balance would be less due to the grant as down payment assistance. The resulting schedule of payments may equate to approximately $1,300 per month, ranging from about $1,150 to $1,550 per month.

Qualifying owners may also receive grants through the Carl Moyer Program's Fleet Modernization Program. Depending on local requirements, grant awards may be as high as $75,000 for a new 2010 model year truck, with payments of less than $800 per month.

Additional financial assistance through State loan guarantee programs provides added "bankability" for the profiled owner/operator. By reducing the risk of default by covering a percentage of the principle of the loan and other fees, banks may provide more competitive loans at rates that may range from 8 percent to 10 percent. Terms of the loan may also be extended from the traditional 5-7 year schedule to a 10 year schedule. Such terms are directly tied to the vehicle owner's economic profile. Combining a grant from one of the State's existing programs, combined with the ARB's loan program, will not only enhance the profiled vehicle owner's "bankability," but may also significantly provide a more favorable financing schedule.

C. Federal Funding Sources

1. U.S. EPA: EPA's National Clean Diesel Campaign

Under the Energy Policy Act of 2005, the Diesel Emissions Reduction Act (DERA) authorized $200 million per year for 5 years for implementation of diesel emissions reduction projects across the US. U.S. EPA's National Clean Diesel Campaign Program (NCDC) consists of the NCDC Grants and Funding Program and the State Clean Diesel Grant Program with the first appropriation of $49.2 million authorized by Congress in 2007. The programs provide technical assistance and grants to assist eligible partners to adopt diesel emissions reduction strategies. Grant opportunities are announced at the national level or via regional agreements such as Region 9 and 10 via the West Coast Collaborative.

2. Congestion Mitigation and Air Quality Improvement Program

The Congestion Mitigation and Air Quality Improvement (CMAQ) program, jointly administered by the Federal Highway Administration and the Federal Transit Administration, was reauthorized in 2005 under the Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). The SAFETEA-LU CMAQ is designed to bolster efforts to reach National Ambient Air Quality Standards This program strengthens the transportation planning and air quality connection and is administered via local and state government. Preference is given to cost-effective emissions reductions measures, such as diesel engine retrofits, as well as other cost-effective emission reduction strategies and congestion reducing projects.

D. Local Agency Programs

Most federal and state programs are administered by local air districts. These incentive programs include the Carl Moyer Program and state funds appropriated by legislation for CMAQ and others. Local agency programs usually focus on projects operating within the local air district boundaries. Most programs allow districts to determine the types of projects they may fund. Funding may be allocated for stationary, marine, off-road or on-road projects.

In addition, certain vehicle types and uses of vehicles may have their own specially funded programs. The Ports of Long Beach and the City of Los Angeles fund the Gateway Cities Clean Air Action Program fleet modernization plan via a combination of use fees (concession and container), Proposition 1B, and other matching sources. This program, operates in conjunction with the San Pedro Bay Ports Clean Air Action Plan and Local Area Council of Governments, and anticipates replacing 16,000 trucks to newer used trucks over the next five years. Other agencies and jurisdictions may also have settlement and mitigation funds available for air quality improvement programs.

1. AB 923 Funds

In 2004, state law was enacted that allows local air districts to collect an additional $2 motor vehicle registration surcharge ($2 MV Fee), to be used to fund projects under four different clean air programs which include the vehicles and equipment under the Carl Moyer Program and school bus replacements under the LESB Program. Not all air districts are allowed to collect the initial DMV registration fee, while some air districts choose not to access the fee. Currently about $50 million per year through 2015 is available to pay for projects that are in advance of, or go beyond regulatory requirements.

As described above, funding opportunities for projects under the Carl Moyer Program would be limited. However, under the LESB Program, local air districts that chose to use AB 923 funds to pay for projects may pay for the replacement of any pre-1987 model year school bus or 1987 and newer model year bus powered by two-stroke engines.

2. AB 2766 Funds

In 1990 and 1991, the California Legislature enacted legislation – AB 2766 (Sher, 1990) and AB 434 (Sher, 1991) – to ensure that California's air districts and other local government agencies have the funding needed to carry out their responsibilities for implementing the California Clean Air Act (CAA). The legislation allowed air districts to adopt a surcharge of up to $4 on motor vehicle registration fees to be used "solely to reduce air pollution from motor vehicles and for related planning, monitoring, enforcement, and technical studies necessary for the implementation of the California CAA of 1988." Most air districts in California have adopted a motor vehicle surcharge that generates roughly $110 million per year statewide. In accordance with ARB guidance, most air districts use at least 50 percent of these funds for emission reduction projects such as transportation control measures and clean vehicle projects. Unlike some of the other available funding sources mentioned above, AB 2766 and AB 434 motor vehicle fees are not required to fund projects which are surplus to regulatory requirements.

3. AB 2522

Assembly Bill 2522, signed into State law on September 30, 2008, authorizes the San Joaquin Valley Air Pollution Control District to increase motor vehicle fees - now at $6 per vehicle - to as much as $30 per vehicle. The additional fees would to be used to fund incentive-based programs to achieve surplus emission reductions to remediate emissions from mobile sources that the District determines are needed to help achieve and maintain ambient air quality standards. If the District opts to collect the full $30 fee, it could generate about $75 million in new revenue per year. Of those funds, at least $10 million are to be used to mitigate air pollution in disproportionately-impacted environmental justice communities. Assembly Bill 2522 authorizes the fees to be collected until 2013. Fee authority is extended to 2024 if the U. S. Environmental Protection Agency approves the reclassification of the District's ozone nonattainment status to "extreme."

XVI. RATIONALE FOR REGULATORY PROVISIONS AND CHANGES TO OTHER REGULATIONS

This chapter describes staff's rationale for some of the proposed provisions of the proposed regulation, as well as the proposed changes to the other existing regulations.

A. Low Use Exemption

A vehicle that is operated less than 1,000 miles and less than 100 hours per year in California would be exempt from any performance requirements. This allows fleet owners to operate some older vehicles if necessary as back up, while not having a significant impact on emissions. This provision also provides flexibility for fleets operating near the borders of California so that out-of-state fleets would have the ability to bring vehicle into California for very brief visits (while not accruing many miles) and be exempt from the performance requirements of the regulation.

In addition, because out-of-state fleets may not be able to predict which vehicles will need to come to California incidentally, staff has also proposed to allow an out-of-state fleet the option, available only to be used once each year, to operate a single vehicle in California for a 3 day period regardless of miles travelled. The fleet owner would be required to report the vehicle information immediately before the trip, but would not have any additional record keeping requirements to meet. With this, an out-of-state fleet would not need to anticipate which vehicles would come to California at the beginning of each year. However, as previously stated, a fleet could only use this option once per year, and only for one vehicle.

During the regulatory process, it was suggested that this threshold be raised to allow for the accrual of additional miles while avoiding the performance requirements. Staff evaluated the emission impacts of raising the 1,000 mile threshold to a higher level, and concluded that raising the mileage threshold would result in the current proposal not meeting the SIP commitments.

B. Fleet Average and BACT Percent Limits

The fleet averaging option provides the most flexibility for fleets to determine the most cost effective action to take. The fleet average option allows fleets to select which vehicles to upgrade or retire rather than having to follow a prescribed schedule. It provides more flexibility to buy used vehicles to comply with the proposed regulation, lowering compliance costs. It also provides a mechanism for fleets to take advantage of NOx control technologies that, while not achieving the maximum NOx emissions reductions, would nonetheless lower fleet emissions and delay vehicle replacements. The fleet average also provides a mechanism to provide credit for the use of alternative fueled vehicles or hybrids.

The BACT percent limits is best suited for fleets that prefer to buy engines with 2010 emissions technology. It allows fleets to replace a vehicle a single time during the compliance period. It is fairly straightforward to understand and to plan for future replacements. It also is the best option for fleets to use if they need to keep some older equipment. For example a fleet that has a specialized 1991 model year crane and 9 vehicles may use this option by installing a verified DECS on the crane and keeping it through 2022 provided that the other vehicles are being replaced to meet the fleet percentage requirements.

C. Delays to the NOx Performance Requirements

1. Vehicles below Specific Mileage Thresholds

Staff has proposed to delay compliance with the NOx performance requirements, while maintaining the PM performance requirements, for vehicles operated below specific mileage thresholds. The proposed mileage thresholds are 7,500 miles per year for tractors and vehicles with a GVWR greater than 33,000 pounds, and 5,000 miles per year for all other vehicles with a GVWR less than 33,000 pounds. These thresholds were proposed based on staff's cost effectiveness evaluation for achieving PM and NOx reductions on individual vehicles, and on the number of vehicles that would potentially qualify for the delay.

First, staff concluded that it was appropriate to establish different thresholds (based on vehicle weight) for medium heavy -duty vehicles and heavy heavy-duty vehicles and tractors. This is because, on average, tractors and vehicles greater than 33,000 pounds are more expensive to replace than smaller vehicles. In addition, larger vehicles tend to drive more miles each year than smaller vehicles. Also, the proposed thresholds generally coincide with thresholds established by the United States Internal Revenue Service regarding tax suspensions, for which fleets with such vehicles may file. This tax suspension applies to highway motor vehicles having taxable gross weights of 55,000 pounds or more that are operated on public highways annually for 7,500 miles or less for agricultural vehicles, or 5,000 miles or less for other businesses.

As part of the analysis, staff evaluated the emissions impacts associated with this proposed provision. Using the statewide vehicle population in the emission inventory, vehicles operated below these mileage thresholds represent about 15 percent of the total vehicle population of in-state vehicles, and about one percent of the total vehicle miles traveled. This represents about a two percent loss in potential total NOx and PM emission benefits.

The following example compares the PM and NOx emissions in 2014 of a vehicle qualifying for this provision relative to a vehicle in a fleet that is meeting NOx and PM performance requirements. In its analysis, staff used a vehicle with a 1990 model year engine traveling 5,000 miles per year and compared it to an average vehicle in a fleet that met the 2014 fleet average and traveled 30,000 miles annually. The results of this comparison are shown below in Table XVI-1.

Table XVI-1: Emissions Comparison of Low Mileage Vehicle and Typical Fleet in 2014

Fleet Comparison	Annual Miles Traveled	NOx (lbs)	PM (lbs)
Typical Vehicle in a Fleet Meeting 2014 Fleet Average	30,000	650	7
1990 Model Year Engine with verified DECS	5,000	240	6

As can be seen, the heavy-duty vehicle with a 1990 model year engine and a DPF that travelled 5,000 miles per year would emit about 240 pounds of NOx per year, and about 6 pounds of PM. A heavy-duty vehicle travelling 30,000 miles in a fleet complying with the proposed regulation in 2014 would emit about 650 pounds NOx and about 7 pounds of PM. Without a verified DECS, the 1990 model year vehicle would emit about 37 pounds of PM annually. Based on this analysis, staff believes that providing a delay in the NOx performance requirements for vehicles that travel below the specific mileage thresholds described above would provide fleets with additional flexibility and reduced costs without sacrificing significant emission benefits.

It was suggested by some stakeholders that fleets would simply increase the number of vehicles that they have so that they may stay below these mileage thresholds. Staff has considered this, but does not believe that such a situation is likely to occur. Because fleets utilizing these provisions still must still install a verified DECS on their vehicle, and because the cost of such a retrofit relative to the value of the vehicle on which it would be installed is often greater, staff does not believe it makes economic sense for fleets to pursue such actions. In fact, staff expects that many fleets will retire some of their older, less critical, lower use vehicles to avoid the cost of verified DECS, and instead better utilize the remaining vehicles that they have, or will rely on subcontractors or rentals where possible.

