California Environmental Protection Agency
AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING

PROPOSED REGULATION FOR IN-USE OFF-ROAD DIESEL VEHICLES

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

April 2007

State of California
AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING

Public Hearing to Consider

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

To be considered by the Air Resources Board at a two-day meeting of the Board that will commence on May 24, 2007, and may continue to May 25, 2007, at

California Environmental Protection Agency
San Diego Marriot Del Mar
Grand Ballroom
11966 El Camino Real
San Diego, CA 92130

Mobile Source Control Division:
Robert Cross, Chief

Heavy-Duty Diesel In-Use Strategies Branch:
Erik White, Chief

In-Use Control Measures Section:
Tony Brasil, Manager

State of California
AIR RESOURCES BOARD

PROPOSED REGULATION FOR IN-USE OFF-ROAD DIESEL VEHICLES

Contributing Authors

Kim Heroy-Rogalski
Jeff Wilson
Elizabeth Yura
Gloria Lindner
Michael Baker
Jacqueline Johnson

Legal Counsel

Michael Terris, Office of Legal Affairs

Supporting Divisions
Mobile Source Operations Division
Planning and Technical Support Division
Research Division
Stationary Source Division

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.

Table of Contents

List of Tables

List of Figures

I. OVERVIEW AND STAFF RECOMMENDATION

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 nearly 180,000 off-road diesel vehicles in the State. 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 regulation is far-reaching; vehicles of dozens of types used in over 8,000 fleets, in industries as diverse as construction, air travel, manufacturing, landscaping, and ski resorts, as well as by a considerable number of public agencies, would be affected. The regulation would affect the warehouse with one diesel forklift, the landscaper with a fleet of a dozen diesel mowers, the county that maintains rural roads, the landfill with a fleet of dozers, as well as the large construction firm or government fleet with hundreds of diesel loaders, graders, scrapers, and rollers.

The regulation, a copy of which is provided in Appendix A, would mean different things for different fleets, depending on their size and on the vintage of their vehicles. Fleets are defined in the regulation as small, medium, or large based on their total horsepower and whether they are a small business. The regulation has the strictest provisions for the largest fleets, which have the most significant emissions and which are most likely able to rapidly understand and absorb the costs of regulation compliance. The regulation has the least stringent provisions for the smallest fleets owned by small businesses or municipalities.

The regulation would establish fleet average emission rate targets for PM and NOx for all off-road vehicles operating in the state, regardless of whether they are California based or not. The targets decline over time, requiring fleets to reduce their emissions further as time goes on. Each year, the regulation requires each fleet to meet the fleet average emission rate targets for PM or apply the highest level verified diesel emission control system 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 turn over a certain percent of their horsepower (8 percent in early years, and 10 percent in later years). Turn over means repowering with a cleaner engine, 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 turnover as long as they achieve the same emission benefits.

Each year, fleets would have the option of satisfying either the fleet average requirements or the mandatory retrofit and/or turnover requirements. To meet the fleet averages, fleets may retrofit their vehicles' exhaust systems with verified diesel emission control devices, replace the engines in existing vehicles with cleaner engines (i.e., repower), retire high-emitting vehicles, and/or designate high-emitting vehicles as low-use vehicles. The regulation would also limit unnecessary idling to 5 minutes.

Small fleets would be subject only to the PM requirements beginning in 2015. Small fleets that do not meet the PM fleet average targets would need to install exhaust retrofits on 20 percent of their horsepower per year beginning in 2014. Small fleets with newer vehicles may choose to either voluntarily accelerate turnover of their fleets enough to meet the PM fleet average targets or to apply some exhaust retrofits.

Medium fleets would be subject to the PM and NOx requirements beginning in 2013. Medium fleets with the oldest vehicles would not be able to meet the fleet average targets and would need to accelerate turnover of engines to 8 percent of their horsepower per year and install exhaust retrofits on 20 percent of their horsepower per year beginning in 2012. Medium fleets with newer vehicles would not have to do the maximum turnover or maximum exhaust retrofit installations but may have to accelerate the purchase of some vehicles and install enough exhaust retrofits to meet the average targets.

Large fleets would be subject to the PM and NOx requirements beginning in 2010. Large fleets with the oldest vehicles would need to accelerate turnover of engines to 8 percent of their horsepower per year and install exhaust retrofits on 20 percent of their horsepower per year beginning in 2009. In 2015, the oldest large and medium fleets would need to further accelerate turnover to 10 percent of their horsepower per year. While the regulation provides time for retrofit vehicles to remain in the fleet, these oldest fleets may also need to turn over some of the oldest engines that are retrofit once the exhaust retrofits are older than 6 years. Large fleets with newer vehicles would need to accelerate turnover of their fleets enough to meet the NOx fleet average targets and to apply enough exhaust retrofits to meet the PM fleet average targets.

The regulation is expected to reduce 48 tons per day (tpd) NOx and 5.2 tpd of PM statewide in 2020. These reductions represent a 32 percent reduction in NOx and a 74 percent reduction in PM from the 2020 emissions that would otherwise occur in the absence of the regulation.

The regulation would also contribute to achieving the 2020 goal set forth in the 2000 Diesel Risk Reduction Plan of reducing diesel PM 85 percent from all diesel sources from 2000 baseline levels. The regulation is projected to reduce PM emissions 37 percent from the 2000 baseline by 2010, and 92 percent by 2020 from the sources subject to this regulation.

The emission reductions from the regulation would be expected to prevent approximately 4,000 premature deaths (1,100 to 6,800, 95% confidence interval) and tens of thousands of cases of asthma-related and other lower respiratory symptoms, and provide a benefit of $18 to $26 billion in avoided premature death and health costs.

The regulation is the next in a series of rules intended to reduce emissions from in-use diesel vehicles and equipment. However, the scope of the regulation dwarfs previous air toxic control measures that the Board has approved. By comparison, the cargo handling air toxic control measure (ATCM) affects about 3,700 pieces of cargo handling equipment; the solid waste collection vehicle rule affects about 12,000 solid waste

collection vehicles; and the portable engine ATCM covers about 33,000 portable engines (ARB, 2005a; ARB, 2006; ARB, 2004). Likewise, the benefits of the proposed regulation are dozens of times larger than those of previous measures. In total, the proposed regulation is expected to reduce 187,000 tons of NOx emissions and 33,000 tons of PM emissions between 2009 and 2030.

The regulation would provide greatly needed reductions of NOx emissions in the South Coast and San Joaquin Valley air basins. These areas must achieve significant NOx reductions from the off-road sector to achieve ambient ozone and fine particulate matter (PM2.5) standards by the federally-mandated deadlines. The deadline for the attainment of the PM2.5 standards in these regions is currently 2015, so emission reductions are urgently needed. Staff expects that despite a comprehensive effort to meet the PM2.5 standard, California may still come up short in achieving the needed emission reductions by the 2015 federal attainment deadline. Because the standard is an annual average, the U.S. EPA requires that all necessary emission reductions be achieved one calendar year sooner, or by 2014. While all sources of NOx emissions are important, off-road diesel vehicles are one of four major categories that will determine whether California is able to meet the 2014 deadline for PM2.5 attainment in the South Coast Air Basin. If the emissions reductions needed to achieve attainment of the federal standards cannot be demonstrated, the Board may need to consider additional measures or changes. However, staff believes the proposed regulation represents the economic limit of what industry could bear, and any further emissions reduction requirements would likely require financial incentives.

The regulation is controversial among the fleets it would impact in large part because it would impose significant costs on industry. The total cost of the regulation is expected to be between $3.0 and $3.4 billion in 2006 expenditure equivalent dollars (2006 dollars). This cost would be spread over the years 2009 to 2030, with the majority of costs occurring between 2010 and 2021. On average over the course of the regulation, the cost would vary between $229 million and $257 million per year, averaging $243 million per year (2006 dollars). About half the cost is expected to be incurred directly by the construction industry, nearly 15 percent by the business services sector, and about 10 percent by the mining industry. Government fleets are expected to incur about 5 percent of the total cost, with the remaining costs spread among various other affected industries.

Costs to individual fleets would vary depending on the size of each fleet, its initial vehicle composition and vehicle age, 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 a typical fleet, total costs over the life of the regulation are expected to be $104 to $117 per horsepower of affected vehicles (in 2006 dollars). Individual fleets may incur average costs anywhere from $0 to about $170 per horsepower (hp), depending on their initial composition and vehicle age. There may be cases where fleets would incur slightly higher costs. Annual costs for a typical fleet would range from $8 to $9 per horsepower per year (2006 dollars). For a typical medium sized fleet with total fleet horsepower of 3,000, the total cost of the regulation is

expected to be about $333,000 (in 2006 dollars), with average annual costs of $27,000 per year (in 2006 dollars) for 21 years.

Overall, most affected businesses could absorb the costs of the proposed regulation with no significant adverse impacts on their profitability. Manufacturing business are the least likely to be able to pass on their cost if the product they manufacture is sold nationally or globally, but the economic impact of the regulation is not expected to be a significant part of normal operating expenses. However, most construction fleets, rental companies, airlines, and landscaping service fleets who compete locally should be able to pass on some or all of the costs of compliance to their customers, thereby maintaining their profitability. Even if fleets were unable to pass on any of the cost of compliance to their customers, staff found that between about 60 and 80 percent of fleets would still be expected to be able to withstand the cost of the regulation without incurring more than a 10 percent change in their return on equity. Small fleets would be more likely to be able to absorb the cost of the regulation without exceeding 10 percent change in "return on owner's equity" (ROE) because they are not subject to the regulation's mandatory turnover provisions, and thereby would incur significantly less costs relative to medium and large fleets. The 20 to 40 percent of fleets for which the regulatory costs exceed a 10 percent change in ROE would have to pass through at least some of the costs to their customers to maintain their profitability.

The regulation is expected to raise the cost of construction in California by no more than 0.3 percent as fleets pass on the cost of compliance to their customers. Customers that could expect to pay higher construction costs include developers, home builders, and government agencies sponsoring road construction and other transportation projects. For the average new home buyer, the expected cost of the regulation could add about $5 per month to a 30-year mortgage.

The regulation would require fleets to change their operating and vehicle purchasing practices. For the first time, owners of off-road vehicles would need to label them and report them to the State. The regulation would require upgrades with newer engines or turnover of vehicles that fleets purchased years ago, and which they had assumed could be used indefinitely. The regulation would require use of retrofit devices that, while verified by the ARB, are unfamiliar to fleets.

The regulation contains flexibility provisions to allow each fleet to find its own most cost-effective way to comply. The regulation would allow fleets to comply by meeting a fleet average so each fleet can choose its own best, most cost-effective path toward compliance. The regulation contains special exemptions for low-use vehicles, specialty vehicles, emergency vehicles, and dedicated snow removal vehicles. The regulation contains provisions that would give fleets more time if they encounter delays in obtaining the engines, vehicles, or retrofits that they need to comply. Finally, the regulation gives the smallest fleets more time to comply, leaving them several years to apply for State incentive funding.

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. The latest seven

workshops held across the state since December 2006 were attended by over 1,500 people. These workshops capped a two-year long outreach and regulation development process that included 19 public workshops and workgroup meetings, dozens of site visits and private meetings with fleet owners, equipment dealers, and industry groups, and multiple mailings to over 300,000 contractors, landfills, owners of portable equipment, and numerous other potential owners of affected off-road vehicles.

Staff recommends that the Board adopt the regulation because its projected benefits - emissions reduced and adverse health impacts avoided - make it worth the anticipated cost and inconvenience to fleets and because emission reductions from the affected vehicles are urgently needed to meet State Implementation Plan commitments.

The following sections provide answers to the most salient questions about the regulation. Supporting material is provided in the Technical Support Document (ARB, 2007a).