Staff also evaluated alternative thresholds and requirements and concluded that the current proposal provides sufficient reductions to California's SIP commitments and an incremental increase would result in not meeting the SIP commitment. As shown in Table XVI-2 a change to the current proposal would increase emissions in key years. The left column shows the emissions increase from permanently exempting all vehicles below the current mileage thresholds from the PM and NOx performance requirements. The middle column represents raising the mileage thresholds to 10,000 miles for all vehicles until 2021; they would still be required to install verified DECS. Finally, the right column shows the impact of permanently exempting all vehicles operating below 10,000 miles from the NOx and PM performance requirements.

Table XVI-2: Alternatives Emission Loss Compared to Staff Proposal (tpd)

Calendar Year	Permanently Exempt from PM and NOx at Current Mileage Threshold		NOx Exempt up to 10,000 Miles until 2021		Permanently Exempt Up to 10,000 Miles	
	NOx	PM	NOx	PM	NOx	PM
2014	0.0	0.3	5.2	0.0	5.2	0.7
2017	0.0	0.3	3.6	0.0	3.6	0.6
2020	0.0	0.2	3.0	0.0	3.0	0.4
2023	3.2	0.2	0.0	0.0	5.9	0.3

2. NOx Exempt Areas

Staff recognizes that air quality problems are less severe in some parts of California. For that reason, staff proposed a special provision for vehicles operating exclusively in counties that are in attainment of the federal ozone and PM ambient air quality standards, and do not contribute to downwind exceedances of the state or federal ozone and PM standards. The provision would allow vehicles that operate exclusively in "NOx exempt areas" to be delay compliance with the NOx performance requirements until January 1, 2021. However, these vehicles would still remain subject to PM performance requirements. This is because diesel PM emission reductions are still necessary to reduce the localized risk of PM exposure, and such an approach is consistent with similar provisions provided in the In-Use Off-Road Diesel Vehicle Regulation.

3. Agricultural Vehicle Provisions

The agricultural vehicle provisions would exempt lower use agricultural vehicles from the NOx and PM performance requirements for a specified period of time. Agricultural vehicles are those that are used exclusively in field operations, those that transport agricultural products to the first point of processing after harvest, and certain trucks owned by chemical supply companies that deliver chemicals or crop protection products from a distribution center to a farm. Under these provisions, agricultural vehicles operating above the mileage thresholds (with the exception of specialty agricultural vehicles) would be required to comply with the NOx and PM performance requirements just as any other vehicle.

In considering these provisions, staff ensured that two key parameters were met. First, that the provisions would not jeopardize the anticipated emission benefits of the proposed regulation such that the State did not meets its SIP commitments, in any year, in the San Joaquin Valley and the South Coast Air Basins; and second, that the provisions did not result in any adverse impacts relative to localized risk. While the proposed agricultural vehicle provisions meet the first parameter, in that the State meets or exceeds its SIP commitments in all years evaluated despite a small loss in emission benefits as a result of the proposed provisions, additional work is needed to more fully understand the scope of any localized risk impacts from the delay in the PM performance standards for these vehicles, and to develop recommendations to address the impact.

a) Compliance with the State's SIP Commitments

Staff estimates there are about 22,000 agricultural vehicles within the scope of the proposed regulation operating in California, which service over 72,000 farms and other agricultural operations through out the state. Agricultural vehicles are most prevalent in the San Joaquin Valley (about half of the statewide population), with the rest operating in other areas of the state (in contrast, there are very few agricultural vehicles operating in the South Coast Air Basin). Information about the statewide population of agricultural vehicles was obtained from a number of sources, including survey data and vehicle registration data from the DMV. In general, and consistent with statewide fleet as a whole, most agricultural vehicle owners have fairly small fleets. Some reported fleets larger than 10 vehicles, and only a few reported owning more than 20 vehicles.

Based on the information available, about 70 percent of the agricultural vehicles in the state are expected to be limited-use agricultural vehicles (operate less than specific mileage thresholds based on the model year of the engine), and 50 percent are expected to be low-use agricultural vehicles (those which operate less than 10,000 miles per year). Using this and other information, staff estimates that a delay in the NOx and PM performance standards for these vehicles will result in a loss of about 1 TPD of SIP NOx reductions in the San Joaquin Valley in 2017. However, despite this, staff estimates that the proposed regulation will still provide 49 TPD of SIP NOx reductions in 2017 in the San Joaquin Valley, matching the State's SIP commitment for this region.

To better ensure that the SIP commitment is met, the proposed regulation would limit the number of limited use and low-use agricultural vehicles that could take advantage of the proposed delay in the NOx and PM performance standards. This is achieved by fleets "locking in" the number of limited use and low-use agricultural vehicles in 2010, based on their 2009 fleet. Once locked in, the number of these vehicles cannot increase over the entire compliance period. In addition, the limited use agricultural vehicle population reported in 2010 must meet the PM and NOx performance standards by January 1, 2017, and the low-use agricultural vehicles that operate above 1,000 miles must meet the NOx and PM performance standards by January 1, 2023. In addition, while the proposed regulation would allow agricultural fleets to replace limited use and low-use vehicles under certain conditions, these vehicles must be replaced with newer vehicles, a natural decrease in emissions from these vehicles over time, until they must meet the NOx and PM performance standards.

b) Definition of Agricultural Vehicle

A number of different types of vehicles are included in the definition of agricultural vehicle, and typically include one of four types:

- vehicles that are used on a farm;
- vehicles that deliver products from a farm to a point of first processing;
- specialty agricultural vehicles, and;
- specialized vehicles that deliver specialty chemicals (fertilizers and crop protection products) to a farm.

The first three types of vehicles are used in the active production, cultivation, and harvesting, and transportation of crops, and for other agricultural operations. These vehicles are typically owned by a farmer, a farmer cooperative, or a custom harvester or hauler (a for-hire operator to perform such services for farmers, typically under a contract). As such, staff believes it is appropriate to include such vehicles in the proposed definition.

Staff also proposed to include vehicles that exclusively deliver fertilizer or crop protection chemicals to a farm. These vehicles are typically specialized, and are required by the United States Department of Transportation to have certain placards. In addition, these vehicles are predominantly owned by farm supply companies, and these companies must have a license through the California Department of Pesticide Regulation and/or the California Department of Food and Agriculture. Staff's rationale for including such vehicles is that these vehicles typically operate on a regional basis, usually within a 50 mile radius of a chemical distribution center. Vehicles in this service are important in the distribution of these chemical products in the agricultural industry, as they are often dispatched on short notice to deliver various chemicals or gases to a farm while the weather conditions are favorable for their application. It is important to note that vehicles that deliver any other products or equipment to the farm such as feed, seed, fuel, cryogenic liquids, parts or other items, would not be included in the this definition.

Specialty agricultural vehicles include a subset of agricultural vehicles including:

- nurse rigs;
- cotton module trucks;
- feed trucks used by cattle and calf feed lots, and;
- water trucks owned and operated by farmers for dust control and irrigation.

Staff included such vehicles in the definition of agricultural vehicles for a number of reasons, including the specialized nature of these vehicles and their high replacement costs, the seasonal nature of their use, their relatively low annual mileage, and their use predominantly on a farm. However, because there is no mileage limitation on these vehicles, and to ensure that the State meets its SIP commitments in 2017, especially in the San Joaquin Valley, staff is proposing to cap the number of these vehicles that may claim the specialty vehicle provisions in any given year. This cap would be no more than 1,100 vehicles in the San Joaquin Air District, and no more than 2,200 statewide trucks. Table XVI-3 shows the estimated number of specialty vehicles, by body type, operating in the state.

Table XVI-3: Specialty Agricultural Vehicle Population Estimates

Body Type	Estimated Number of Vehicles (2008)	
	San Joaquin Valley	Statewide
Cotton module	170	193
Water	622	1,022
Feed Trucks (Cattle and Calf Feed Lots)	10	100
Nurse Rig	94	190
Total	896	1,505

c) Localized Risk Impacts

While staff believes that the proposed amendments will meet the state's PM and NOx emission reduction commitments under the SIP, there is still a need to ensure that any delay in the PM performance standards does not have an adverse impact on the anticipated reduction in exposure risk to diesel PM. To evaluate the potential impacts on risk from staff's proposed agricultural vehicle provisions, staff performed a health risk assessment of two "generic" agricultural processing facilities that might receive vehicles that do not meet the PM performance standards of the proposed regulation.

For its analysis, staff modeled two generic facilities, one in the Bakersfield area, and one in the city of Commerce. In its analysis, staff assumed only vehicles that do not meet the PM performance standards (i.e., do not have DPFs) visited the facility. As such, to the extent that vehicles that do meet the PM performance standards visit these facilities, the estimated risk impacts are conservative. In other words, the potential risk impact of staff's proposal depends not on the total number of trucks that visit a facility, but rather on the number of trucks that visit a facility and do not have PM controls installed. In addition, actual risk levels will vary due to site specific parameters, including the number of uncontrolled trucks and associated emission rates, operating schedules, routes traveled to the location, site configuration, site meteorology, and distance to receptors.

To investigate the potential risks associated with low-use and limited use agricultural vehicles used to transport agricultural commodities from the field to a processing facility, ARB staff developed general assumptions bracketing a range of possible operating scenarios and estimated potential cancer risks. Using this approach, cancer risk was estimated as a function of the number of "uncontrolled" truck trips and the distance from the roadway or processing facility. A description of staff's assessment is provided in Appendix E. Since the activity at any given processing facility can vary based on its throughput, staff's analysis provides an initial assessment of potential impacts of staff's proposal. However, unless an actual facility is modeled, using data specific to that facility, the actual risk from staff's proposal cannot be determined.

Table XVI-4 below provides the results of staff's analysis for Bakersfield and shows the distances from the facility or roadway boundary wherein the risk is above 10 in a million for different uncontrolled agricultural vehicle volumes. For example, a facility that has 28,800 roundtrip truck trips per year, the risk level of 10 in a million could extend to a downwind distance of about 1,100 feet from the facility or roadway boundary.

Table XVI-4: Distances from the Facility Boundary wherein the Risk is 10 in a Million for Different Agricultural Vehicle Volumes

Vehicles/Yr	Distance (Meters)	Distance (Feet)
5,760	N/A	N/A
11,520	50	164
17,280	120	394
23,040	250	820
28,800	350	1,148
43,200	600	1,968
57,600	850	2,789
72,000	1,000	3,281
86,400	1,300	4,265
115,200	1,700	5,577
144,000	1,900	6,234

Because of the uncertainty with staff's analysis, it is unclear as to the actual impact of staff's proposal on sensitive receptors near agricultural processing facilities. While many of these facilities are located in rural areas, away from population centers, not all of them are. In addition, even for those that are located in rural areas, it is necessary in some instances for these vehicles to travel through more urban areas. Finally, while staff's analysis looked at individual facilities, it was not able to understand the cumulative impact of several facilities located in close proximity to one another. While staff does not believe that these findings are sufficient to delay staff's proposal for low-use and limited use agricultural vehicles, staff believes it is necessary to better understand this potential impact by evaluating several actual facilities throughout the state. Staff intends to continue their evaluation of the potential risk impacts of this proposal over the next 12 to 18 months, and, if appropriate, develop recommendations to ensure that the proposal does not result in an unacceptable impact on risk to communities.

4. Unique Vehicles

While the regulation was written to allow the purchase of used vehicles to lower the overall costs of the proposed regulation, staff recognizes that certain types of vehicles that perform special functions are less common and that used a vehicle may not exist. In the event that such a vehicle needed to be replaced, there may not be a used replacement available, and the fleet owner would be forced to purchase a new replacement vehicle. To alleviate such a situation, staff is proposing to delay the compliance with the NOx performance requirements of such vehicles until January 1, 2021. In receiving such flexibility, the fleet owner would have to take action to ensure that all other vehicles in that fleet meet the NOx and PM performance standards. In other words, the unique vehicle would need to be included in the fleet for determining the fleet average or the BACT percentages, and all other vehicles would still have to be cleaned up first. However, once all other vehicles in the fleet meet the BACT criteria, the remaining unique vehicle would need to take actions to meet the specific criteria in the proposed regulation.

D. Cab Over Engine Tractors with 57 foot Trailers

In California, the overall length of a truck and semi-trailer combination can be no more than 65 feet. However, a semi-trailer as long as 57 feet can be pulled provided the truck-tractor is a short cab over-engine type tractor. A 57 foot trailer cannot legally be pulled by a tractor with a conventional configuration. However, production of new cab over-engine type tractors in North America ceased in 2007, using 2006 model year engines. As such, no new cab over engine type tractors having 2007 model year engines are available, and none are expected to be made in the future.

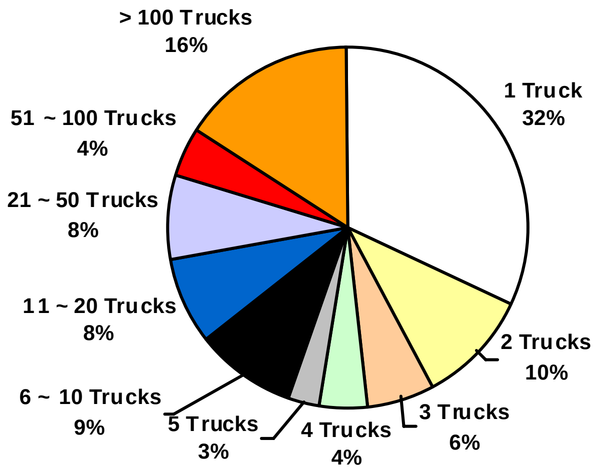
To address this, staff is proposing a provision to delay the NOx performance requirements for cab over-engine type tractors exclusively pulling 57 foot trailers until January 1, 2018. Businesses that typically use such configurations include those that haul products that have a low density such as empty cans, bottles, or pallets.

Unless high efficiency verified NOx and PM DECS become available, the proposed regulation would impose a significant cost for businesses using these vehicles and 57 foot trailers because the regulation would effectively require the replacement of both the tractor and the trailer. This is because operators using cab over engine type tractor would have to switch to using conventional cab truck-tractors pulling 53 foot trailers in order to stay within California's length laws. The 4 foot difference between the two trailers amounts to about 7 percent less cargo that can be carried. As a result, these companies will experience an annual economic loss because the shorter trailer will carry less cargo. More truck trips would be required to deliver the same amount of product. More trips would result in using more fuel and in higher fuel expense. Similarly, additional trips would result in more operating expenses such as increase wages paid by the business.

E. Small Fleet Provisions

Staff is proposing to delay the NOx and PM performance requirements for fleets of three or fewer vehicles until January 1, 2013. According to 2006 DMV data, as shown in Figure XVI-1, almost 50 percent of fleets have three or fewer diesel vehicles subject to the proposed regulation. Also, small fleets tend to operate older vehicles relative to larger fleets, but would not benefit from the flexibility provided by the fleet average option or the BACT percent limit option because of the limited number of vehicles.

Figure XVI-1: Number of Vehicles by Fleet Size (California Department of Motor Vehicles, 2006)



Because of the economic challenges facing small fleet operators, staff believes it is appropriate to provide additional time for compliance, and to establish somewhat lesser regulatory requirements for small fleet operators during the first years of the program. However, while additional time is provided, these vehicles will still ultimately need to meet the same NOx and PM performance standards as a vehicle owned by a larger fleet operator. As such, staff believes that the proposed small fleet provisions will reduce the initial costs to small fleets to comply with the proposed regulation in the near term, but will still provide substantial emission reductions from these vehicles in the long run.

F. Credit for Hybrid and Alternative Fuel Vehicles

Staff is proposing credit for the use of hybrid vehicles to accelerate the introduction of hybrid technology in heavy-duty vehicles. Hybrid technology can play an important role in meeting California's goals of reducing GHG emission under AB32.

While hybrid diesel vehicles production today is low, due to increasing fuel prices and the growing maturity of the hybrid technology, the wide spread use and availability of hybrid vehicles in the future is anticipated. At this point in time, staff believes it is appropriate to establish provisions in the proposed regulation that will encourage the purchase and use of medium heavy-duty and heavy heavy-duty hybrid vehicles. While the benefit of hybrid technology to reduce GHG emissions is clear, it also has the potential to provide criteria pollutant emission reductions as well.

Many truck and system makers are currently developing heavy-duty hybrid prototypes or pre-production units, an important point in the evolution of hybrid technology, but these efforts have not yet achieved critical mass. One of the key barriers to the early success of hybrid vehicles is that production volumes are low, so prices remain high.

The hybrid credit staff is proposing to include in the regulation would be provided for a hybrid vehicle as long as the fuel economy of the hybrid is at least 20 percent better than an equivalent, conventionally fueled vehicle. A number of hybrid platforms have already achieved this level of incremental efficiency improvement, and staff does not believe that it will present a barrier for receiving credit. Staff has also proposed that the credit would expire January 1, 2018. By that time staff believes hybrids will be much more common and will likely be more cost-effective to operate than conventional vehicles, eliminating the need top provide further credits.

G. Enforceability Provisions

1. Requirements for Possession of Valid Operating Permit

Staff is proposing that in order for fleets to take advantage of any of the flexibility provisions or compliance extensions of the proposed regulation, including the fleet average, BACT percent limits, small fleet, etc, that the fleet operator possess and provide one of the following valid operating permits:

- a valid California motor carrier of property number,
- a valid identification number assigned by the United States Secretary of the Department of Transportation, or
- a valid operating authority number issued by the Public Utilities Commission, or
- other applicable valid operating authority number approved by the Executive Officer.

This requirement was included at the suggestion of stakeholders to ensure that fleets that are utilizing the flexibility provided by the regulation are also complying with applicable operating permit requirements to lawfully travel on California highways. Staff believes that such a requirement will improve the overall enforceability of the regulation.

2. Requirements for Brokers, Motor Carriers and Other Vehicle Dispatchers

In an effort to ensure that all vehicle owners comply with the proposed regulation, in-state or out-of-state motor carriers, California-based brokers, or California residents that operate or direct the operation of any vehicle subject to the proposed regulation would be responsible for hiring fleets with compliant trucks. Both motor carriers and brokers direct the operation of their drivers, and as such, are in a unique position to verify compliance with the proposed regulation. Such a requirement is already in place for other aspects of motor vehicle compliance, such as requiring proof of vehicle insurance, proper drivers licensing, and proof of compliance with various drug testing, vehicle safety, and worker compensation requirements.

The proposed regulation would require these motor carriers and brokers to retain records documenting that the drivers they hire or dispatch are in compliance with the proposed regulation, but would have an affirmative defense for violations by a vehicle operator they dispatched if they can demonstrate that they verified the compliance status of the operator at the time they were hired or dispatched.

To assist these motor carriers and brokers, the proposed regulation includes the development of a system to allow them to easily determine the compliance status of any business or vehicle operator. Under such a system, vehicle owners would electronically report to ARB the information regarding their vehicles and their compliance mechanism. Upon completion, an Internet based system would generate a Certification of Reported Compliance that would be available for printing and would be available on-line. The system would allow motor carriers and brokers to determine which of their drivers have reported compliance with the proposed regulation to ARB.

H. Exclusion of Personal Use Motor Homes

Staff has proposed to exempt non-commercial motor homes from the scope of the proposed regulation for a number of reasons. First, owners of these vehicles do not have the ability to offset the compliance costs since personal use motor homes do not generate income nor appreciate in value. In addition, these vehicles typically operate very few miles in California, and as such, do not contribute significantly towards emissions relative to other vehicles covered by the proposed regulation.

According to 2007 California Emission Forecasting System (CEFS) estimation, the annual average PM and NOx emissions from diesel-powered motor homes for the years between 2007 and 2020 are less than 0.3 percent and 0.5 percent, respectively, of the overall mobile fleet emission respectively (ARB, 2007a). The EMFAC2007 estimates that the annual mileage driven per motor home in calendar year 2010 is approximately 3,000 miles within the state (ARB, 2007b). Since the average mileage is low, it would indicate that most private use motor homes are not driven a significant number of miles within the state, are used infrequently, or are parked for a significant amount of the time.

Considering the potential financial burden on owners of personal use motor homes, and the fact that most personal use motor homes would qualify for the proposed delay of the NOx performance requirements based on their mileage, staff believes that excluding personal use motor homes from the proposed truck and bus regulation is appropriate.

I. Safety Considerations

Through the course of the development of the proposed regulation, staff considered potential concerns raised by affected stakeholders regarding safety from the operation of vehicles that had been retrofit with verified DECS. These issues included: requirements for diesel retrofits on agricultural and fuel delivery vehicles could lead to fires, increased engine operating temperatures due to backpressure, and potential visibility restrictions. While many of these concerns are unfounded, staff believes it is appropriate to include provisions in the proposed regulation which could address any safety concerns regarding the use of verified DECS under the regulation. Such an approach was also included in the In-Use Off-Road Diesel Vehicle Regulation for the same purpose.

A safety issue was also raised regarding the use of SCR systems, and the use of ammonia or urea as reducing agents. While ammonia is significantly more hazardous than urea, its use as a reductant in SCR systems for diesel vehicles is limited, with no major engine or DECS manufacturers proposing its use. The preferred reductant is urea, which has limited health effects in that it can cause skin or eye irritation if these parts of the body are exposed.

It is not the intent of the proposed regulation to require the unsafe installations of any verified DECS. In fact, the proposed regulation only requires retrofits if they are verified as proven, effective, durable, safe, and warrantied; it never requires retrofits if they are not verified, will not work, or are unsafe. To address this, the proposed regulation provides a process under which the Executive Officer could determine that if a verified DECS cannot be installed safely, its use is not required. We believe the safety provisions in the verification procedure and the proposed regulation are adequate to ensure that the regulation will not require any unsafe installations. The proposed regulation also contains an appeals procedure so that if a fleet owner disagrees with the Executive Officer's decision regarding the safety of a device, the fleet owner has the opportunity to challenge an Executive Officer's determination that a retrofit device does not impair the safe operation of a vehicle.

J. School Buses

Currently there are about 24,000 school buses that transport children to and from school in California each year. School buses tend to accrue fewer miles than many other heavy-duty vehicles operating in California, which leads to vehicles having a long useful life. As such, school bus fleets tend to be comprised of buses that have been or will operate for 30 years or more. Additionally, school buses are also predominately operated by local school districts which are dependent on limited public funds. Since replacing these vehicles is costly, school districts are likely not able to comply with the NOx performance requirement due to limited school district budgets.

However, reducing diesel PM emissions is critical due to reducing the health risks associated with exposure to diesel PM, especially for children. School age children are especially vulnerable to the affects of air pollution.