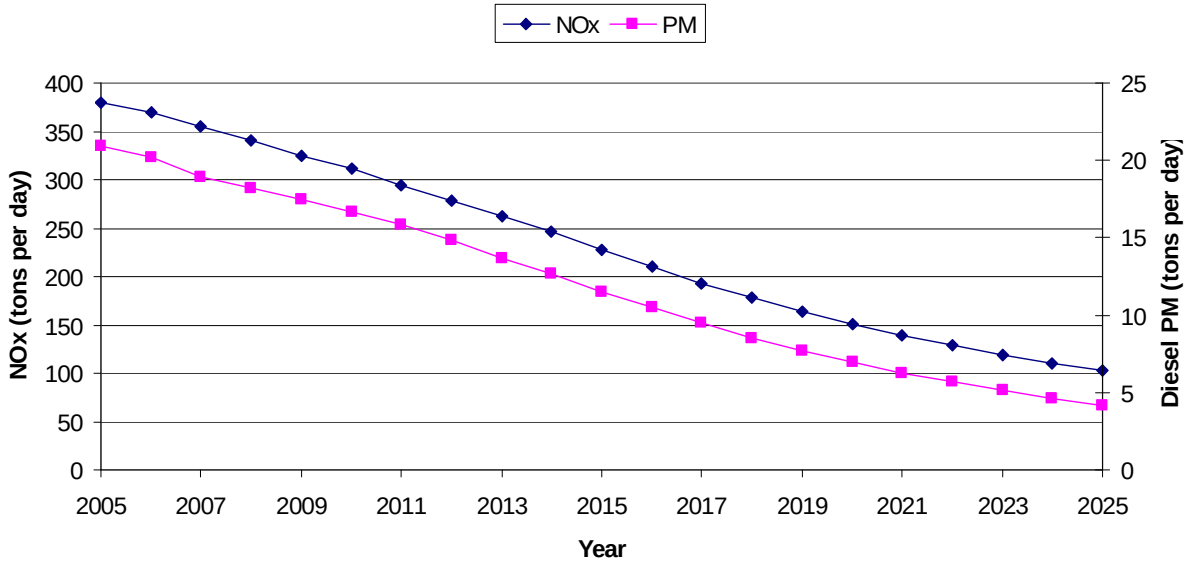
II. NEED FOR EMISSION REDUCTIONS

A. How significant are the emissions targeted by the regulation?

Off-road vehicles are a significant source of diesel particulate matter, as well as NOx emissions that lead to ozone and ambient PM. Statewide, they are responsible for nearly a quarter of the total PM emissions from mobile diesel sources and nearly a fifth of the total NOx emissions from mobile diesel sources. Although increasingly stringent new engine standards are reducing emissions from off-road diesel vehicles over time, because of their durability, most vehicles operate for several decades before being retired. Thus, in-use off-road diesel vehicles would continue to pose significant health risk for many years if this proposed regulation is not adopted. As discussed further below, without reductions from this large source category, the South Coast and San Joaquin Valley would be unable to attain the federal ambient air quality standards.

The regulation is projected to affect approximately 180,000 vehicles (year 2005 population), which currently emit about 386 tons per day of NOx emissions and 23 tons per day of PM emissions. Figure II-1 shows the statewide trend in diesel PM and NOx emissions that would be expected without the regulation. As can be seen, emissions would trend naturally down as the fleet gradually turned over to newer, cleaner engines. However, these reductions are not sufficient for many areas of the state to meet clean air standards. Because of this, the proposed regulation accelerates this anticipated reduction in emissions.

Figure II-1 – Statewide PM and NOx Emissions from In-Use Off-Road Diesel Vehicles without Regulation



In-use off-road diesel vehicles covered by the regulation are significant contributors to the State's total diesel mobile source emissions of PM and NOx. As Figure II-2 shows,

in 2005, off-road diesel vehicles were responsible for 24 percent of the total statewide diesel mobile source PM emissions, and 19 percent of the total statewide diesel mobile source NOx emissions.

As Figure II-3 shows, in 2020, without the regulation, the vehicles would still be responsible for 20 percent of total statewide diesel mobile source PM emissions and 19 percent of total statewide diesel mobile source NOx emissions.

Figure II-2 - In-Use Off-road Diesel Vehicle Contribution to Statewide PM and NOx Inventory- 2005[1]

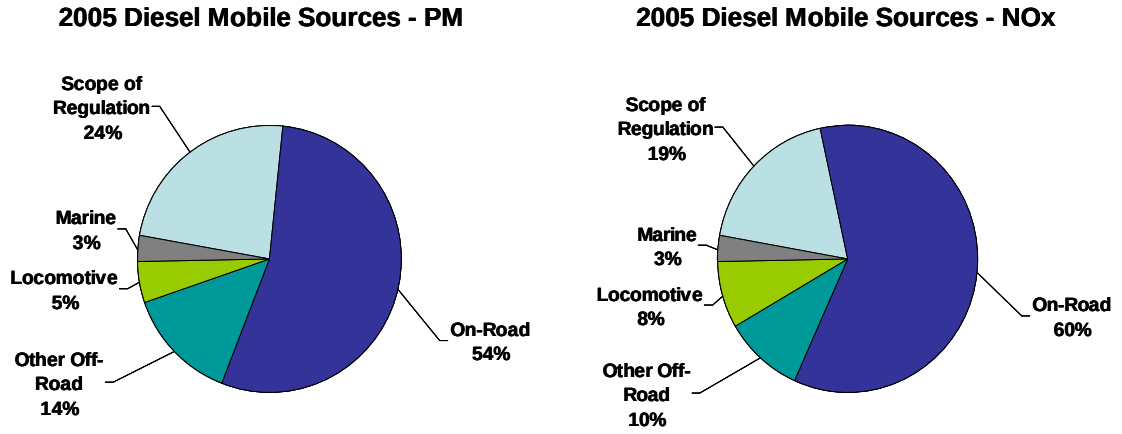
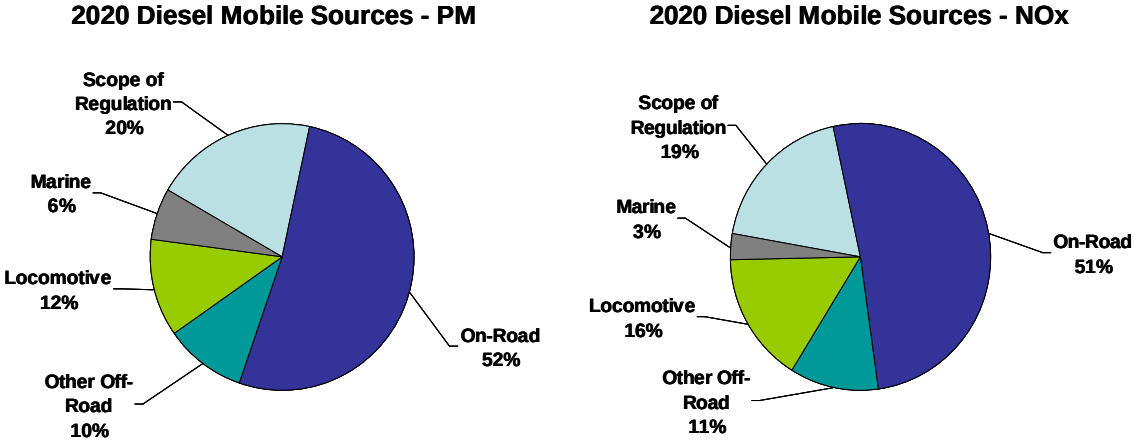


Figure II-3 - In-Use Off-road Diesel Vehicle Contribution to Statewide PM and NOx Inventory - 2020, Without Regulation



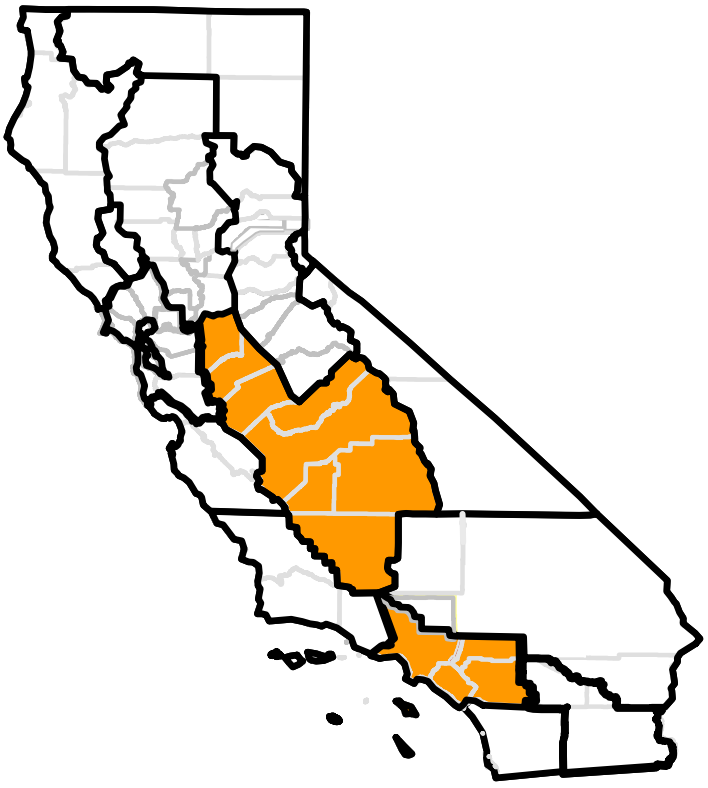
[1] Emissions from in-use off-road diesel vehicles covered by the proposed rule are labeled "Scope of Regulation." Other off-road sources are labeled "Other Off-road."

B. Why are diesel particulate matter emission reductions needed?

In 1998, following the ARB's identification of diesel PM as a toxic air contaminant (TAC), California embarked on an ambitious strategy to reduce emissions from diesel-fueled engines. The Diesel Risk Reduction Plan (DRRP), adopted by the Board in October 2000, outlined steps to reduce diesel emissions and associated potential cancer risks by 75 percent in 2010 and by 85 percent by 2020. Because of the potency and the large amount of emissions to California's air, diesel PM is the primary contributor to adverse health impacts, including an estimated 70 percent of all cancer risks, from TACs. The proposed regulation would achieve the emission reduction goals of the DRRP for off-road vehicles subject to the regulation.

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

Figure II-4 - Areas of California that Exceed the Federal Annual PM2.5 Standard



Under the federal Clean Air Act (CAA), the U.S. Environmental Protection Agency (U.S. EPA) has established National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health, including PM2.5. Set to protect public health, the NAAQS are adopted based on a review of health studies by experts and a public

process. Areas in the State that exceed the NAAQS are required by federal law to develop State Implementation Plans (SIPs) describing how they would attain the standards by certain deadlines. Figure II-4 shows the areas of California that exceed the federal PM2.5 standard.

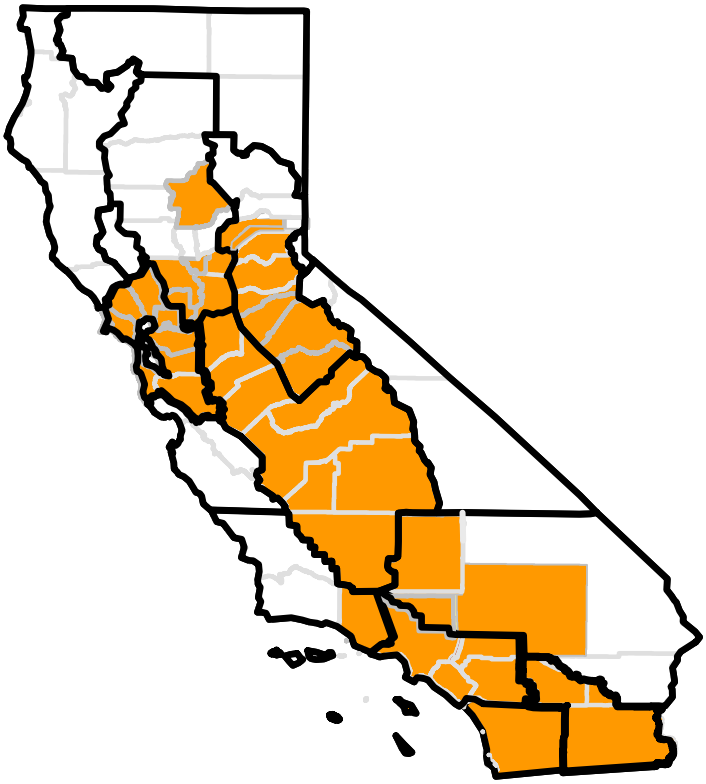
Neither the South Coast nor the San Joaquin Valley is in attainment for the PM2.5 NAAQS. Under the federal CAA, both are required to attain the PM2.5 standard by 2015, and the PM2.5 SIPs are due to U.S. EPA by April 2008. In addition to reductions in directly emitted diesel PM, these areas must achieve significant NOx reductions (NOx is a precursor to PM in the atmosphere) from the off-road sector to achieve the ambient PM2.5 standard by the federally-mandated deadlines. Staff expect that despite a comprehensive effort to achieve reductions from all possible sources to meet the PM2.5 standard, California may still come up short of achieving the needed emission reductions by the 2015 attainment deadline. Because the standard is an annual average, the U.S. EPA requires that all necessary emission reductions be achieved one calendar year sooner, or by 2014. While all sources of NOx emissions are important, off-road diesel vehicles are one of four major categories that will determine whether California is able to meet the 2014 deadline for PM2.5 attainment in the South Coast Air Basin. If the emissions reductions needed to achieve attainment of the federal standards cannot be demonstrated, the Board may need to consider additional measures or changes. However, staff believes the proposed regulation represents the economic limit of what industry could bear, and any further emissions reduction requirements would likely require financial incentives.

C. Why are oxides of nitrogen emission reductions needed?

NOx emission reductions are needed because NOx leads to formation in the atmosphere of ozone and PM2.5. Ozone is a powerful oxidant, and exposure to ozone can result in reduced lung function, increased respiratory symptoms, increased airway hyper-reactivity, and increased airway inflammation. Exposure to ozone is also associated with premature death, hospitalization for cardiopulmonary causes, and emergency room visits for asthma. Because of these health effects, U.S. EPA has established 8-hour NAAQS for ozone.