As such, staff is proposing that each school bus fleet or school bus sub-fleet (diesel-fueled vehicles that will be incorporated as part of the school bus fleet) must comply with PM (but not the NOx) performance requirements of the proposed regulation that are specific for school buses. Under this schedule, by January 1, 2014, all diesel fueled school buses must be retrofitted with the highest level verified diesel emission control strategy available to be used on any engine used in school buses regardless of the compliance option chosen. However, school bus fleets or school bus sub-fleets do not need to meet the NOx performance requirements of the proposed regulation.

In addition, any school bus manufactured before April 1, 1977, must be taken out of service no later than January 1, 2012. This is because these vehicles were manufactured before minimum federal safety standards were in place. However, incentive funding through Proposition 1B is available to replace these buses.

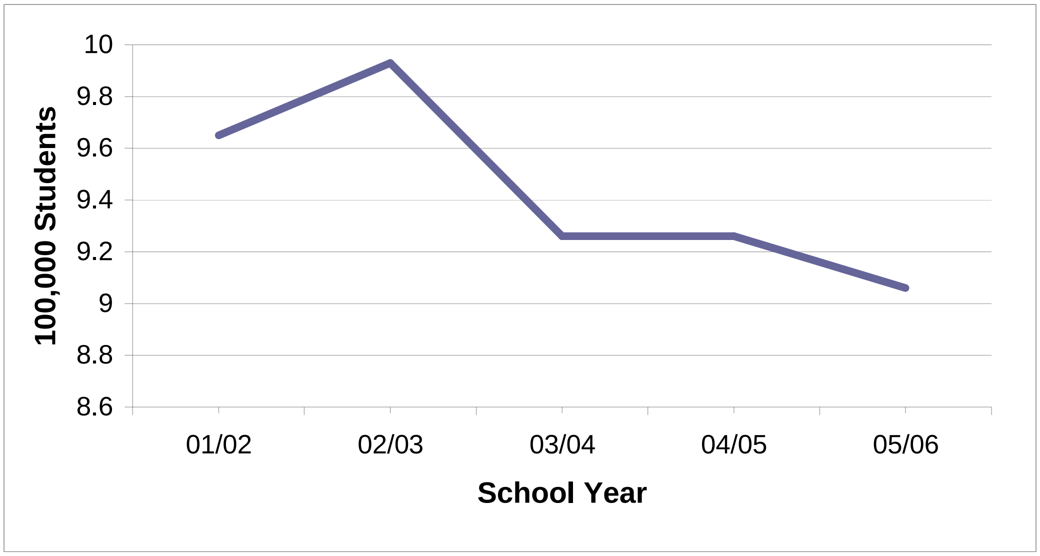
Appendix I further discusses the regulatory requirements, available incentive funding, and existing technology available for school buses.

1. Safety Issues

During the development of the proposed regulation, several school district stakeholders expressed concerns about the potential safety impacts of staff's proposal on school children. This concern was expressed in the context that many school districts do not have the funding available to meet the proposed PM performance standards for school buses, and will likely reduce or eliminate school transportation services instead of complying with the proposed requirements. This would in turn mean that many children will be either forced to walk to school or ride in a private vehicle, which many studies have shown is significantly less safe than transportation via a school bus.

Staff agrees with these stakeholders on the safety advantage that school buses provide relative to other forms of transportation, and it is not the intent of the staff to establish requirements that would reduce the health impacts on school children while simultaneously reducing the safety of school children. However, as can be seen in Figure XVI-2, the number of students transported annually in California has been declining statewide since 2002 as school districts across the state have reduced or eliminated school transportation services. Staff does not believe that the proposed regulation will have an effect on this continuing trend, but will continue to monitor the situation. If transportation services are adversely impacted by the proposed regulation, staff will consider, as appropriate, alternatives to ensure the safety of school children is not jeopardized.

Figure XVI-2: California K-12 Students Transported at Public Expense



Source: Data from School Transportation News Buyer's Guide as reported by the California Department of Education.

K. Drayage (Port) Trucks

Drayage trucks are diesel-fueled, heavy-duty trucks that transport containers, bulk, and break-bulk goods to and from ports and intermodal rail yards to other locations. Staff estimates that about 20,000 drayage trucks regularly service ports and rail yards in California. ARB adopted a regulation in December 2007 that requires all vehicles entering ports and intermodal rail yards to have PM controls by December 31, 2009, except for 2004 to 2006 model year engines. Staff at that time were concerned with creating any incompatibility with the then planned proposed regulation because it was uncertain what the final proposal would be.

To ensure consistency between the requirements in the drayage truck regulation and the proposed regulation, staff is proposing to require drayage trucks with 2004-2006 model year engines to install the highest level verified DECS according to the same schedule as all other trucks subject to the proposed regulation. This requirement would align the drayage truck regulation with the proposed regulation. This would also help meet the State's PM emission reduction commitments, and would ensure uncontrolled trucks would not cycle into the drayage fleet to avoid the requirements of the proposed regulation.

Staff is also proposing to include drayage trucks in the scope of the proposed regulation beginning January 1, 2021. This would harmonize the requirements between the two regulations after that date, and would provide additional emission reductions needed to meet the 2023 ozone SIP commitments.

L. Two-Engine Cranes

Throughout the regulatory development process, staff has been working to address a number of issues regarding the control of emissions from two-engine cranes by multiple regulations. As discussed in Chapter XI, cranes are currently regulated by as many as four different regulations, including the In-Use Off-Road Diesel Vehicle Regulation, the Portable Engine and Equipment Regulation, the Cargo Handling Equipment Regulation, and the statewide Portable Engine Registration Program. This has created a confusing and conflicting regulatory environment. To address this issue, and to provide a path for crane operators to clean-up these vehicles in a more cost-effective manner, staff's proposal would place the regulation and clean-up of all two-engine cranes in the In-Use Off-Road Diesel Vehicle Regulation. Staff believes that this approach is superior to the current approach. This is especially true when considering the unique issues facing cranes, including the safety and feasibility of repowering and/or retrofitting upper crane engines.

In evaluating two-engine cranes as part of this regulatory effort, staff identified the following areas of concern:

- Issues with compliance with more than one regulation
- Feasibility issues with the replacement and/or retrofit of auxiliary engines
- Safety compliance issues
- OSHA and Cal-OSHA re-certifications
- Costs

Some of these issues are further discussed below.

1. Feasibility of Repowering and Retrofitting

Modifications to the original crane design cannot be easily performed. Each modification requires specialized engineering to design/specify parts to ensure the safe operation of a modified crane. For example, the repower or retrofit of a secondary engine can create safety and design concerns, as the secondary engine is part of the counterweight system of the crane. A small weight change can have a significant impact on a crane's lifting capacity and interfere with the electronic controls programmed into the crane's positioning system gear (Sierra, 2007).

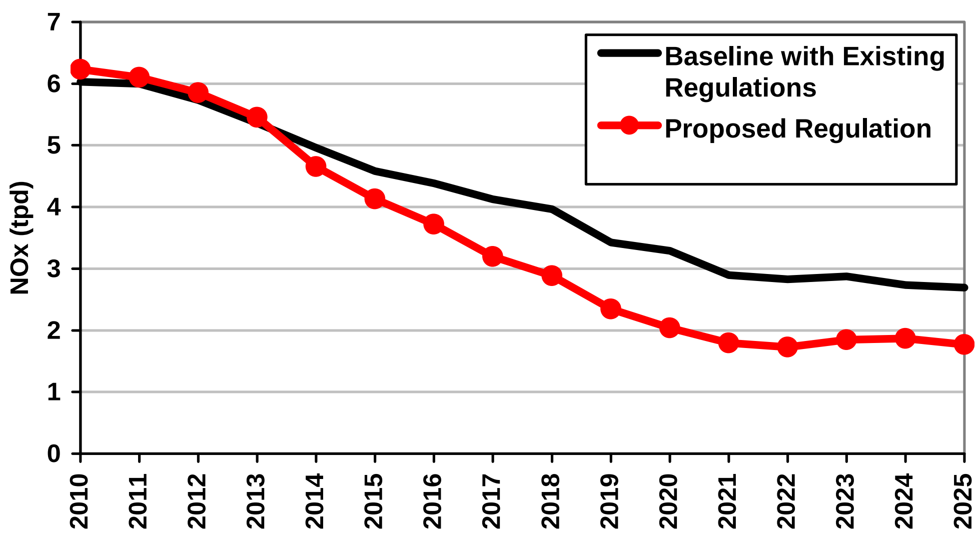
Repowering or retrofitting secondary crane engines requires crane manufacturers' approval first, and then requires recertification by OSHA and Cal-OSHA. Therefore any modification, alteration or change to a crane that affects its original design, and is not authorized and approved by the crane manufacturer, is strictly prohibited and voids any manufacturer warranties (Sierra, 2008 and Sierra 2007). This includes changes associated with repowering or retrofitting the auxiliary engine. Most two-engine crane manufacturers have submitted to staff that physical changes to the crane are unauthorized. Copies of these letters are provided in Appendix L.

Without staff's proposed modifications, many two-engine cranes in California would have to be replaced to meet the existing requirements of existing regulations since these engines cannot be replaced with newer, cleaner engines. Such a requirement would result in significant costs to crane operators, as new two-engine cranes can cost as much as several million dollars.

2. Impact on Emissions

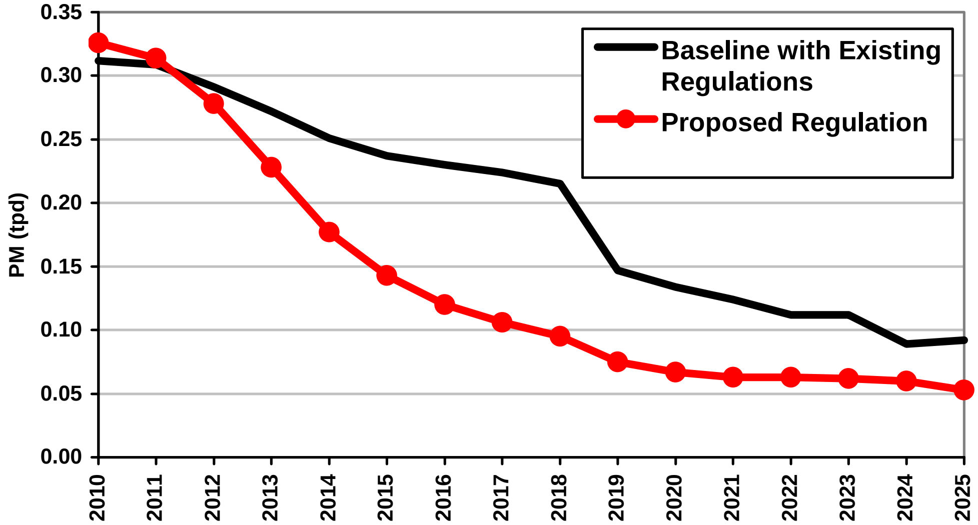
Staff evaluated the emission impacts of their proposal using information provided by crane operators and from DMV data. In their analysis, staff modeled the emission benefits from two-engine cranes under existing regulations, and then compared this to the anticipated emission benefits of the staff proposal. The results of this analysis for NOx are shown in Figure XVI-3. As can be seen, there would be a slight increase in NOx emissions in 2010 through 2013 from staff's proposal, but a considerable NOx benefit after 2013.

Figure XVI-3:   NOx Emissions Benefits of Staff Proposal



As shown in Figure XVI-4, the current proposal would result in a small increase in PM emissions in 2010, but would result in substantial PM reductions thereafter.