Figure II-5 shows the areas of California that exceed the federal 8-hour ozone standard. Most areas of the State, and in fact the places where most people live, exceed the federal 8-hour ozone standard. Requirements for attainment of the federal 8-hour ozone standard begin in some areas of the state as early as 2007. Currently, the South Coast's and San Joaquin Valley's deadlines for ozone attainment are 2021 and 2013, respectively.

Figure II-5 - Areas in California that Exceed the Federal 8-Hour Ozone Standard



The ozone SIP and PM2.5 SIPs are due to the U.S. EPA by June 2007 and April 2008, respectively and must necessarily include significant NOx reductions. The magnitude of emission reductions is large and represents an estimated 60 percent reduction in NOx emissions from 2006 levels (i.e., a total reduction of hundreds of tons per day) – and the time frame short to attain NAAQS in South Coast and San Joaquin Valley. The extremely large emission reductions needed in the South Coast and San Joaquin Valley drive the need for NOx reductions from this regulation.

D. What health impacts are occurring today due to the emissions from affected vehicles?

Table II-1 below summarizes the adverse health impacts occurring today from the current population of off-road diesel vehicles that would be covered by the proposed regulation. Staff estimates that approximately 1,100 premature deaths were associated with the baseline uncontrolled emissions from in-use off-road diesel vehicles in year 2005. The health impacts include direct effects from diesel particulate matter as well as effects from secondary pollutants such as nitrate particles.

Table II-1 - Health Impacts from Baseline Emissions of In-Use Off-road Diesel Vehicles Covered By Regulation (2005)[2]

Endpoint	Pollutant	# of Cases (Mean)	# of Cases 95% Confidence Intervals (Low - High)
Premature Mortality	NOx	450	120-770
	PM	690	190-1,200
	Total	1,100	310-1,900
Hospital admissions (Respiratory)	NOx	100	60-130
	PM	150	90-200
	Total	240	150-330
Hospital admissions (Cardiovascular)	NOx	180	110-270
	PM	270	170-420
	Total	440	280-690
Asthma & Lower Respiratory Symptoms	NOx.	13,000	5,000-20,000
	PM	19,000	7,400-31,000
	Total	32,000	12,000-51,000
Acute Bronchitis	NOx	1,100	0-2,300
	PM	1,600	0-3,500
	Total	2,600	0-5,700
Work Loss Days	NOx	77,000	65,000-89,000
	PM	120,000	100,000-140,000
	Total	190,000	170,000-220,000
Minor Restricted Activity Days	NOx	440,000	360,000-520,000
	PM	680,000	550,000-800,000
	Total	1,100,000	920,000-1,300,000

The health impacts from in-use off-road diesel vehicles are significant. To put the magnitude of impact in context, off-road diesel vehicles covered by the proposed regulation are equivalent to nearly one third of the number of deaths due to environmental tobacco smoke (secondhand smoke) and one fourth the number of deaths due to motor vehicle accidents. Secondhand smoke is estimated to cause to 4,021 premature deaths per year in California (ARB, 2006), while motor vehicle accidents killed 4,329 people in California in 2005 (NCSA, 2005).

E. What cancer risk would be expected from a typical large construction project and how would this regulation reduce this?

To evaluate the magnitude of risk to receptors from exposure to nearby construction sites, staff performed a risk assessment for a typical large two-year long construction project. This methodology is commonly used as a tool to estimate risk, from a generic

[2] Table includes indirect health impacts from NOx formation of secondary particulate as well as direct health impacts from PM. Table does not include indirect health impacts from NOx formation of ozone.

perspective, from a particular activity. The results from this assessment can then be overlaid on an actual population (i.e., those living near a potential construction site), to quantify risk from an actual project. Because staff's assessment was generic in nature, an actual number of affected individuals cannot be quantified, as any estimate would vary based on local population density (i.e., the more people near the site, the greater number of affected individuals.)

To get an upper end (conservative) estimate of possible risk, staff assumed all vehicles operating at the site were old and dirty (i.e., Tier 0 or uncontrolled). Staff estimated the risk to nearby receptors under various meteorological conditions. The analysis showed that cancer risks from such a project were not insignificant, but were much less than other large point sources that have been evaluated such as ports, rail yards, and distribution centers.

Even under the most unfavorable meteorological conditions modeled (i.e., those most conducive to elevated risk), the construction project would generate risks greater than 10 in a million for an area of only 26 acres surrounding the project. The actual numbers of affected individuals would depend on the population around a specific project. 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, 2005b). By comparison, the combined risk from the Ports of Long Beach and Los Angeles is estimated to subject an area of over 163,000 acres and over 2,000,000 people to a cancer risk of over 10 in a million, with 2,500 acres and 53,000 people subject to much higher risks of over 500 in a million (ARB, 2005c).

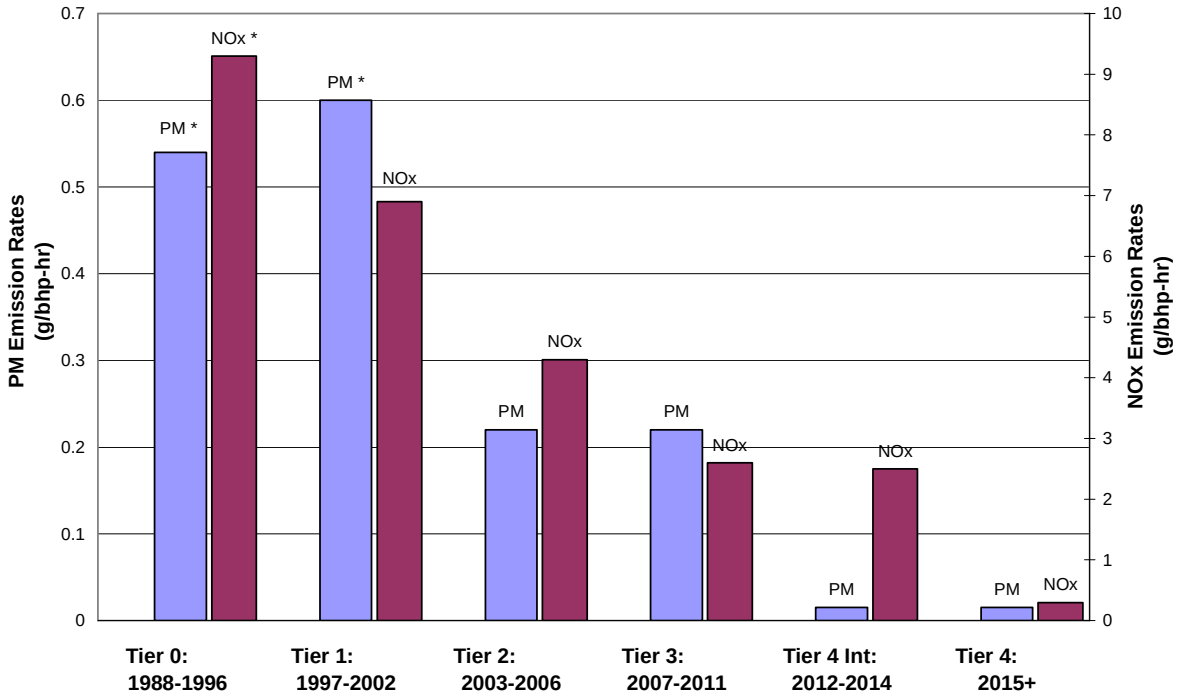
As the proposed regulation is implemented, the statewide construction fleet would become dramatically cleaner and staff's modeling indicates that the associated cancer risk from these types of construction projects would drop significantly.

F. What new engine emission standards apply to vehicles covered by the proposed regulation?

Since the mid 1990's, new engine standards adopted by U.S. EPA and ARB have required new off-road engines to become progressively cleaner. In developing the new engine standards, staff has worked closely with U.S. EPA to develop a harmonized federal and California program to more effectively control emissions from off-road vehicles. The emission standards are divided into four increasingly stringent levels (Tiers); the allowed emission level and effective dates vary with horsepower. Until the mid-1990s, off-road diesel engines were not subject to any emission standards (commonly known as Tier 0 or "uncontrolled"). In 1996 through 2000, the Tier 1 standards took effect. By 2006, all engine sizes were subject to Tier 2. Between 2006 and 2008, Tier 3 standards took effect for some horsepower groups. 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 require the use of advanced exhaust after-treatment technologies to control both PM and NOx, and will result in diesel engines that will be over 90 percent cleaner than Tier 0 engines. Figure II-6 illustrates how these standards change over time for one horsepower group, 100 to 174 horsepower engines. The numerical

standards vary by horsepower group, but the downward trend is the same for all horsepower groups.

Figure II-6 - ARB and U.S. EPA Diesel PM and NOx Emission Standards for New Off-road Engines 100 to 174 Horsepower



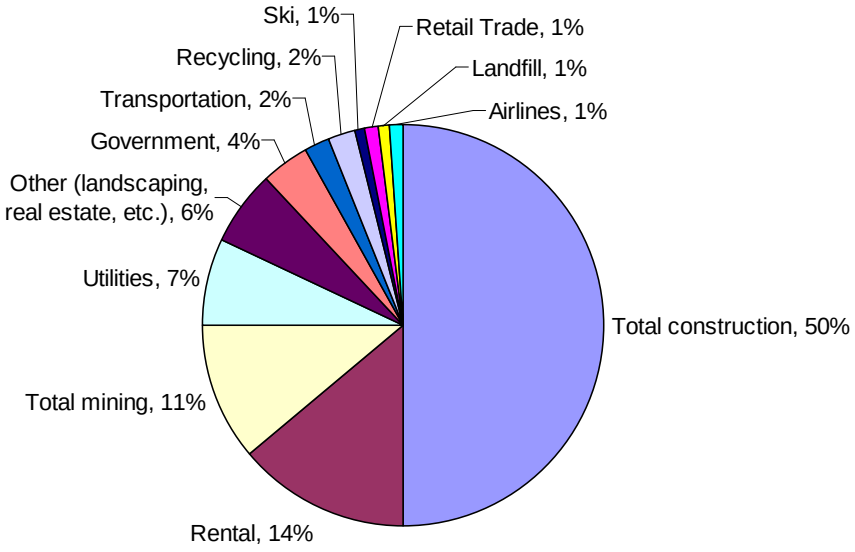
* - Estimated emission rate is shown because standards did not exist for this pollutant at that time.

III. AFFECTED INDUSTRIES AND VEHICLES

A. What industries and types of fleets would be affected by the proposed regulation?

The regulation would affect nearly all public and private fleets of off-road diesel vehicles operating in California. Industries such as construction, mining, landscaping, airlines, retail, wholesale, equipment rental, ski, oil and gas drilling, recycling, utilities, telephone and cable, and many others would be subject to the regulation. Government agencies engaged in road maintenance, park maintenance, and other activities would also be affected. Figure III-1 shows the distribution of fleet types, according to results from the 2005 ARB Off-road Equipment Survey.

Figure III-1 - Fleet Types Subject to the In-Use Off-road Diesel Vehicle Regulation (Percent of Vehicles Affected)



Construction vehicles make up roughly half of the vehicles affected by this regulation. A wide variety of construction vehicles, commonly ranging from 25 hp to 600 hp, are utilized during the various stages of different construction projects, which include tasks such as demolition, grubbing and clearing, dewatering, earthwork (excavation), grading, paving/surfacing, foundation work, building erection and other infrastructure developments. Vehicles used in construction range from production machines like large scrapers, which commonly have high utilization and are the primary source of income, to support or specialty vehicles like specialty paving equipment that are not highly utilized but are necessary to perform individual projects. Construction businesses range from owner operators and independent small contractor businesses with one vehicle to extremely large fleets with hundreds of vehicles and thousands of employees. There are also thousands of smaller subcontractors who most commonly perform somewhat

specialized work to support large projects led by larger contractors. In total, construction firms currently employ about 942,000 people in California and construction employment has been growing in recent years at about 0.5 percent per year (EDD, 2007). In 2006, building permits were issued for approximately 60 billion dollars in residential and nonresidential construction in California (DOF, 2007a).

Just fewer than 15 percent of the vehicles covered by the regulation are owned by rental companies. Rental companies tend to operate newer vehicles and provide individual consumers and contractors with the temporary use, on a fee basis, of a wide range of products and goods, including general construction, heavy vehicles, tools, and light equipment. In 2006, the rental industry generated revenues in California of an estimated $6.3 billion (American Rental Association, 2007).

Mining fleets make up a little over 10 percent of the vehicles covered by the regulation. The mining category represents about 1,000 active mines in California. The most common type of mining performed in California is open pit mining, which has activities similar to the earthwork and grading aspects of construction. Vehicles used in open pit mining typically include a broad a range of vehicles ranging from small horsepower vehicles up to the largest vehicles manufactured, with the largest vehicles typically having horsepower ranging from about 500 to several thousand horsepower. These high horsepower vehicles include trucks, loaders, and heavy shovels. Smaller vehicles, such as smaller loaders, graders and drill rigs, range from 150 hp to 500 hp and provide support and production functions. Mines often also have a limited number of small support vehicles with engines as small as 30 to 40 horsepower. Mining operations in California are varied, with operations ranging from fleets with a handful of vehicles at a single mine employing dozens of employees operating one shift a day to those operating hundreds of vehicles and employing hundreds of employees around the clock at numerous mines throughout the state.

The industrial sector includes thousands of manufacturing facilities and wholesale and retail distribution points throughout the state where forklifts, cranes and other tractors are used to facilitate manufacturing and to distribute raw materials and finished product. This sector includes a wide variety of business types, including ski resorts, recycling facilities, landfills, refineries, power plants, retail goods, wholesale good, utility services, golf courses, sewage treatment plants, landscape materials, factories and many other business types.

About one percent of affected vehicles are airport ground support equipment (GSE). Airport GSE vehicles perform a variety of functions, including but not limited to: aircraft maintenance, pushing or towing aircraft, transporting cargo to and from aircraft, loading cargo, and baggage handling. GSE vehicles include equipment types such as baggage tugs, belt loaders, and cargo loaders. Some airlines own and operate their own GSE, while others hire fixed base operators to service their aircraft. The largest airline fleets of GSE have several hundred vehicles spread across a number of airports.

B. How many and what types of vehicles are subject to the regulation?

Staff estimates that about 180,000 vehicles currently in use would be subject to the proposed regulation. Staff worked closely with stakeholders and gathered all publicly available information to update and refine estimates of off-road vehicle populations, their characteristics, and their expected lifetimes. The information gathered was incorporated into ARB's OFFROAD2007 model to estimate the number, types, and ages of vehicles affected by the regulation. Further detail on the sources of data used to develop staff's inventory estimates is included in the Technical Support Document.

The off-road diesel-powered mobile vehicles that would be subject to the requirements of this regulation are diverse. From off-road vehicles with engines as small as 25 hp to those with engines bigger than 2,500 hp, the regulation would affect any mobile (i.e., self-propelled) diesel-fueled vehicle that cannot be registered and licensed to drive on-road in California. The regulation would also cover workover rigs. Some examples of vehicle types affected include backhoes, dozers, loaders, trenchers, scrapers, forklifts, snow cats, baggage tugs, cargo loaders, belt loaders, and aircraft tractors. Table III-1 below shows the five most populous types of vehicles affected by the regulation.

Table III-1 - Top 5 Types of Vehicles Affected by In-Use Off-road Diesel Vehicle Regulation

Vehicle Category	2005 Population
Tractors/Loaders/Backhoes	30,665
Skid Steer Loaders	29,138
Rubber Tired Loaders	19,580
Excavators	19,354
Crawler Tractors	16,130

Figure III-2 shows the emission standard tier distribution of vehicles covered by the regulation. Over half of the vehicles are Tier 0 (i.e., uncertified engines), the newest of which were produced in 1999.

The majority of vehicles affected are relatively old. Figure III-3 shows the distribution of vehicles subject to the proposed regulation by age. The average age of affected vehicles in the State are about 10 years old, and nearly all vehicles are less than 40 years old, although some are much older.

Figure III-2 – Statewide Engine Tier Distribution of Vehicle Population Subject to Regulation (2005)

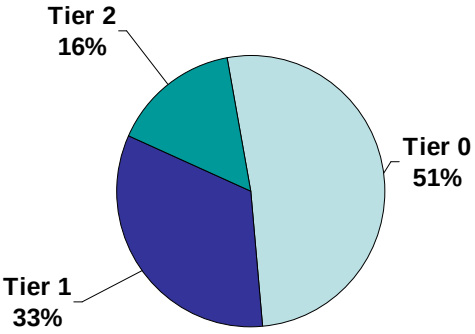
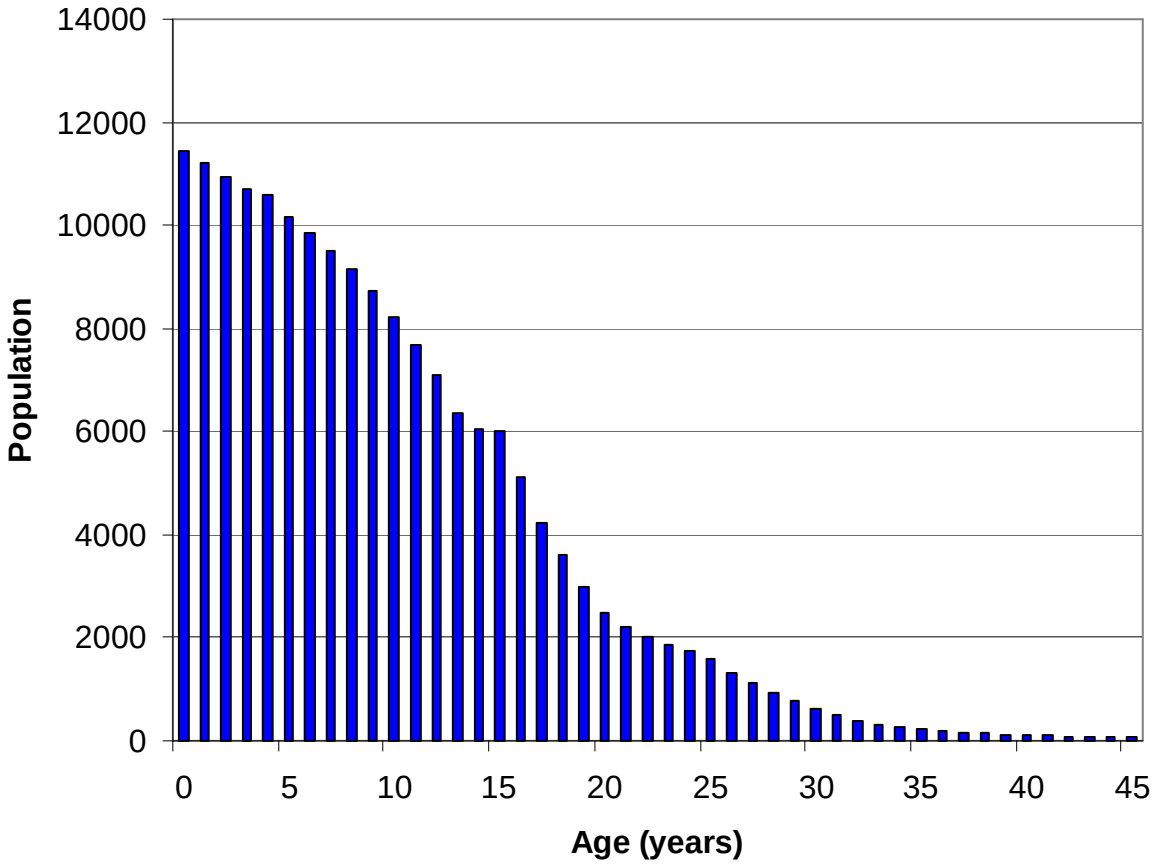


Figure III-3 - In-Use Off-road Diesel Vehicle Population by Age (2005)[3]



[3] Figure III-3 represents vehicles from 0 to 45 years old in 2005. There are an additional about 400 vehicles or 0.2% of the population that are between 46 and 76 years old not represented in the graph.

IV. DESCRIPTION OF REGULATION

A. What would the proposed regulation require?

The proposed regulation is included in Appendix A and contains different requirements for fleets of differing sizes, with the strictest provisions applying to the largest fleets. The regulation divides fleets into one of three categories, based on total horsepower of the affected vehicles and the type of owner. The fleet size definitions are summarized in Table IV-1 below.

Table IV-1 - Fleet Size Definitions

Fleet Size	Owner	Total Horsepower[4]
Small	Municipality	Less than or equal to 1,500 hp
	Small business (as defined in California Government Code 11342.610)	Less than or equal to 1,500 hp
	Municipality fleet in a low-population county	Any
Medium	Municipality	1,501 to 5,000 hp
	Business	Less than or equal to 5,000 hp and does not meet small fleet definition
Large	Municipality	Greater than 5,000 hp
	Business	Greater than 5,000 hp
	State and federal government fleets	Any

The regulation would establish the same fleet average emission rate targets for PM and NOx for medium and large fleets. The PM targets are delayed for five years for small fleets. Figure IV-1 depicts the large and medium fleet average targets for PM, compared to the overall fleet average emission rate expected for the California fleet in the absence of the regulation. Similarly, Figure IV-2 depicts the large and medium fleet NOx targets for the statewide fleet as a whole versus the overall fleet average emission rate expected in the absence of the regulation. Note that medium fleets would not be subject to the targets until 2013. The fleet average targets would drive fleets to clean up their fleets faster than natural turnover would. Figure IV-1 and Figure IV-2 are based on the horsepower distribution in the statewide fleet. Each individual fleet's emission targets would vary depending on the distribution of horsepower in their fleet.

[4] The sum of horsepower of all affected vehicles is used to determine the fleet size. Low-use vehicles (those that operate less than 100 hours per year) need not be included in the sum. All State and federal government fleets are considered large, regardless of total horsepower.

Figure IV-1 - Large and Medium PM Targets Versus Baseline PM Average for California Fleet as a Whole

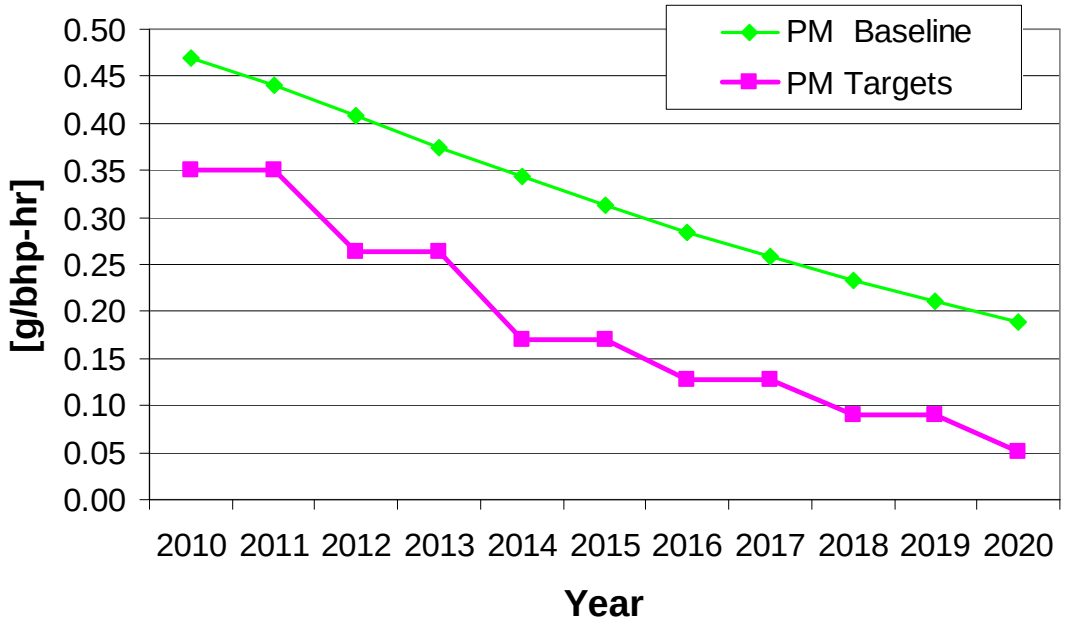
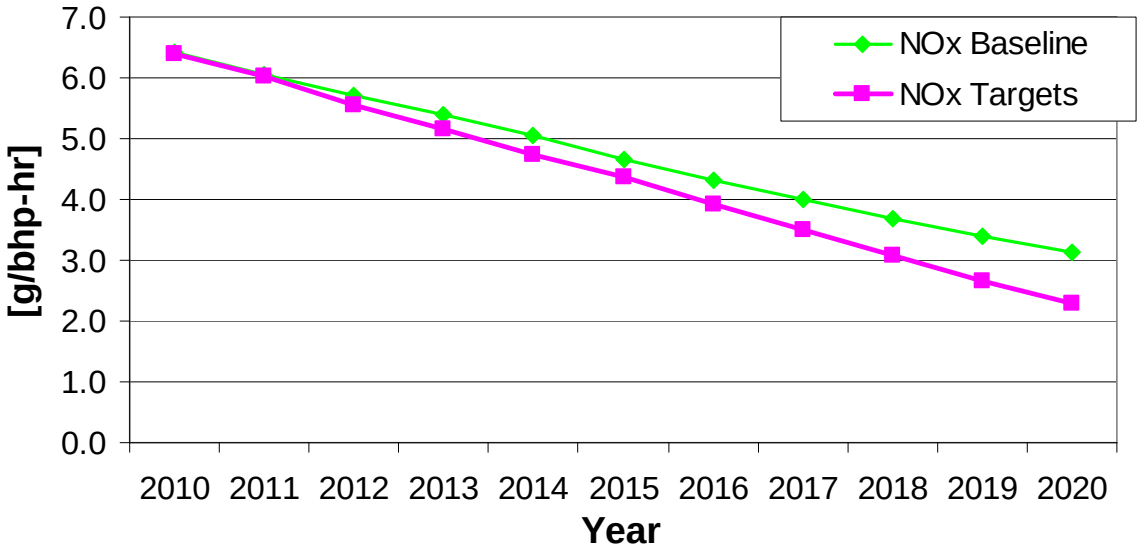


Figure IV-2 - Large and Medium NOx Targets Versus Baseline NOx Average for California Fleet as a Whole



Each year, fleets would have the option of satisfying either the fleet average requirements or the Best Available Control Technology (BACT) retrofit and/or turnover requirements. Satisfying either is an acceptable way to demonstrate compliance with the regulation.