Figure XVI-4: PM Emissions Benefits of Staff Proposal



Because of this analysis, staff believes that this proposal will result in additional emission benefits relative to current regulations, and will achieve these reductions at a substantial cost savings. More details on the estimates for number of cranes and details of the emissions calculations methodology are in Appendix L.

3. Effect on SOON

In adding two-engine cranes to the proposed amendments to the In-Use Off-Road Diesel Vehicle Regulation, staff is also proposing to exclude the horsepower in two-engine cranes from a fleet's maximum horsepower in determining eligibility for Surplus Off-Road Opt-in for NOx (SOON). This would be consistent with the intent of the regulation in that the second engine in two-engine cranes, as well as the propulsion engine in on-road two-engine cranes, which were never previously part of the regulation, were not considered in determining fleet size and eligibility for the SOON program.

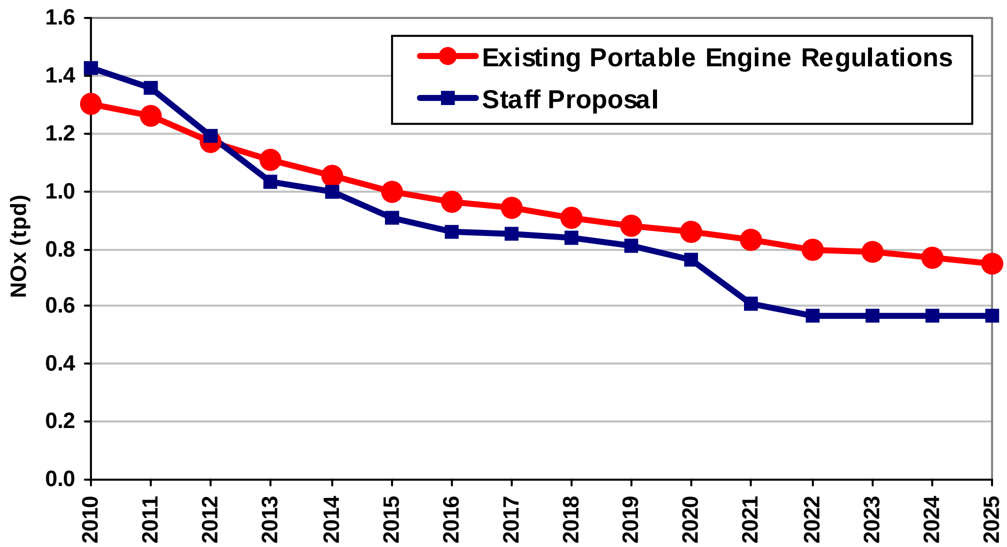
M. Privately-Owned Two-Engine Street Sweepers

For many of the same reasons as mentioned for the two-engine crane, staff is proposing changes for privately-owned with two-engine sweepers. These changes are intended to provide a more straightforward regulatory approach, while reducing the overall cost of cleaning up these vehicles.

Based on information provided by the sweeper industry, in many cases it is infeasible to repower the auxiliary engines in these vehicles with new engines (which are subject to the Portable Engine and Equipment Regulation); the only alternative is to replace the entire vehicle with a new vehicle having a certified engine. Staff does not believe it is necessary or financially feasible for many fleets to purchase new vehicles simply to comply with the requirements of the Portable Engine and Equipment Regulation.

Therefore, staff is proposing to regulate both engines under the proposed regulation. In this way, private sweeper operators would still be required to install PM controls on both the drive engines and the auxiliary engines in the 2010 to 2013 timeframe under the proposed regulation. The results for NOx are shown in Figure XVI-5. There would be a small increase in NOx emissions prior to 2012 but there would lower emissions starting in 2013. For PM there could be a minimal loss in benefits in 2010 but considerable benefits after 2011. With the current staff proposal, all engines would have verified DECS by January 2014. The Portable Engine and Equipment Regulation would require a phase-in of verified DECS starting in 2013.

Figure XVI-5: NOx Emissions with Staff Proposal



To further reduce costs to sweeper fleets, while incentivizing the purchase of newer, cleaner private two-engine sweepers, staff is proposing to modify the Public Agency and Utility Diesel-Fueled Vehicles Regulation such that municipalities may receive retirement credit for the sale of two-engine sweepers having certified 2004 through 2006 model year engines within California. Currently, municipalities may only receive retirement credit if such vehicles are sold outside the state; municipal fleets cannot currently receive credit if the vehicle is sold in state, unless BACT is applied. This change would allow private sweeper fleet operators to purchase cleaner used sweepers to comply with the proposed regulation, thereby lowering their cost to clean up their vehicles.

N. Privately-Owned Utilities Alternative Proposal

Privately-owned utility fleets are currently subject to the existing Public Agencies and Utility On-road Heavy-duty Diesel-fueled Vehicles Regulation, and must apply BACT to all of their vehicles, depending on model year, by December 31, 2011. Staff has proposed to include these fleets within the applicability of the proposed regulation. This has created concern among affected privately-owned utility fleets that are currently accelerating the purchase of vehicle with 2007 and newer model year engines to meet the PM requirements.

To address this, a number of the private utilities in California proposed a delay in meeting the Pubic Agency and Utility On-road Heavy-duty Diesel-fueled Vehicles requirements that would allow them to purchase more 2010 and 2007 and later model year engines rather than installing more PM retrofits. Information supplied by the utilities show that utility fleet vehicles operate an average of 7,800 miles per year and typically buy new vehicles and use them for 12 to 20 years. Staff evaluated the utility proposed option and agreed that it was appropriate to make changes to the existing regulation for Pubic Agency and Utility On-road Heavy-duty Diesel-fueled Vehicles to provide an option to delay the remaining PM requirements by 2 years while adding requirements that, by 2013, at least 30 percent of the vehicles in the fleet must have 2010 model year engines, and an additional 20 percent must have 2007 or newer engines. All other vehicles would need to meet the BACT requirements for PM. In addition, staff is proposing to require these fleets to meet the PM and NOx performance standards of the proposed In-Use Heavy Duty Vehicle Regulation beginning January 1, 2021.

Overall, staff believes their proposal will provide an overall net air quality benefit. As such, staff believes that it is appropriate to provide the proposed option so that private utility fleets may purchase more 2010 and later model year engines to meet the BACT provisions of the fleet regulation for Public Agencies, which will provide additional long term NOx benefits relative to the current regulatory structure, and because the proposal would provide the same PM benefits in 2014 and beyond, consistent with the other vehicles subject to the proposed regulation.

O. Workover Rigs

Currently, the idling regulations restrict idling to five minutes, with certain exceptions for where idling is required to perform a specific job function. The regulations also require that the engine automatically shut off after five minutes of idling without interaction from the driver. Typically, in vehicles PTO, the engine shutdown system is normally overridden when in PTO mode. For most vehicles this occurs when a vehicle’s engine is idling and the engine’s power is used to perform certain specialized non mobile functions. However, unlike other vehicles, workover rigs use PTO to propel the vehicle and do not use PTO to power the specialized work while stationary. To address this, staff is proposing changes to the idling regulations to exempt workover rigs from the motor vehicle idling limit while they are performing the work for which the vehicle was specially designed. This proposal would allow a workover rig to carry out its specialized function when the vehicle is stationary and the engine is working.

P. Other Changes

1. Public Agency and Utility On-road Heavy-duty Diesel-fueled Vehicles

Staff is proposing other changes to this regulation that would:

- expand the scope and applicability of the regulation to include light heavy-duty engines that were inadvertently omitted from the original scope of the regulation
- address concerns with the introduction of 2007 model year and newer engines certified under the ABT provisions at PM levels greater than the 2007 model year standard of 0.01 g/bhp-hr, and;
- provide a means of ensuring that vehicle owners get BACT credit for vehicles sold out of state and that vehicles sold out of state cannot be re-sold in California unless they met the BACT requirements

These revisions are consistent with the original intent of the regulation to require upgrades of all engines that did not meet the PM BACT standard of 0.01 grams per brake horsepower hour, and will help fleets subject to this regulation ensure that they receive proper compliance credit for their actions.

2. In-Use Off-Road Diesel Vehicle Regulation

Staff is proposing to modify section 2449 (e)(7) to clarify the exemption provision for low-use vehicles. The current regulatory language in the section exempts low-use vehicles from all of the performance requirements in section 2449(d). In proposing that regulation, it was not the intent of staff to exempt low use vehicles from those provisions. The proposed modifications would require low-use vehicles to comply with the requirements for adding vehicles to a fleet and with the idling requirements, consistent with staff's original intent, and with how other off-road vehicles are covered.

Also, new language is proposed in the In-Use Off-Road Diesel Vehicle Regulation that would clarify the repower requirements for workover rigs (and other on-road vehicles subject to that regulation). This new language would require that any replacement engine must be an on-road engine if the workover rig is to be registered and driven on public roadways. This is to clarify that, as new, these vehicles should have had on-road engines installed in them.

3. Purpose and Definitions of Diesel Particulate Matter Control Measure

Under the current definition of "municipality", agencies of the United States of America are subject to the regulation for municipality and utility heavy-duty diesel vehicles. However, it was determined that CAA section 118 did not require federal fleet operators to comply with the municipality and utility fleet regulation because the regulation did not generally apply to nongovernmental entities.

Staff's proposal would amend the definition of municipality by excluding federal agencies from the municipality and utility fleet regulation. Consequently, fleets owned by the federal government would then be subject to the proposed regulation. In addition, staff is including tribal reservations and Rancherias because the sovereign nature of tribes is similar to the federal government.

4. Mobile Cargo Handling Equipment

Staff examined the environmental impacts of removing both single-engine and two-engine mobile cranes and sweepers from the Cargo Handling Equipment Regulation. This would affect approximately 30 cranes and 40 sweepers statewide. Staff's analysis showed that the affected equipment is responsible for only about one percent of the overall statewide cargo handling equipment emissions (or 0.006 tons per day of diesel PM and 0.14 tons per day of NOx in 2008). Complying with the Off-Road and proposed regulations would, in some cases, delay compliance until after the more stringent 2010 on-road and final Tier 4 off-road engine standards take effect. This would slightly decrease near-term reductions, but enhance the long term emission reductions are expected to be greater, particularly for cranes, which have long useful lives.

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XVII. ENFORCEMENT

As in all its programs, it is the goal of the ARB to ensure uniform compliance across the industry, so that no one entity obtains an unfair economic advantage by not complying with the requirements of the regulation. This chapter discusses ARB preliminary plans regarding enforcement of the proposed regulation.

A. Overview

Any heavy-duty diesel vehicle traveling in California, including vehicles registered in other states and foreign countries, is subject to ARB inspection. Enforcement activities will have to increase significantly for staff to accomplish the program's goal of consistent enforcement of the proposed regulation. Successful enforcement of the proposed regulation will depend on other important elements of the ARB's enforcement program. These include active outreach to regulated industries and training and compliance assistance. Given the complexity of the proposed regulation and the many critical decisions that fleets will have to make, there could be a large number of fleets that will seek staff's assistance. Staff will be available to help those fleets that do request such assistance.

For heavy-duty vehicles, current enforcement activities for existing regulations include inspections at border crossings, California Highway Patrol (CHP) weigh stations, fleet facilities, randomly selected roadside locations, and audits of records. ARB's enforcement staff currently uses the inspection and audit methods they have developed during their many years of experience enforcing the Heavy-Duty Vehicle Inspection Program, the Periodic Smoke Inspection Program, and in coordination with CHP staff.