Each year, all fleets would be required to demonstrate their fleet meets the fleet average emission rate targets for PM or to apply the highest level verified diesel emission control system (VDECS) to 20 percent of the horsepower in their fleets. The highest level VDECS would only be required if a system has been verified by ARB to be effective and durable for the engine on which it would be installed, and if the system can be used safely. The ARB's verification program, previously adopted by the Board, is intended to ensure that a device achieves the advertised emission reductions and has been evaluated for durability. Also, to receive ARB verification, the device manufacturer is required to warrant the VDECS and the engine against any damage caused by the device.

Each year, large and medium fleets would also be required to demonstrate that they meet the fleet average emission rate targets for NOx or have turned over a certain percent of the horsepower in their fleet (8 percent in early years, and 10 percent in later years). If retrofits that reduce NOx emissions become available and verified, they may be used in lieu of turnover.

The targets would decline over time, and would require fleets to reduce their emissions as time goes on. To meet the PM or NOx fleet averages, fleets may retrofit their vehicles' exhaust systems with verified emission control devices to reduce PM and/or NOx emissions, replace the engines in existing vehicles with cleaner engines (i.e., repower), retire high-emitting vehicles, and/or designate high-emitting vehicles as low-use vehicles. If retrofits that reduce NOx emissions become available, they may be used to lower NOx emissions in lieu of turnover as long as they achieve the same emission benefits.

Finally, the regulation would require that operators of off-road diesel vehicles shut down their vehicles rather than idle for more than 5 minutes, unless such idling is necessary for the proper or safe operation of the vehicle.

B. What are the reporting and recordkeeping requirements?

All fleets would be required to report their affected vehicles and associated engine and retrofit data to ARB beginning in 2009. Then, annually thereafter, fleets would need to report any changes made in the prior year. Fleets would also be required to label all affected vehicles with a unique equipment identification number (EIN) assigned by ARB. The EIN stays with the vehicle even if it is sold to a new owner, just like a license plate number for an on-road vehicle.

When vehicles are purchased or brought into the State, the owner would have 30 days from the date of purchase or entry to inform ARB of the purchase and apply to ARB for an EIN.

Fleets would be required to keep records of all data reported, as well as any changes made since their last reporting, until 2030, or as long as the owner still owns the fleet. Fleets would be required to provide the records to ARB within five business days upon request.

C. Would the regulation apply to out-of-state companies?

The regulation would apply to any affected vehicles being operated in California, whether they belong to government agencies, companies based inside California, or companies based outside the state. If they maintain fleets in California, out-of-state companies must meet the fleet requirements and abide by the idling limits just like any other fleet.

Out-of state companies that bring affected vehicles to California would have to report and label the vehicles. Vehicles brought into California must be reported to ARB within 30 days. If the vehicle does not have an EIN, ARB would assign one. The owner has 30 days upon receipt of the EIN to label the vehicle.

If a vehicle brought in from out-of-state is used less than 100 hours per year in California, it would qualify as low-use. However, if an owner wants to claim a vehicle that is used both inside and outside California as low-use, the owner would have to submit a log to ARB showing the date and hour meter reading upon entry to California and the date and hour meter reading upon exit.

Out-of-state companies that bring vehicles to California for the first time after March 1, 2009, must meet the fleet average requirements within three months of bringing vehicles to California. Such out-of-state fleets do not have the option of complying with the BACT mandatory retrofit and turnover requirements.

D. Would farmers, ranchers, and loggers be affected?

Vehicles used for over half their annual operating hours in agricultural operations are not covered by the regulation. Off-road diesel vehicles used in agricultural operations are expected to be covered by a future control measure. Agricultural operations include the growing or harvesting of crops (including forest operations), the raising of fowl or animals, as well as agricultural crop preparation services such as cotton gins, nut hullers and processors, dehydrators, and feed and grain mills.

E. Why is the regulation more stringent for larger fleets?

Staff proposed an earlier initial compliance deadline for the largest fleets because staff believes the largest fleets have the resources to understand and comply rapidly with the regulation. The larger fleets, with their economies of scale, greater revenue streams, and greater access to financing, are more likely to be able to absorb or pass through the cost of the regulation without major disruption. Finally, enforcing the regulation early in the implementation process for just the relatively few largest fleets would present less of a challenge than enforcing the regulation for the very numerous smallest fleets. In

these first years of implementation, ARB inspectors would have the opportunity to better learn the industry and observe common violations.

Conversely, staff proposed more time to the smallest fleets that are also small businesses, because many of them are one or two-person operations, for whom learning about and understanding the regulation may be a bigger challenge. In addition, smaller fleets would have fewer compliance options to choose from because of the limited number of vehicles they own. That is, larger fleets may be able to select their easiest, lowest cost vehicles to clean up in the early years, thereby giving themselves additional time to find solutions for their more expensive or difficult to control vehicles. Small fleets with only a few vehicles may not have this opportunity.

F. Would there be exemptions from the turnover requirements?

Small fleets (fleets with less than 1,500 total horsepower that are small businesses or municipalities, and municipalities in counties with low populations regardless of total horsepower) would not subject to the NOx fleet average requirements nor the turnover requirements. Similarly, fleets which operate exclusively in areas that are in attainment with the NAAQS for ozone and PM2.5 and do not contribute to downwind violations would also be excluded from the NOx requirements.

For the remaining fleets subject to the turnover requirements, the following vehicles would be exempt from turnover requirements:

- Vehicles less than 10 years old;
- Specialty vehicles if certain criteria are met;
- Engines equipped with the best available PM exhaust retrofit, installed within the past six years; and
- Engines meeting the Tier 4 or interim Tier 4 standards.

Finally, if NOx retrofits become available and verified, they may be used in lieu of the mandatory turnover so long as they achieve equivalent emission reductions.

G. Would there be exemptions from the PM exhaust retrofit requirements?

The following engines would be exempt from exhaust retrofit requirements:

- Engines in vehicles less than 5 years old;
- Engines for which there is no retrofit available or for which the retrofit cannot be safely installed;
- New engines that come with a diesel particulate filter (DPF);
- Engines already retrofit with the best available PM exhaust retrofit that achieves at least 50 percent PM reduction at the time of installation; and
- Engines retrofit with an experimental diesel emission control strategy approved by ARB's Executive Officer.

H. What if a VDECS is not safe for my particular vehicle or vehicle application?

If a fleet owner believes that a retrofit that is verified for a vehicle in his fleet would not be safe to operate, he would be able to apply to ARB with supporting documentation. ARB's Executive Officer may determine that the VDECS would not be appropriate for a certain vehicle or vehicle application because it impairs the safe operation of the vehicle. For example, in some cases VDECS may impair driver visibility, may not be able to be safely mounted without damaging the structural integrity of the vehicle, or may cause other safety concerns. In such a case, the VDECS in question would not be required, even though it might be verified for the particular engine in question.

I. Would there be special provisions for low-use vehicles?

Vehicles used less than 100 hours per year (either in the past year or on average over the past three years) need comply only with the labeling, reporting, and recordkeeping requirements. They do not need to be included when figuring compliance with the fleet average targets, nor do they need to be retrofit or turned over.

J. Would there be special provisions for vehicles used for emergency operations?

Vehicles used solely for emergency operations (for example, for fighting forest fires) would need to comply only with the labeling, reporting, and recordkeeping requirements. They would not need to be included when figuring compliance with the fleet average targets and would not need to be retrofit or turned over. For vehicles used part-time for emergency operations (such as for emergency road repairs or fighting forest fires), hours for emergency use would not need to be included when determining low-use status.

K. What if there are delays in the availability of retrofit systems, repowers, or new vehicles?

The regulation would not penalize fleets for delays in the availability of retrofits, repowers, or new vehicles. As long as the fleet owner orders the required retrofit, repower, or new vehicle at least six months prior to the required compliance date, the fleet owner would be able to count the new retrofit, repowered engine, or new vehicle just as if it had been delivered. The owner would need to place the new equipment or vehicles into operation immediately upon receipt.

The Executive Officer would also be able to grant additional time to fleets or groups of fleets if there were a delay in the availability of interim or final Tier 4 vehicles.

L. The proposed regulation is hard to understand, could it be simplified?

To simplify the regulation would require the removal of many of the elements that provide much of its flexibility, including the fleet average provisions. For a regulation to cover such a diverse and complex set of fleets and to provide the flexibility it needs to address the many situations and special cases that may arise and remain enforceable,

it must be somewhat complex. Situations that may arise, such as addressing fleets that add vehicles, face manufacturer delays, move vehicles in and out of state, apply experimental retrofits, or operate specialty vehicles, must be adequately addressed. Thus, the regulation is by necessity rather long and complex.

Much of the complexity of the regulation stems from its fleet average provisions. The regulation could be simplified, for example, by requiring that all vehicles be retrofit by a certain date, or by requiring phase-out of all engines of a certain tier by a certain date. However, doing so, would sacrifice much of the flexibility that the regulation provides and would result in higher compliance costs for no commensurate emission benefit. Further, for some fleets that specialize in operations with long-lived vehicles, the increased economic burden could be difficult to absorb without severe losses in profitability.

Staff plans to develop and provide fleets with a set of electronic tools for reporting and for determining compliance planning and tracking. Also, fleets who wish to avoid the complexity of the fleet average altogether may instead choose to comply exclusively with the mandatory annual turnover and retrofit provisions. Staff envisions that the electronic reporting system would automatically determine the fleet average and targets for each fleet such that fleets would be aware of whether or not they meet the fleet targets before taking more action than required. Staff also expects to commit significant resources for outreach and education about the regulation to assist fleets in meeting the requirements.

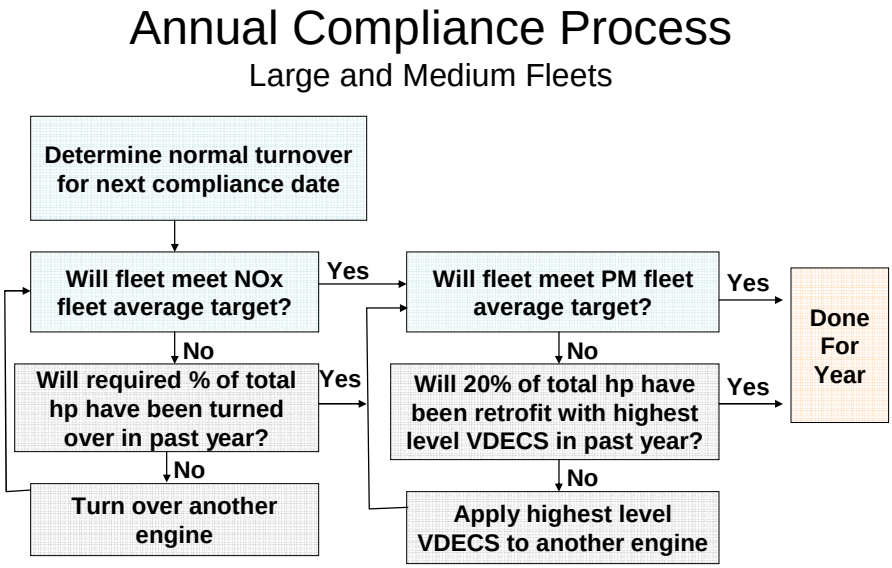
M. What would the regulation actually require fleets to do?

Because of the unique nature of each fleet, the regulation would mean different things for different fleets, depending on their size and on the vintage of their vehicles. For the fleets with the newest vehicles and high natural turnover rates as part of their normal business model, such as some rental fleets, the regulation would impose only labeling, reporting, and recordkeeping requirements.

Figure IV-3 below provides a graphical depiction of the compliance process. Note that large and medium fleets would be required to meet both the NOx and PM elements of the regulation, while small fleets would only have to comply with the PM components.

Small fleets with older vehicles would need to install exhaust retrofits on 20 percent of their horsepower per year beginning in 2014 because it would be unlikely they would be able to meet the PM fleet average. Small fleets with newer vehicles may choose to either voluntarily accelerate turnover of their fleets (for PM reasons only, as they do not need to meet any NOx requirements) enough to meet the PM fleet average targets or to apply some exhaust retrofits.

Figure IV-3 - Compliance Flowchart for Affected Fleets



Note: Turn over means repower with cleaner engine, replace vehicle with used vehicle or new vehicle, designate as low-use, or decrease fleet size. If NOx retrofits become available, they may be used in lieu of turnover.

Medium fleets with the oldest vehicles would need to accelerate turnover of engines to 8 percent of their horsepower per year and install exhaust retrofits on 20 percent of their horsepower per year beginning in 2012. Similarly, large fleets with the oldest vehicles would need to accelerate turnover of engines to 8 percent of their horsepower per year and install exhaust retrofits on 20 percent of their horsepower per year beginning in 2009. In 2015, the oldest large and medium fleets would need to further accelerate turnover to 10 percent of their horsepower per year. These actions would need to continue until the fleet averages are met. If the NOx fleet average is still not met, vehicles that are retrofit early in the implementation period may also need to be turned over once the exhaust retrofits are older than 6 years.

Large and medium fleets with newer vehicles would need to accelerate turnover of their fleets enough to meet the NOx fleet average targets and to apply enough exhaust retrofits to meet the PM fleet average targets. Most likely, such newer fleets would need to do less than 8 percent per year turnover and less than 20 percent per year exhaust retrofits, in the early years.

Also, if NOx exhaust retrofits, such as selective catalytic reduction, become verified and available for off-road diesel vehicles, the regulation would allow fleets to use these retrofits to meet the NOx fleet average targets or in lieu of the mandatory turnover. Staff believes that if such NOx exhaust retrofit technologies become available, they could lower the compliance costs below the estimates provided in this staff report.

N. Would there be special provisions for the areas of the state that meet the federal clean air standards?

Fleets that operate exclusively in counties that attain all the NAAQS and that do not contribute to downwind violations of the federal ozone standard would be exempt from the NOx fleet averages and the mandatory turnover requirements of the regulation. These counties are Alpine, Colusa, Del Norte, Glenn, Humboldt, Lake, Lassen, Mendocino, Modoc, Monterey, Plumas, San Benito, San Luis Obispo, Santa Cruz, Shasta, Sierra, Siskiyou, Trinity, Tehama, and Yuba. Fleets in these counties would still need to meet the PM fleet average or PM exhaust retrofit requirements.

O. Would there be special provisions for the areas of the state that are sparsely populated?

Municipalities in low-population counties (generally those with less than 125,000 people) would be classified as small fleets, would have more time to comply with the PM requirements, and would not be subject to the NOx requirements of the regulation.

P. When would the regulation take effect?

The regulation's idling requirements and restrictions on adding Tier 0 vehicles to fleets would begin in 2009. Initial reporting of fleet information to ARB would also begin in 2009 – with the largest fleets reporting first on May 1, and medium and small fleets having a few additional months to report. The first fleet average compliance dates would be March 1, 2010 for large fleets, March 1, 2013 for medium fleets, and March 1, 2015 for small fleets. The fleet averages would become more stringent over time, declining until 2020 for large and medium fleets, and until 2025 for small fleets.

Q. Would the regulation include special provisions for sensitive receptors?

Sensitive receptors, including such individuals as children, the elderly, and people whose health is already compromised, are particularly susceptible to pollution from diesel vehicles (ARB, 2005d). Staff considered including special requirements in the regulation for off-road vehicles used near sites where such sensitive receptors are likely to be present such as at schools and hospitals, but ultimately decided a fleet-based regulation that cleans up the entire fleet would be preferable for the following reasons:

- As previously discussed, the long term risk from any one construction project is expected to be low and is already subject to an environmental review process. For large public projects and for those that require any kind of public permitting or approval, the California Environmental Quality Act (CEQA) already requires a process by which risks from individual projects are evaluated and mitigated. This provides for project specific mitigation that takes into account local land use (such as how close is the nearest school, day care center, hospital, etc).
- The transient nature of off-road diesel vehicle use makes it more difficult to impose sensitive receptor provisions. Although several of ARB's existing air toxic control measures, such as that for emergency standby diesel generators, contain special requirements for sensitive receptors, the transient nature of off-road diesel vehicles (often used for just a short time and then moved to another

location) makes it much more difficult to incorporate special provisions for sensitive receptors into a statewide rule like that proposed.
- Sensitive receptor provisions would add complexity and make compliance and enforcement much more challenging.

The proposed regulation would require the gradual cleaning up of the statewide fleet of in-use off-road diesel vehicles. As the fleet is cleaned up, and especially as exhaust retrofits that capture toxic diesel PM emissions begin to be installed, the risk to sensitive receptors will decrease, along with the risk to all breathers in California. As discussed below, local agencies and others may wish to take action to further reduce the risk posed by large construction projects.

R. Could local agencies consider additional controls to further reduce the risk posed by large construction projects?

Yes, for large construction projects, local governments, communities, and developers may wish to consider additional requirements to limit the public's exposure to toxic emissions from diesel vehicles. Diesel PM is a carcinogen, and – as such – has no safe threshold below which there is no risk. Local agencies could choose to impose in-use operational controls, such as hours of use restrictions, or could possibly impose additional requirements through the CEQA process for projects that cause significant environmental impacts or through public project contract requirements.

For example, local governments, communities, or developers could adopt to limit construction-related diesel PM exposure to sensitive receptors could include those listed below. Such requirements could be applied to all projects within a certain distance of sensitive sites, or could be limited only to those of a certain duration or that disturb greater than a certain area of soil. The following requirements could be adopted on a project specific basis as mitigation measures as part of the CEQA or National Environmental Policy Act (NEPA) process or built into contract requirements for public projects:

- Limit construction vehicles used near such sensitive sites to vehicles cleaner than a certain tier (Tier 2 or cleaner, for example) and require that all such vehicles be retrofit with the highest level verified diesel emission control system.
- Limit construction to times when sensitive receptors are not present. For example, projects within 500 feet of a school could be limited to non-school hours.
- At a minimum, developers and public agencies that sponsor large construction projects should ensure that any contractors they hire have reported their vehicles to ARB and are in compliance with the proposed regulation.

Local governments could also consider the risk from off-road diesel vehicles when considering approval for construction near where sensitive receptors are likely to be present (i.e., schools, hospitals, housing). Conversely, land use planners may wish to consider the location of existing landfills, recycling centers, and other facilities that require the use of diesel vehicles when siting homes and schools and hospitals.

Several land use handbooks exist to help guide local land use decisions – for example, the *Air Quality and Land Use Handbook* (ARB, 2005d), and the *Guidance Document for Addressing Air Quality Issues in General Plans and Local Planning* (South Coast Air Quality Management District, 2004).

S. Would the regulation give credit to fleets that take early action to reduce their emissions?

The regulation would provide credit for early compliance action in a number of ways. First and foremost, such fleets would start out closer to meeting the fleet average targets and therefore would have less further action to take to reach the targets. Also, fleets that have phased out the dirtiest engines (Tier 0) would not be required to do any mandatory turnover of Tier 1 or newer vehicles until 2013.

Some fleets who took or are taking early action to reduce their emissions still would not meet the fleet average targets in the early years, either because they have longer-lived vehicles or because they started out with an older fleet. The following provisions would provide early action credit to such fleets, for such actions as:

- Early retrofits – Level 2 or 3 retrofits installed before March 1, 2009 may be counted double toward later requirements for mandatory annual retrofit requirements. This double credit for early retrofits would give fleets incentive to install retrofits early and would allow the market to ramp up production and installations of retrofit systems.
- Early repowers - Repowers to Tier 1 or better installed before March 1, 2009 may be counted toward later mandatory turnover requirements.
- Early turnover – Fleets that turned over their Tier 0 vehicles at a rate that was greater than 8 percent per year of their total horsepower between March 1, 2006 and March 1, 2009 may apply to ARB's Executive Officer for credit towards later mandatory turnover requirements.

V. REGULATORY AUTHORITY

A. Does ARB have the authority to adopt and enforce the regulation?

ARB has authority under California law to adopt the proposed regulation. California Health and Safety Code (HSC) sections 43000, 43000.5, 43013(b) and 43018 provide broad authority for ARB to adopt emission standards and other regulations to reduce emissions from new and in-use vehicular and other mobile sources. Under HSC sections 43013(b) and 43018, ARB is directly authorized to adopt emission standards for off-road vehicular sources, as expeditiously as possible, to meet state ambient air quality standards. ARB is further mandated by California law under HSC section 39667 to adopt Air Toxic Control Measures (ATCMs) for new and in-use vehicular sources, including off-road diesel vehicles, for identified TACs, such as diesel PM.

Under federal and California law, ARB is the primary agency in California responsible for making certain that all regions of the State attain and maintain NAAQS. To achieve this, California must adopt all feasible measures to obtain the necessary emission reductions, including measures from mobile sources. The federal CAA preempts states, including California, from adopting requirements for new off-road engines less than 175 horsepower used in farm or construction equipment. However, California may adopt emission standards for in-use off-road engines (federal CAA section 209(e)(2)). Because the proposed regulation addresses in-use rather than new off-road engines, it is permitted by the federal Clean Air Act. For example, turnover of a vehicle is not required until a vehicle is older than 10 years. California must obtain authorization from the Administrator of the U.S. EPA before the in-use emission standards of this proposed regulation become enforceable. Since the proposed regulation is not within the scope of any existing U.S. EPA authorizations, California must obtain a new authorization from U.S. EPA prior to the regulation becoming effective.

VI. EMISSION BENEFITS

A. What would be the emission benefits of the regulation?

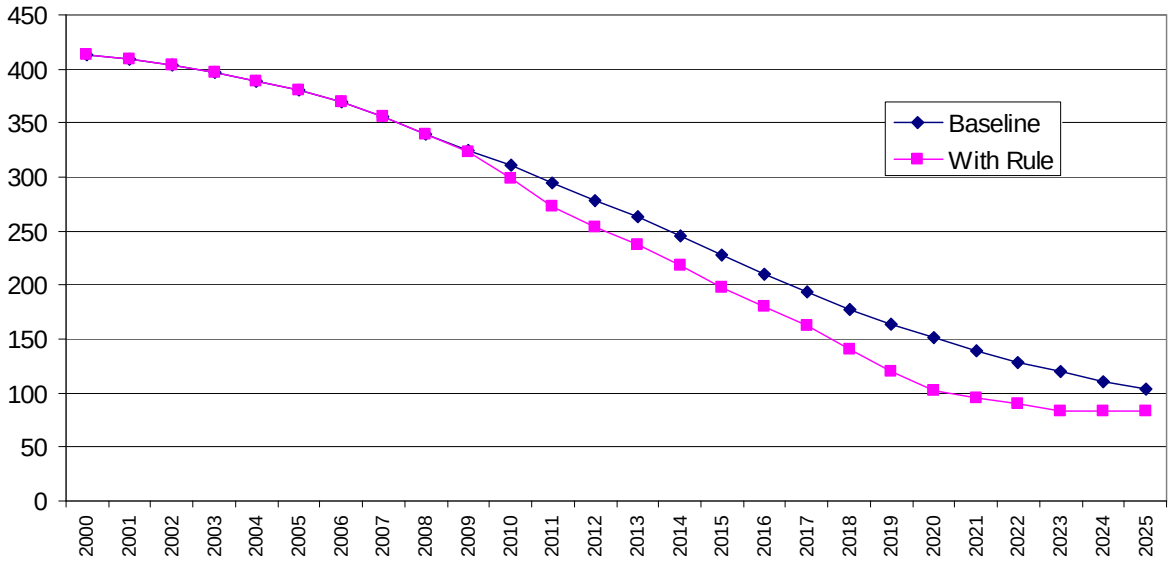
The regulation would be expected to significantly reduce emissions of NOx and PM. The regulation would achieve the 2020 goal of reducing PM 85 percent from 2000 baseline levels set forth in the 2000 Diesel Risk Reduction Plan. The regulation is projected to reduce PM emissions 37 percent from the 2000 baseline by 2010, and 92 percent by 2020. Although NOx and PM emissions are both projected to drop from now through 2020 even in the absence of the regulation, the proposed regulation would accelerate the anticipated emission reductions. For example, the PM emission inventory projected for 2020 with regulation in place would not be reached in the absence of the regulation until after 2025.

As shown in Table VI-1, the regulation would provide significant near- and long-term NOx emission benefits. As shown in Table 4, NOx is expected to be about 13 percent lower in 2015 as a result of the regulation, and by 2020, NOx emissions would be 32 percent lower than would occur in the absence of the regulation. Figure VI-1 below shows the NOx emissions expected with and without the regulation.