B. Planned Enforcement Activities for Proposed Regulation

ARB's enforcement staff will use the inspection and audit methods they have developed during their many years of experience enforcing the Heavy-Duty Vehicle Inspection Program (adopted into law in 1988) and the Periodic Smoke Inspection Program (adopted into law in 1990). Enforcement activities will include inspections at border crossings, CHP weigh stations, fleet facilities, and randomly selected roadside locations, and audits of records. These activities could result in corrective actions and substantial civil penalties for non-compliance with the regulation.

The critical elements to the successful enforcement of the proposed regulation would be the annual reporting, if using the BACT percentage limits or the fleet averaging option, or vehicle inspections if the BACT option is used. Reporting will allow staff to initially determine whether fleets have either met the fleet average targets or complied with the BACT percentage limits requirements. Fleets would report each vehicle, its vehicle identification number (VIN), its engine data, its model year, as well as any actions taken to comply. For vehicles claiming one of the exemptions from the NOx or PM requirements, owners will report the appropriate information such as miles driven, location where miles occurred, hours of use, and date of installation of control technology.

Fleets that report noncompliance with any of the proposed PM and NOx performance requirements will automatically be subject to enforcement action, as will fleets choosing to use the fleet averaging option or the BACT percentage limits option that do not report at all. Fleets that submit questionable annual reports will also be subject to follow-up inspections and possible enforcement action. An annual report that appears appropriate will not preclude its fleet from an ARB audit.

Each vehicle that installs a verified DECS will need to carry in the cab of the vehicle documentation demonstrating proper installation and proof that the device has been verified by ARB. When ARB inspectors conduct a business audit, they will be able to link the VIN or the engine serial number to whatever action was claimed for that vehicle. They will be able to tell if the vehicle does not have the engine claimed, or is not outfitted with the retrofits claimed or whether the retrofits have been correctly installed. Even though in most cases inspectors may not be able to view an owner's entire fleet because it will be dispersed in various locations, inspectors will be able to verify compliance for whatever vehicles they encounter. If inspectors find vehicles without the retrofits that were reported or with different model engines that were reported, fleets would be subject to enforcement action.

If inspectors find vehicles that choose to utilize retrofit technology to comply with the regulation but are not carrying the proper verified DECS documentation, then that will be an immediate indication of noncompliance. Vehicles driving in from out-of-state will need to carry the same documentation.

ARB inspectors may use a variety of opportunities to find and inspect vehicles that are subject to the regulation. For example, they may conduct audits of fleets at facilities including but not limited to truck stops, weigh stations, and temporary roadside inspection facilities. They may also inspect truck terminals at business facilities or at ports and rail stations. A search of CHP's Biennial Inspection of Terminals database may also provide a way to target inspectors toward larger trucking terminals.

They may also inspect vehicles at the border crossings where vehicles are routinely inspected for produce. Finally, inspections may be triggered if ARB receives reports from the public that indicate that certain vehicles has been observed with smoking exhaust or that a fleet is not in compliance with the rule.

Enforcement of the rule will be conducted similarly to enforcement of ARB's commercial vehicle and school bus idling rules. Complaints from the public via calls to the 1-800-END-SMOG toll-free line or on-line reporting trigger inspections or further enforcement action.

Staff would provide public access to the names of the companies who have reported. While details of each fleet and its compliance strategy would not be made public, the public would be able to search the reporting database to confirm whether companies they are considering hiring have reported and submitted the required certifications of compliance. This would allow motor carriers, brokers, and others wishing to hire compliant trucking firms an avenue to ensure they hire only fleets that have reported their data to ARB or can demonstrate compliance with the regulation. The system would also allow companies to check whether their competitors have complied with regulation. If a motor carrier is considering hiring a trucking company or an owner-operator to move goods, it can check the reporting database and at least see if the company reported that it is complying using the fleet averaging or BACT percentage limits if it chose that option to comply. Because the rule would impose significant costs, to ensure a level playing field, it would be important to ensure that firms who are competing against one another are all complying. Certain business and professions codes that protect fair competition may be used against a non-complying firm.

ARB would have the responsibility for enforcing the proposed rule. From time to time, local air district staff may encounter vehicles that they believe are not in compliance with the proposed regulation. In addition, district inspectors may observe or be told by the public of situations where vehicles are smoking excessively. In these situations, the district staff could notify ARB staff so that ARB staff can take appropriate enforcement action.

C. Need for Additional Resources

The proposed regulation would affect over 400,000 in-state only or over 900,000 both in-state and out-of-state on road diesel vehicles operating in California, including vehicles registered in other states and foreign countries. To ensure uniform compliance across the industry, guarantee no one entity obtains an unfair economic advantage by not complying with the requirements, and to achieve the emission reductions projected for the proposed regulations, enforcement activity will need to increase significantly. Subsequently, existing staffing levels will need to be increased to meet the increased demand for inspections and other enforcement activities.

It is also anticipated additional staffing would be required to conduct implementation and outreach activities such as statewide training workshops, seminars, trade show presentations, and booths conferences and expositions. Staff further anticipates an increase in requests for information and assistance, the development of compliance guidance documents and other tools to assist potential stakeholders with implementation. A web based regulatory tracking system for fleet reporting, enforcement verification purposes, and status reports on the rule's implementation would be required.

In addition, additional contracting with CHP staff will likely be required for enforcement. Based on the cost of CHP participation under the current scope of ARB's field enforcement activities, and the projected increases in roadside inspections required for enforcement of the regulation, additional funding would also be required.

XVIII. ALTERNATIVE CONSIDERED

Throughout the regulatory development process, staff considered a number of alternative possible approaches to the rule structure. The alternatives considered and reasons they were rejected in favor of the chosen proposed regulation are provided in this chapter.

In developing the regulation, staff considered the following goals:

- Achieve the maximum, fastest possible, reductions in toxic PM emissions;
- Maximize NOx reductions to aid in attainment of federal air quality standards in the South Coast and San Joaquin Valley;
- Meet the SIP commitments
- Minimize the costs for fleets and, in particular, minimize the frequency of fleets replacing existing vehicle with new vehicles;
- Achieve cost-effective emission reductions on a dollar per ton basis.

Staff sought to achieve these goals while considering the technology available today, as well as the technology that is likely to become available in the future.

Overall, the proposed regulation was selected as the best regulatory structure. It meets the goals of maximizing necessary PM and NOx emission reductions by cost-effective emission reductions. The proposed regulation provides flexibility in that it allows fleets to choose one of three compliance options each year. Small fleets (3 or fewer vehicles) are given additional time for compliance, and the regulation provides credit for both early actions to reduce PM emissions and the use of hybrid and alternative fuel vehicles. The proposed regulation also has lesser requirements for vehicles with lower usage, for those that drive exclusively in NOx-exempt areas, and for agricultural vehicles.

A. Retrofit Only Regulation

Staff considered a traditional BACT PM retrofit only regulation. This is similar to previous adopted regulations for solid waste collection vehicles, transit and urban bus fleets, and public and utility fleets. Such a regulation would require fleets to phase-in a certain percent of PM retrofits each year until all vehicles are retrofit in the fleet. Such a regulation would achieve the goal of maximizing the fastest possible reductions in PM emissions. A retrofit-only regulation would also achieve some NOx emission reductions as a result of replacing vehicles with newer vehicles in lieu of retrofits. It could also result in lower costs for fleets and minimize the need for fleets to replace existing vehicles with new vehicles since there are many PM-only retrofits available that are not as expensive as retrofits that achieve both PM and NOx reductions, or as expensive as replacing the engine or vehicle.

Although this proposal would maximize the necessary PM emission reductions, it would fall significantly short of achieving the NOx emissions needed for attainment of federal air quality standards in the South Coast and San Joaquin Valley Air Basins. Substantial

NOx emission reductions are needed not only to achieve federal air quality standards but also to meet progress requirements for the ozone standard required under California state law.

B. August 2007 ARB Staff Proposal

Staff's first draft proposed regulatory language was presented at public workshops held in August, 2007. The proposal consisted of requiring the application of NOx and PM BACT in two phases, optional fleet averaging provisions for non-interstate vehicles, or a combination of the two requirements. This two-phase approach is shown below in Table XVIII-1.

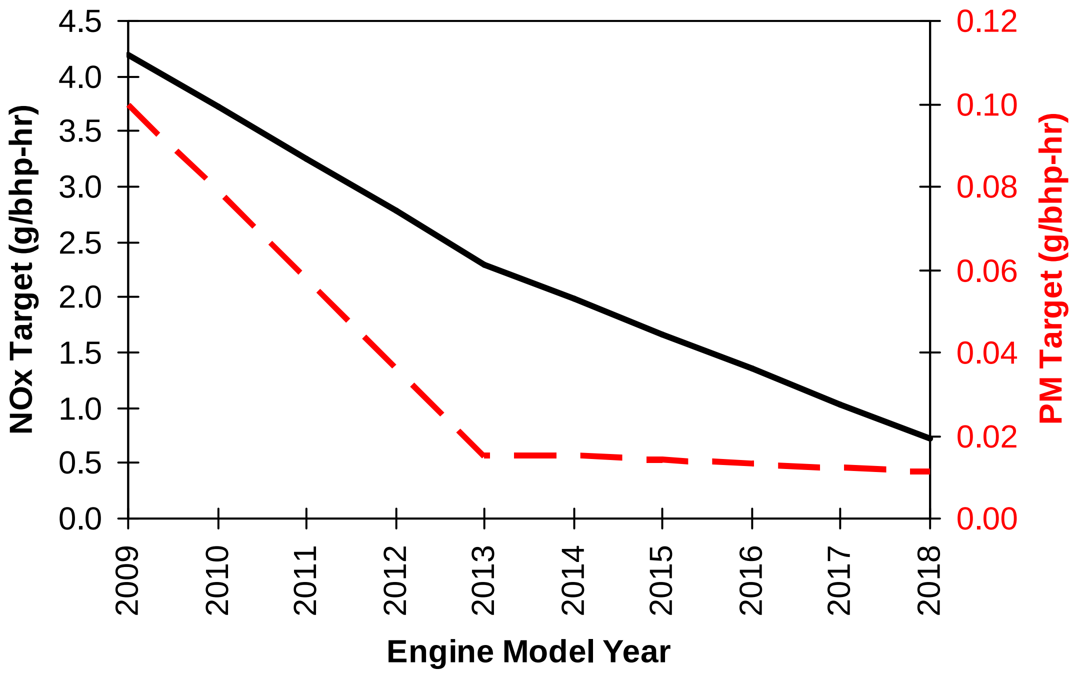
Table XVIII-1: August 2007 ARB Staff Proposed BACT Schedule

Phase	Standard	Engine Model Year	Compliance Date (December 31)
Phase 1	2004 and later MY engine with highest level DECS	Pre 1994	2009
		1994 – 1997	2010
		1998 – 1999	2011
		2000 – 2002	2012
		2003 – 2006	2013
Phase 2	2007 and later MY engine	Pre 2003	2017
		2003 – 2004	2018
		2005 – 2006	2019

For Phase 1, meeting the BACT requirement included replacing a vehicle with a vehicle equipped with an engine that met the 2004 and later emission standards, and had the highest level verified DECS, or applying a verified DECS that, when applied, provided equivalent NOx and PM emission reductions. In Phase 2, beginning in 2017, all vehicles would have had to meet or exceed the emissions standards of a 2007 and later model year engine by the end of 2020. Compliance with these requirements could have included replacing an older vehicle with a new or used cleaner vehicle, installing a cleaner engine, retrofitting an existing vehicle, and/or retiring older, dirtier vehicles.