Table VI-1- Statewide NOx Emission Reductions from the In-Use Off-road Diesel Vehicle Regulation (tons per day)

Emission Reductions	2010	2015	2020	2025
NOx Without Regulation	311	228	151	103
NOx with Regulation	298	198	103	84
Benefits of Regulation	13	30	48	20
Percent Reduction	4%	13%	32%	19%

Figure VI-1 - Statewide NOx Emissions Inventory With and Without Regulation (tons per day)

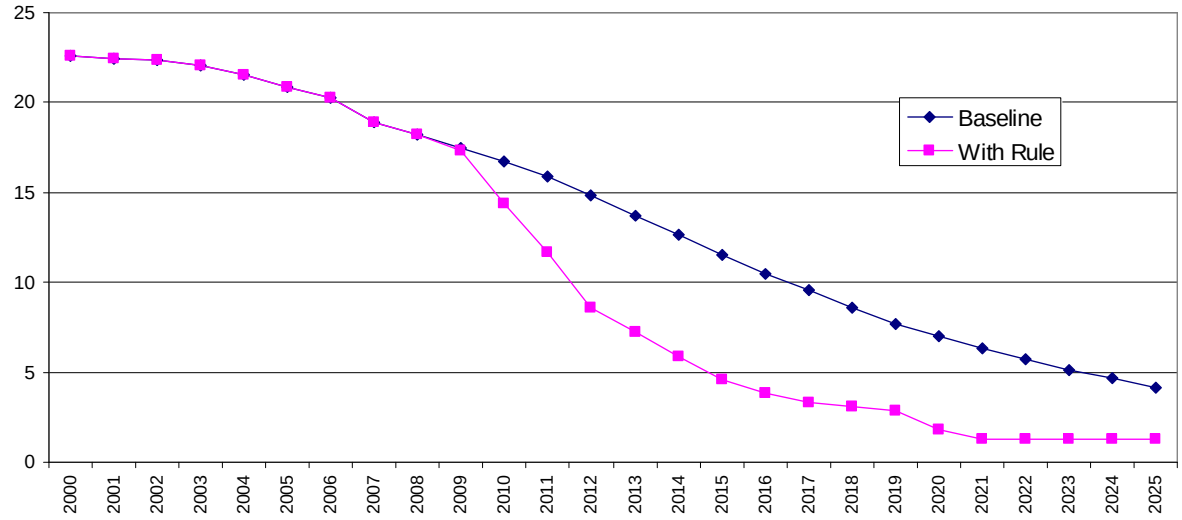


Similar to NOx, significant near-term and long-term PM benefits would be expected from the regulation. As shown in Table VI-2 and depicted graphically in Figure VI-2, PM emissions would be 60 percent lower in 2015, and 69 percent lower in 2020 than they would be in the absence of the regulation. The large reductions prior to 2013 are a result of fleets retiring some of their dirtiest engines and installing PM exhaust retrofits on nearly 20 percent of their hp per year. After 2013, most fleets would meet the PM fleet average targets and would be able to continue to meet subsequent PM averages with engine turnover and a small number of PM exhaust retrofits per year. PM emissions decline again in 2020 and 2021 when all remaining diesel engines that do not have PM exhaust retrofits would be required to have them.

Table VI-2 – Statewide PM Emission Reductions from the In-Use Off-road Diesel Vehicle Regulation (tons per day)

Emission Reductions	2010	2015	2020	2025
PM Without Regulation	16.7	11.5	7.0	4.2
PM With Regulation	14.4	4.6	1.8	1.3
PM Benefits of Regulation	2.3	6.9	5.2	2.9
Percent Reduction	14%	60%	74%	69%

Figure VI-2 - Statewide PM Emissions Inventory With and Without Regulation (tons per day)



The proposed regulation is one of the new measures included in the draft SIP currently being developed by ARB staff. Both the South Coast and San Joaquin Valley must achieve significant NOx reductions to meet the ambient PM2.5 standard by the federally mandated 2015 deadline. U.S. EPA guidelines require that the necessary emission reductions be achieved by 2014 for PM2.5. Significant NOx reductions are also needed by these two regions to meet their ozone attainment deadlines which are currently 2021 for the South Coast and 2013 for the San Joaquin Valley. In light of the magnitude of the NOx reductions needed, these two regions are expected to take the full time allowable, with ozone attainment deadlines as late as 2024 (ARB 2007b). The necessary emission reductions would then have to be achieved by 2023 for ozone attainment.

As shown in Table VI-3, the proposed regulation would reduce annual average NOx emissions from off-road diesel vehicles in the South Coast by about 10 tons per day in 2014 and 13 tons per day in 2023. In 2014, the projected annual average NOx emissions would be about 11 percent lower than would occur in the absence of the regulation, and in 2023, they would be 30 percent below the 2023 baseline emissions. Annual average directly emitted PM2.5 emissions would be decreased by more than 50 percent (or 2.7 tons per day) in 2014 and by over 90 percent (or 1.5 tons per day) in 2023.

Table VI-3 - Projected Emissions Reductions for South Coast

Calendar Year	Annual Average Emissions (tons per day)					
	PM2.5		NOx		ROG	
	Baseline	Reductions	Baseline	Reductions	Baseline	Reductions
2010	6.6	0.9	117	4.8	14.9	1.0
2014	5.0	2.7	93	10.3	12.0	2.5
2020	2.8	2.1	55	17.6	8.5	2.7
2023	2.0	1.5	44	13.1	7.4	1.8

As shown in Table VI-4, the proposed regulation would reduce annual average NOx emissions from off-road diesel vehicles in the San Joaquin Valley by about 3.6 tons per day in 2014 and 5.1 tons per day in 2023. In 2014, the projected annual average NOx emissions would be about 11 percent lower than would occur in the absence of the regulation, and in 2023, they would be 30 percent below the 2023 baseline emissions.

Table VI-4 - Projected Emissions Reductions for San Joaquin Valley

Calendar Year	Annual Average Emissions (tons per day)					
	PM2.5		NOx		ROG	
	Baseline	Reductions	Baseline	Reductions	Baseline	Reductions
2010	2.0	0.3	41	1.7	4.7	0.3
2014	1.5	0.8	33	3.6	3.8	0.8
2020	0.9	0.6	22	6.9	2.9	0.9
2023	0.7	0.5	17	5.1	2.5	0.6

B. What effect would the regulation have on the health of Californians?

The emission reductions obtained from this regulation would result in lower ambient PM levels and reductions of exposure to diesel PM. Staff estimates that approximately 4,000 premature deaths (1,100 – 6,800, 95 percent confidence interval (95% CI)) statewide would be avoided by the year 2030 from the implementation of the proposed regulation. Estimates of other health effects avoided statewide include:

- 840 hospital admissions due to respiratory causes (540 to 1,200, 95% CI)
- 1,600 hospital admissions due to cardiovascular causes (980 to 2,400, 95% CI)
- 110,000 cases of asthma-related and other lower respiratory symptoms (43,000 to 180,000, 95% CI)
- 9,200 cases of acute bronchitis (0 to 20,000, 95% CI)
- 680,000 work loss days (580,000 to 790,000, 95% CI)
- 3,900,000 minor restricted activity days (3,200,000 to 4,600,000, 95% CI)

Benefits from the proposed regulation are substantial. Staff estimates the benefits to be $26 billion using a 3% discount rate or $18 billion using a 7% discount rate. (CARB follows U.S. EPA practice in reporting results using both 3% and 7% discount rates.) Nearly all of the monetized benefits result from avoiding premature death. The estimated benefits from avoided morbidity are less than $400 million with a 3% discount

rate and less than $300 million with a 7% discount rate. Most of the benefits, approximately 85 percent, are associated with reduced diesel PM, and the remaining 15 percent with reduced NOx.

C. What effect would the regulation have on global warming and greenhouse gas emissions?

Although some actions required by the regulation would slightly increase carbon dioxide (CO_2) greenhouse gas emissions because they have a fuel economy penalty impact on fleets, on the whole, staff expects the regulation to result in a negligible effect on global warming. The regulation would push fleets to move from uncontrolled engines to cleaner engines with NOx controls and to apply exhaust retrofits. These cleaner engines and retrofit devices can have a fuel economy penalty as high as two to four percent. When more fuel is burned, more CO_2 is produced, and CO_2 is a greenhouse gas.

The following actions required by the regulation, however, would reduce greenhouse gas emissions and are expected to offset the fuel penalty effects:

- The regulation reduces black carbon emissions, which contribute to global warming.
- The regulation also limits unnecessary idling, which would reduce CO_2 emissions.
- The regulation gives credit for use of electric vehicles, including double credit incentives for the replacement of diesel engines with electric vehicles in early years. While not expected to be widely used in construction, electric vehicles are expected to be used by the airline industry and may have applications in mining as well. On a lifecycle basis, electric vehicles have lower associated CO_2 emissions than diesel vehicles (Delucchi, 2005).

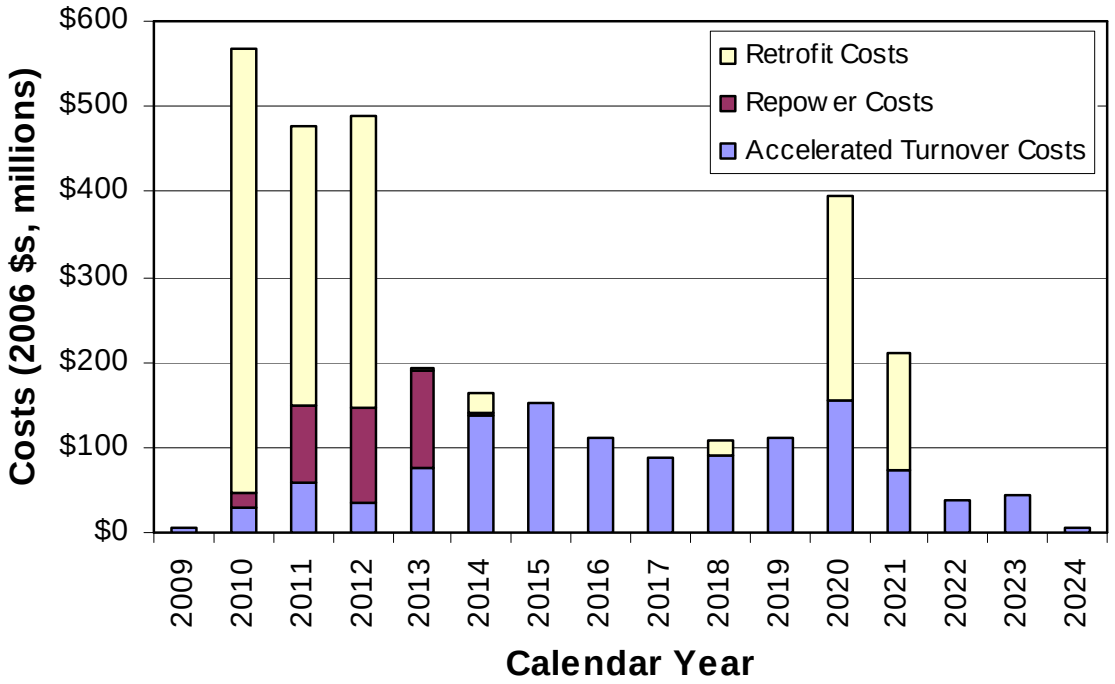
VII. COSTS AND ECONOMIC IMPACTS

A. How much would the regulation cost?

The total statewide cost of the regulation is expected to be significant. The total cumulative cost of the regulation between 2009 and 2030 would be between $3.0 and 3.4 billion (2006 dollars), with the majority of costs these costs occurring between 2010 and 2021. Annually, this would represent $229 million to $257 million per year, averaging $243 million per year (2006 dollars). The total cost includes the expected cost of exhaust retrofit devices and repowers, as well as the cost of accelerating turnover to newer vehicles. No cost savings are included from lower vehicle maintenance costs as a result of operating newer engines or vehicles. Expenditures for new vehicles that would be incurred in the absence of the regulation due to natural turnover (i.e., money that fleets are already spending on new vehicles) over this same period are estimated to be about $16.1 billion ($8.6 billion in 2006 dollars) and would not be attributed to the regulation nor included in these estimates.

Figure VII-1 shows the costs projected for each year, and the portion of cost due to accelerated turnover, engine repowers, and exhaust retrofits (including retrofit maintenance, fuel penalty, etc.) The majority of the regulation's cost - just over half – would be due to costs for exhaust retrofits.

Figure VII-1- Statewide Annual Costs (in millions) from In-Use Off-road Diesel Vehicle Regulation (2006 dollars)[5]



To put the regulatory cost in context, on an annual basis, the cost to the construction industry is less than 0.3 percent per year of the total annual statewide value of construction in California, which in 2006 was about $60 billion (DOF, 2007a), and represents the annual statewide increase in construction costs anticipated as a result of the regulation.

B. How much would the regulation cost fleets?

Costs to fleets would vary depending on the size of each fleet, its initial composition and vehicle age, 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). Additionally, there would be ongoing costs for annual reporting and annual maintenance costs for retrofits.

Table VII-1 presents the expected range of costs on a per horsepower basis for small, medium and large fleets based on the average vehicle age at the beginning of the regulation. As Table VII-1 shows, fleets that start out older would face higher per horsepower costs. The youngest, cleanest fleets may only incur additional costs for reporting and recordkeeping. Some fleets may pay up to approximately $170 per hp, depending on their initial composition, vehicle age, and compliance strategy. Some fleets may incur slightly higher costs. Small fleets face the lower average costs than

[5] The costs in this figure do not include reporting costs, which are expected to be about $8 million in 2009 and $2 million per year in subsequent years.

medium and large fleets. Table VII-2 below presents costs for a typical small, medium and large fleet.