The proposed fleet averaging option applied only to fleets that are registered to exclusively operate in California. To use the fleet average option, each year fleets would have had to demonstrate that, their fleet average emission rate was less than the fleet average emission target rate as shown in Figure XVIII-1. This compliance option also required that by December 31, 2019, all vehicles must meet engine model-year 2007 PM and NOx emissions standards. Staff also proposed special provisions for low use vehicles (less than 1000 miles and less than 100 hours per year), vehicles used for emergency operations, manufacturer delays, and use of experimental diesel control technology. The staff also proposed credit for use of diesel hybrid electric vehicles and alternative fuel vehicles.

Figure XVIII-1: August 2007 ARB Staff Proposed Fleet Average PM and NOx Emission Targets



While this proposal would have maximized PM emissions reductions by 2014 (this proposal would have provided equivalent PM reductions to the proposed regulation), it did not provide the NOx emission reductions needed to meet the State's SIP commitments in the San Joaquin and South Coast Air Basins. As a result, this alternative was not considered.

In addition, this proposal did not minimize the costs to fleets, especially owner-operator type fleets or small fleets with three or fewer vehicles. It also did not minimize the need for engine or vehicle replacement.

C. January 2008 ARB Staff Proposal

Staff again revised its proposed regulatory language and presented it at the series of public workshops held in January and February 2008. The proposal was modified to reflect the modernization program envisioned in the 2007 SIP.

The January 2008 proposal consisted of revised NOx and PM BACT requirements, more stringent fleet averaging provisions, and new special provisions for small fleets and specialty vehicles. It also contains special provisions for low mileage vehicles and vehicles that travel exclusively in certain less polluted areas in California. Staff also scaled back the applicability of the proposed regulation by excluding pickups and other vehicles with GVWR less than 14,000 pounds (except diesel shuttle buses), emergency vehicles, tactical military vehicles, and personal use motor homes.

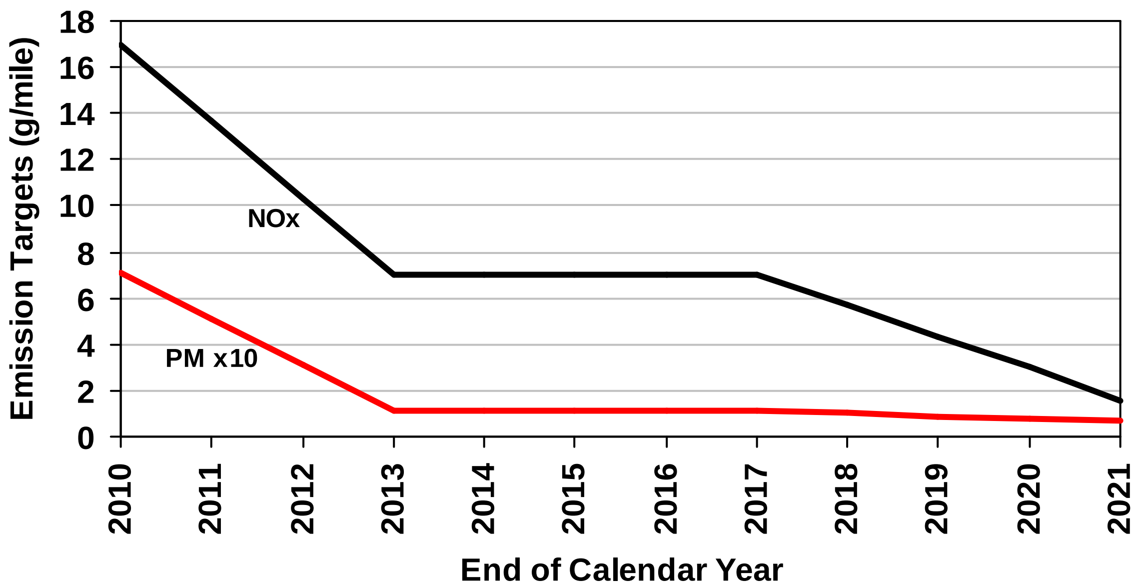
Again, staff proposed a two-phase NOx and PM BACT schedule, but revised the NOx BACT requirement to require compliance in Phase 1 with a vehicle equipped with an engine that met the 2007 and later emission standard by 2014. In the second phase, the NOx BACT requirement was strengthened to require a vehicle equipped with an engine that met the 2010 and later emission standard by 2022. Table XVIII-2 outlines the proposed two-phase BACT schedule in the January, 2008, staff proposal.

Table XVIII-2: January 2008 ARB Staff Proposed BACT Schedule

Phase	Standard	Engine Model Year	Compliance Date (December 31)
Phase 1	2007 and later MY engine	Pre 1998	2010
		1998 – 2002	2011
		2003 – 2004	2012
		2005 and newer	2013
Phase 2	2010 and later MY engine	Pre 2004	2017
		2004 – 2006	2018
		2007	2019
		2008	2020
		2009	2021

In the January 2008 ARB staff proposal, staff proposed a fleet averaging compliance option that would have allowed a mix of cleaner and dirtier engines, and would have applied to all vehicles in a fleet, regardless of the origin of the vehicle's registration (just as the current fleet average provision in the proposed regulation does). This compliance option would have required fleets to have achieved 2007 model-year equivalent emission reductions from 25 percent of their fleet by the end of 2010, 50 percent by the end of 2011, 75 percent by the end of 2012, and 100 percent by the end of 2013. Similarly, the fleets would have had to achieve 2010 model-year equivalent emission reductions from their fleet by 2021. Figure XVIII-2 shows the fleet average emission targets that fleets would have to meet at the end of each compliance year.

Figure XVIII-2: January 2008 ARB Staff Proposed Fleet Average Emission Targets



ARB staff also proposed a new, special provision for small fleets. Under this provision, small fleets were defined as a fleet with three or fewer vehicles. A fleet with one vehicle would have been required to upgrade the vehicle to a 2007 emission equivalent engine by the end of 2012. A fleet with two vehicles would have been required to upgrade to a 2007 emissions equivalent engine by the end of 2011 for the first vehicle and by the end of 2013 for the second vehicle. Fleets with three vehicles would have been required to upgrade to a 2007 emissions equivalent engine starting in 2010. Table XVIII-3 shows the ARB staff's January 2008 proposed compliance schedule for small fleets.

Table XVIII-3: January 2008 ARB Staff Proposed Compliance Schedule for Small Fleets

Fleet Size	Upgrade to 2007 Equivalent Engine (by December 31)
1 Vehicle	2012
2 Vehicles	2011 and 2013
3 Vehicles	2010, 2012, and 2013

Staff also proposed requiring public utilities (which are subject to the provisions of the Fleet Rule for Public Agencies and Utilities) to upgrade to 2010 engine emissions between 2017 to 2021, providing double credit for hybrid vehicles, and additional credit for existing alternative fueled vehicles. ARB staff also proposed incorporating two-engine cranes into ARB's In-Use Off-Road Diesel Vehicle Regulation, and added PM only retrofit requirements for school buses.

Figure XVIII-3 compares the NOx emissions of the ARB January, 2008, proposal to the emissions of the current staff proposal. In this case, staff did not model the phase-in of the January proposal, and instead modeled a simple case that assumed compliance by 2014 and 2020. Figure XVIII-3 shows that in 2014 and 2020 the ARB January proposal would have resulted in more NOx reductions than the current staff proposal in 2014 but less reductions in 2017. Figure XVIII-4 shows that the January 2008 proposal would have achieved essentially the same PM2.5 emissions reductions as the current staff proposal.

Figure XVIII-3: ARB January Proposal (NOx Emissions)

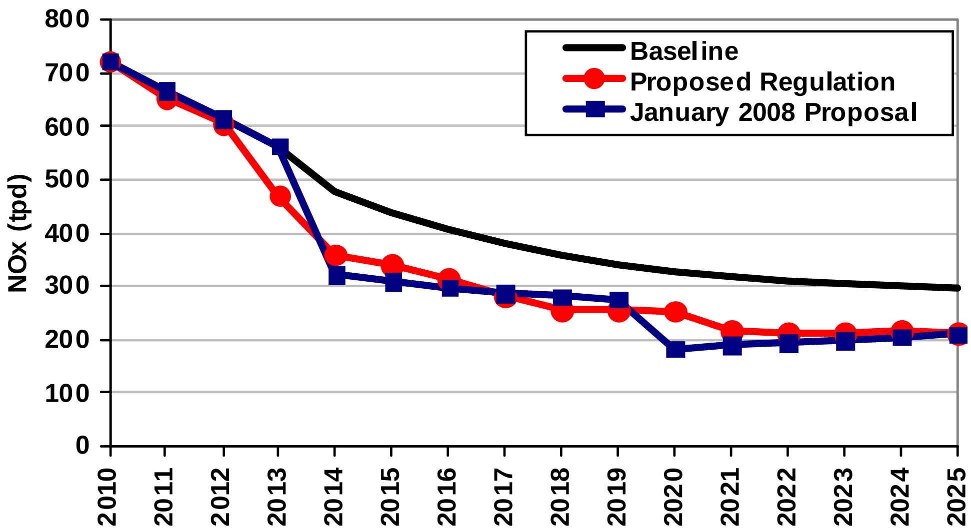
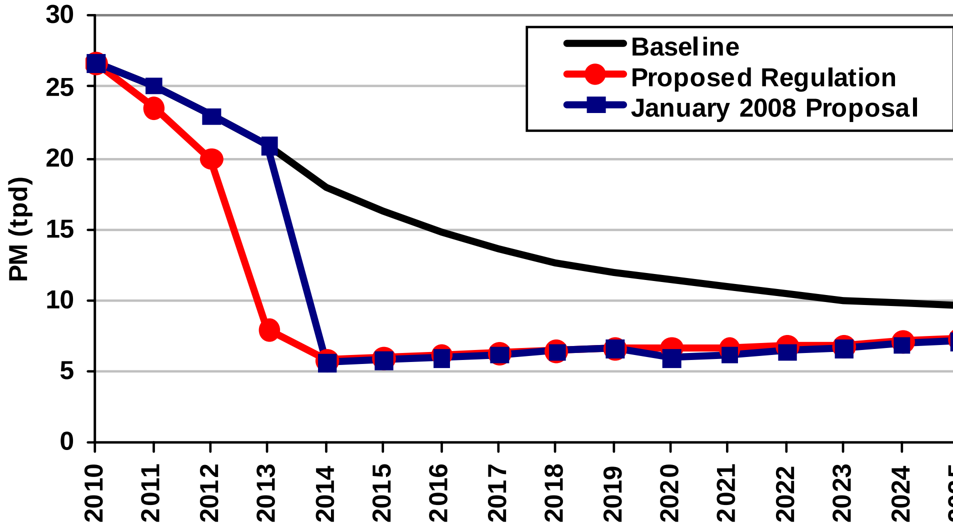


Figure XVIII-4: ARB January Proposal (PM Emissions)



However, while this approach achieved additional emission reductions relative to the proposed regulation in 2013, it did not allow most fleets much opportunity to spread out their vehicle replacements past the 2014 period. It would also have created greater demand for 2007 model year engines, and would have resulted in higher capital investments in the first four years relative to the current proposal. Staff estimates that this approach would have resulted in additional regulatory costs of about $1 billion relative to the proposed regulation. Additional information about staff's analysis is provided in Appendix N.

D. Street Sweeper Industry Proposal

Staff also considered a regulatory proposal from the California Chapter of the North American Power Sweeping Association (NAPSA). The proposal included a schedule for phasing out older sweeper vehicles through 2022. Under this proposal, by 2022, sweeper fleets would be required to have 50 percent of their fleet with 2007 or newer model year engines (NAPSA, 2008). The proposal also included provisions to exempt certain types of sweepers from existing diesel emission regulations that apply to the auxiliary engine on two-engine sweepers, and to exempt from the proposed regulation sweeper fleet owners with two or fewer sweepers that do not sweep for hire or in a commercial capacity.

As shown in Table XVIII-4, the proposed phase-out schedule began in 2011, with sweeper fleets being required to retire or remove 1979 and older vehicles, limiting the mileage on 1980 to 1989 model year sweepers, and allowing 1990 and newer model year sweepers to continue to operate uncontrolled until 2018. Beginning in 2018, sweepers with model year engines 1980 to 1989 would have to be retired, 1990 to 1997 model year sweepers would be permitted to operate with limited mileage, and 1998 and newer vehicles would continue to operate uncontrolled. Finally, in 2022, vehicles with model year engines 1990 to 1997 would have to be retired, 1998 to 2006 model year engines would be permitted to operate with limited mileage, and fleets would be required to have 50 percent of their fleet with sweepers with 2007 or newer model year engines, while the remaining 50 percent of their vehicles could operate uncontrolled.

Table XVIII-4: NAPSA July 2008 Proposal for Street Sweepers

Compliance Year	Model Year	Requirement
2011	Pre - 1979	Retire
	1980 – 1989	Operate less than 15,000 miles per year
	1990 and newer	Unlimited operation
2018	1980 – 1989	Retire
	1990 – 1997	Operate less than 15,000 miles per year
	1998 and newer	Unlimited operation
2022	1990 – 1997	Retire
	1998 – 2006	Operate less than 15,000 miles per year
	Fleets required to have 50% of fleets with 2007 or newer engines	

NAPSA also proposed that the Fleet Rule for Public Agencies and Utilities be modified to allow public agencies to receive retirement credit for in-state sales of used sweepers and provide double credit for public agencies selling sweepers to comply with that rule.

ARB staff considered the proposal from NAPSA and met a number of times with representatives to discuss the proposal and their concerns. Staff estimates that there are about 1,250 to 2,000 sweepers operating in California that would be subject to the proposed regulation. Although the proposal would substantially reduce the regulatory costs to sweeper fleets, it would also forgo a substantial percentage of emission reductions of both PM and NOx from these vehicles. Since sweepers frequently operate in urban areas, and especially residential neighborhoods, staff was concerned that the loss in reductions of diesel PM emissions could result in a substantial loss in the anticipated risk reductions provided by the proposed regulation. In addition, the loss of both PM and NOx reductions from these vehicles would reduce the overall emission reductions needed from the proposed regulation to meet the state's SIP commitments in the San Joaquin Valley and South Coast air basins. Additional information about staff's analysis is provided in Appendix M.

However, staff recognized that the street sweeper industry is subject to multiple ARB regulations, including the Portable Equipment ATCM, the Mobile Cargo Handling Equipment at Ports and Intermodal Rail Yards regulation, and the proposed regulation. Each of these regulations has different compliance requirements on various sweeper engines at different times. In addition, the private sweeper industry has historically purchased used sweepers from municipalities. However, under the Fleet Rule for Public Agencies and Utilities, municipalities cannot receive BACT credit unless they sell a non-compliant sweeper (that is, one that has not had BACT applied to it) out of state. This has essentially stopped the supply of used sweepers for the California private sweeper industry.

In order to streamline complying with these various regulations, and to continue to realize emission reductions from these sweepers, staff has proposed special provisions for certain two-engine sweepers, while clarifying the applicability of these other regulations to two-engine sweepers. In addition, to increase the supply of cleaner, used municipal sweepers, staff is proposing to allow municipalities the ability to obtain BACT credit (in the Fleet Rule for Public Agencies and Utilities) for the sale of a two-engine sweeper with a 2004 and later propulsion engine to a private sweeper operator.

E. Driving Toward a Cleaner California Proposal

“Driving Toward A Cleaner California” (DTCC) is a coalition of business leaders and industry representatives that developed an alternative proposal in response to the proposed regulation. The DTCC proposal includes:

- more generous mileage exemptions;
- early incentives;
- specialty vehicles provisions;
- a less aggressive compliance schedule for businesses subject to two or more ARB regulations;
- consideration of safety and compatibility issues, and;
- more flexible provisions if diesel emission control technology is not available.

The proposal would retain the same three compliance options in the proposed regulation, but would modify the compliance schedule and requirements. It also would add a fourth compliance option which would apply only to single units vehicles.

DTCC also proposed revisions to increase the mileage exemptions for certain model year engines. As shown below in Table XVIII-5, starting December 31, 2010, 2004 or newer model year engines would be exempt from any performance requirements if their mileage is less than 30,000 miles per year. After December 31, 2020, these vehicles would be required to be replaced with vehicle having 2010 or newer model year engines.

For vehicles driven less than 15,000 miles per year, but more than 7,500 miles per year, 1994 or newer engines with level 3 PM diesel control technology installed would be exempt from any further performance requirements until December 31, 2020. Starting December 31, 2020, these vehicles would have to be replaced with a vehicle having a 2007 or newer model year engine, and the mileage would need to remain below 15,000 miles per year. For vehicles driven less than 7,500 miles per year, vehicles with level 3 PM diesel control technology installed would be exempt from any performance requirements until December 31, 2020. After December 31, 2020, vehicles would have to be replaced with a vehicle having a 2004 model year or equivalent engine, and the mileage would need to remain below 7,500 miles per year.

Table XVIII-5: DTCC Proposal for Mileage Exemptions

Annual Mileage	Engine Model Year/Technology	Exemption End Date (December 31)
Up to 30,000	2004 or newer	2020
	2010 or newer	N/A
Up to 15,000	1994 with Level 3 DECS	2020
	2007 or newer	N/A
Up to 7,500	Level 3 DECS	2020
	2004 or newer	N/A

DTCC also proposed that fleet owners who purchase and operate 2007 or newer model year engines or equivalent and are not subject to the drayage truck regulation before December 31, 2009, would get 2 additional years, starting December 31, 2020, to comply under the current proposed BACT schedule for 2007 or newer model year engines. In addition, DTCC proposed that by December 31, 2012 dedicated use or single unit vehicles meet a 1994 or later model year engine standard and have a level 3 diesel PM control technology installed. These vehicles would then have to meet a 2007 engine standard in 2020.

- DTCC also proposed that the staff should be required to address any and all safety concerns and allow for specific exemptions related to emission reduction technology and safe operation, including the transport of hazardous or flammable materials and other considerations, and that staff should develop a personalized compliance schedule for businesses subject to two or more ARB regulations. The schedule would allow compliance on a schedule which considers the financial impacts of all regulations rather than the schedule required by each regulation.

DTCC also proposed changes to the BACT implementation schedule that would delay any of the NOx BACT performance standards until 2014. DTCC's proposed changes to the BACT schedule are shown below in Table XVIII-6.

Table XVIII-6: DTCC Proposed BACT Schedule

Compliance Deadline (as of December 31)	Engine Model Years	BACT Requirements
2010	Pre - 1994	PM BACT
2011	1994 – 1997	PM BACT
2012	1998 – 2003	PM BACT
2013	2004 – 2006	PM BACT
2014	Pre – 1994	NOx and PM BACT
2015	1994 – 1997	NOx and PM BACT
2016	1998 – 2003	NOx and PM BACT
2017	2004 – 2006	NOx and PM BACT
2018	NA	NA
2019	NA	NA
2020	2007	NOx and PM BACT
2021	2008	NOx and PM BACT
2022	2009	NOx and PM BACT

DTCC also proposed changes to the proposed fleet averaging provisions. This including counting vehicles retired in a fleet before December 31, 2010, as 2010 compliant until December 31, 2017, for purposes of fleet averaging. Under the DTCC proposal, each retired vehicle would count as a 2010 model year equivalent and would be included in the total fleet average until 2017. The proposal also would, in general, delay the NOx fleet average emission targets. However, the PM fleet average emission targets would remain the same as in the proposed regulation.

DTCC also proposed changes to the BACT percent limit provisions, which would, in general, delay the NOx BACT percent limits. However, the PM fleet average emission targets would remain the same, for the most part, as in the proposed regulation. DTCC proposed BACT percent limits are shown in Table XVIII-7. DTCC also proposed that vehicles retired be counted as a BACT compliant vehicle in a fleet before the end of each compliance year.

Table XVIII-7: DTCC Proposed BACT Percent Limits

Compliance Deadline (as of December 31)	Percentage of Total Fleet Complying with BACT	
	PM BACT	NOx BACT
2010	25%	NA
2011	25%	NA
2012	50%	25%
2013	100%	25%
2014	100%	50%
2015	100%	50%
2016	100%	75%
2017	100%	75%
2018	100%	80%
2019	100%	90%
2020	100%	90%
2021	100%	90%
2022	100%	100%

Staff analyzed the four main provisions of the proposal together. The results are shown in Figure XVIII-5 for NOx and Figure XVIII-6 for PM. The primary difference between the DTCC proposal and the proposed regulation is the rate at which emissions benefits are realized. The proposed regulation would achieve substantially more reductions between 2012 and 2020. Beginning in 2021, the DTCC proposal would achieve similar emissions benefits to the proposed regulation. Overall, the DTCC proposal would achieve roughly half of the emissions benefits that would be achieved by the proposed regulation. The DTCC proposal would not meet California's SIP commitments in any year. Additional information about staff's analysis is provided in Appendix N.

Figure XVIII-5: DTCC Stakeholder Proposal (NOx Emissions)

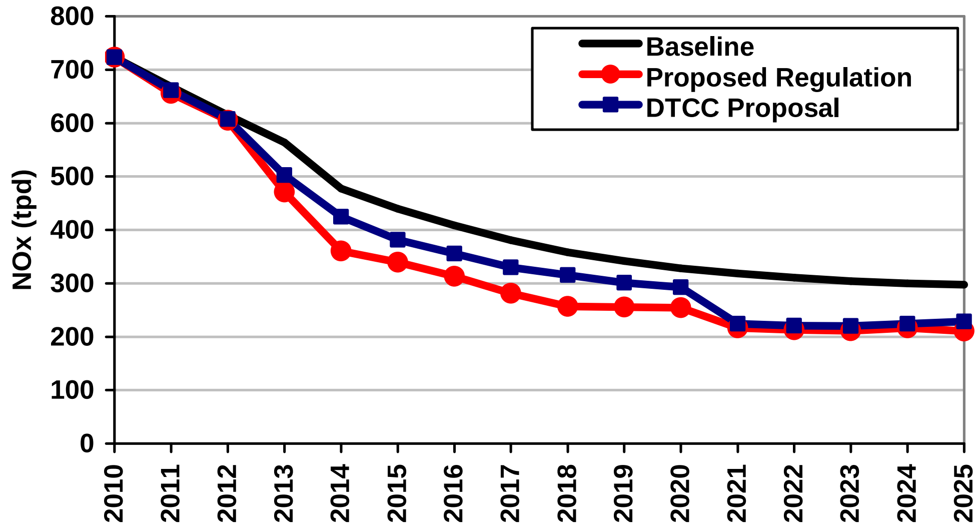


Figure XVIII-6: DTCC Stakeholder Proposal (PM Emissions)