Table VII-1 – Expected Total Regulation Cost for Fleets with Various Initial Average Ages (2006 dollars)

Average Fleet Age (years)	Small Fleets ($/hp)	Medium Fleets ($/hp)	Large Fleets ($/hp)
Less than 8	0-50	0-50	0-50
8 to 12	0-110	40-110	40-115
12 to 16	0-110	75-120	75-130
16 to 20	0-150	75-150	110-150
20 and up	0-150	110-150	110-180

Table VII-2 – Expected Annual Cost Due to Regulation for a Typical Medium, and Large Fleet

Fleet Category	Total Fleet Horsepower	Typical $/hp/yr Cost (2006 $s)	Typical Annual Cost ($/yr, 2006 $s)
Small	1,000	$6.0	$6,000
Medium	3,000	$8.9	$27,000
Large	10,000	$8.9	$89,000

C. What would be the impact on small businesses?

The total cost for a small business (i.e., a small fleet) to comply with the regulation would be approximately $73/hp. Of this, $21/hp represents the typical ongoing costs for retrofit maintenance, fuel economy losses, and ongoing reporting costs. A typical small business with 1,000 horsepower could expect the total cost of the regulation over its lifetime to be $73,000 (2006 dollars), with average annual costs of $6,000 per year (2006 dollars) over the years 2009 to 2030.

D. What would be the impact on government agencies?

Two separate economic impacts may apply at the state government level: costs of compliance for state agencies that own affected diesel vehicles and costs for ARB to implement and enforce the regulations. The proposed regulation would not affect federal funding to the state. The total cost to state agencies for compliance would be expected to be between $48 million and $54 million (2006 dollars). Average annual state agency costs for compliance would be about $4 million per year between 2009 and 2030. For a typical state agency fleet, the expected total cost would be about $110/hp. The cost for ARB to implement and enforce the regulation would be expected to be $3 million per year on average for the years 2009 to 2030. Overall, the total costs to State agencies would be approximately $84 to $90 million.

The regulation would also impose costs on local agencies that own affected vehicles. The total cost to local agencies for compliance is expected to be about $100 million (2006 dollars). Total annual costs for all affected agencies are expected to be about $8 million per year. The estimated total cost for local government fleets on a dollar per horsepower basis, is shown in Table VII-3.

Table VII-3 – Expected Total Regulation Cost for Local Government Fleets by Type (2006 Dollars)

Fleet Type	Low Cost (2006 $/hp)	High Cost (2006 $/hp)
Low Population County Local Municipality Fleets	$62	$70
Captive Attainment Area Local Municipality Fleets	$82	$92
All Other Local Government Fleets	$109	$122

E. How significant would the regulation's costs be to fleets, and how would fleets handle the costs?

Staff expects many affected businesses would pass through the regulation's costs to their customers. This could be achieved, for example, through higher bids for construction projects throughout the state, resulting in higher revenue (but not necessarily higher profits) for affected fleets. As previously discussed, the increase in construction costs would be less than 0.3 percent.

Staff believes that most fleets would be able to absorb the costs of the proposed regulation should they not be able to pass costs on to their customers, without significantly harming their profitability. This finding is based on staff's analysis of the estimated change in "return on owner's equity" (ROE) for fleets within each industry type affected by the regulation. A 10 percent decline in ROE has traditionally been used by ARB to indicate a significant impact on profitability. For fleets that do not pass through any of the cost of compliance to their customers, the ROE analysis found that between about 60 and 80 percent of fleets would still be expected to be able to absorb the cost of the regulation without incurring more than a 10 percent change in ROE. Small fleets are more likely to be able to absorb the cost of the regulation without exceeding a 10 percent change in ROE because they are not subject to the regulation's mandatory turnover provisions, resulting in significantly less costs relative to medium and large fleets. For the 20 to 40 percent of fleets for which the regulatory costs exceed a 10 percent change in ROE, these fleets will have to pass through at least some of the costs to their customers in the form of higher prices for their services to maintain their profitability.

Any necessary increases in revenue will be higher for firms where vehicles provide the primary source of income and will be lower where vehicles are used primarily as for

support services. Also, some fleets may find it more difficult to raise revenues if they are competing against competitors who start with cleaner fleets. Such fleets will need to consider other means of managing costs, such as renting or leasing vehicles rather than owning them.

Most construction firms that compete for projects with other construction firms, rental companies, airlines, and landscape services companies are expected to be able to pass on their costs to customers. Rental companies may actually see an increase in revenue as many affected fleets downsize, retire less-used vehicles, and consider rental as a more attractive alternative to owning vehicles.

Municipalities and government fleets would need to absorb the costs as part of their operating budgets and therefore would need to increase operating budgets to cover the cost of the regulation. In addition, some mining and most industrial and manufacturing businesses are not expected to be able to pass on most of the costs incurred by this regulation because they operate in very competitive national markets. However, staff expects that off-road vehicle use in this sector represents a smaller percentage of the company's total operating expense and that the increase in cost attributable to the regulation is only a small portion of the operating expense. Thus, many are expected to be able to absorb the costs without a significant impact on profitability.

Costs for small fleets are generally lower in total than for medium or large fleets, but costs as a percent of revenue are often higher. However, because their initial compliance dates do not begin until 2015, many small fleets would have the opportunity to pursue the use of incentive funds, such as those available through the Carl Moyer program to install needed retrofits or repowers early. Also, because small fleets' compliance begins later, their fleets may have naturally turned over and come closer to the targets by 2015. This could offset some or all of the regulation's impact for small fleets.

In addition to the ROE analysis for typical fleets discussed above, staff performed a case study on the economic impacts of the regulation for seven actual California construction fleets who voluntarily shared financial and fleet data with ARB. Staff evaluated the regulatory costs relative to the fleets' financial data to determine the expected economic impact of the regulation on the fleets. It is important to note that the vehicle profiles of these fleets are not representative of the California fleet as a whole, and as such, the regulatory costs to each fleet are unique and different than the statewide average. It is also important to note that staff does not believe these fleets are statistically representative of the economic impacts of the regulation on the California fleet as a whole. Financial and fleet differences between companies (overhead costs, wage scales, type of work, insurance costs, profitability, etc) are great. However, the results show how a handful of actual fleets in the state would be impacted by the proposed regulation.

Staff's analysis of these seven fleets showed that one of the fleets evaluated would be able to absorb the cost of the regulation no noticeable impact on their profitability (i.e., compliance costs would reduce the profitability less than 10 percent) and so does not

necessarily need to raise revenues to comply with the regulation. The remaining six fleets would either have to bear significantly lower profits or pass on some of the costs to their customers to increase revenue. In total, for the seven fleets analyzed, the revenue increase needed ranged from none up to 4 percent, with most fleets right in the middle.

The greatest economic impact, as expected, was on the largest fleet with the oldest, most expensive, longest-lived vehicles. This fleet was an earth-moving fleet with all Tier 0 vehicles. For this fleet, staff estimated that the annual cost of the regulation would significantly exceed the company's annual profits. To remain viable, such a heavily impacted fleet would need to pass on most, if not all, of the costs of the regulation to its customers. Staff's analysis showed that the regulation would require an increase in revenues for this fleet of about 2.4 percent to bring the impact of the regulation to less than 10 percent ROE.

F. How would the regulation affect customers?

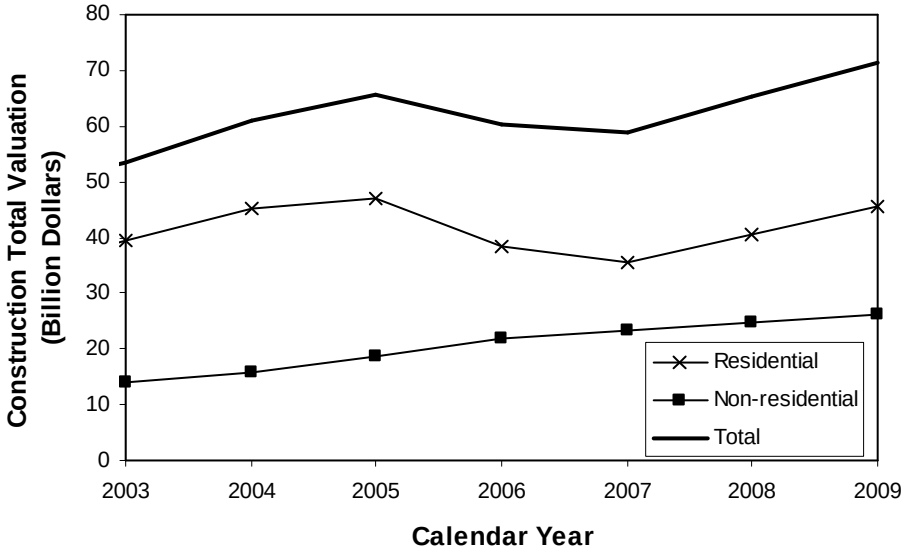
The regulation is expected to increase the cost of construction, mined materials, and other services performed by off-road vehicles in the state. Customers that could expect to pay higher construction costs include developers, home builders, and government agencies sponsoring road construction and other transportation projects. For construction, this increase would be expected to be less than 0.3 percent.

To put this in perspective, the regulation would impact all types of construction, including new housing. Based on the number of housing permits issued each year, and allocating half of the regulatory costs to construction (which is proportional to their representation of horsepower in the statewide fleet), staff estimates that the regulation could increase the cost of a new home by less than $1,000 (which represents about a 0.3 percent increase in price for a median priced home in California). In considering the impact of this on a potential new homebuyer, for a new home purchased with a 30-year mortgage, this cost would represent about a $5 per month increase in the mortgage payment.

G. How would the regulation affect the construction industry?

While the cost of the regulation would be significant to the construction industry, staff does not believe it would impact the ability of the industry to meet the current demand for building projects. As can be seen in Figure 16, construction valuation had been steadily increasing from 2002 until 2006, when a downturn in the residential housing industry reduced this valuation (DOF, 2007a). However, despite the downturn in residential construction, non-residential construction has grown by more than 5 percent per year since 2002 and is projected to increase in the next several years. Between 2007 and 2009, construction valuation is expected to increase over 10 billion dollars, which greatly exceeds the expected cumulative cost of this regulation.

Figure VII-2 - California Construction Valuation



H. How would the regulation impact the value of existing vehicles?

The regulation would tend to decrease the value of older, dirtier vehicles and increase the value of newer, cleaner vehicles. Beginning March 1, 2009, fleets in California would not be permitted to add Tier 0 vehicles to their fleets. After the first fleet average compliance dates, fleets would be restricted from adding vehicles that exceed the fleet targets for engines in the same horsepower group (i.e., they cannot add vehicles that make their fleet dirtier).

However, even with this restriction, the demand in the United States and around the world for used Tier 0 and Tier 1 vehicles would not evaporate. Staff expects that there would be significant continued demand for construction vehicles worldwide such that these older vehicles would retain much of its residual value, less increased transportation costs to destinations outside California.

However, staff cannot predict with certainty the decrease in value of Tier 0 vehicles as a result of the regulation, but for modeling purposes, staff assumed a decrease in value of $10 per horsepower for each Tier 0 piece replaced. This is an approximation of the shipping costs for transporting a Tier 0 vehicle for sale out of state.

I. What would be the statewide economic impact of the regulation?

Staff would not expect a noticeable change in employment, business creation, elimination, or expansion, and business competitiveness in California due to the regulation. As discussed above, staff's analysis of the estimated change in "return on owner's equity" for fleets within each industry type affected by the regulation indicated the proposed regulation would not alter significantly the profitability of most businesses. In addition to an assessment of the regulation's impact on individual fleets, staff in consultation with University of California, Berkeley researchers also conducted an assessment of the economic impacts of the proposed regulation on the California

economy. Staff used a computable general equilibrium model of the California economy called E-DRAM to model the many complex interactions of the California economy. The results of the analysis confirmed that in the context of the State's economy, the economic impact of the proposed regulation is minor and is not expected to impose a noticeable impact.

According to the E-DRAM analysis, in 2010, the year of highest annual costs due to the regulation, the costs of the proposed regulation would reduce California economic output by roughly $700 million (0.02 percent) and California employment by approximately 1,000 jobs (0.01 percent). Personal income would also decline by roughly $2.3 billion (0.2 percent) in 2010. Changes in the overall economy on the order of 0.02 percent are not expected to be noticeable.

The E-DRAM analysis did not include the economic benefit expected due to decreased health costs due to the health benefits of the proposed regulation. These benefits are expected to be between $18 billion and $26 billion from 2009 to 2030 and would offset the impacts described above.

J. What would be the impact of the regulation on employment?

Because the regulation imposes a cost on the overall economy, as noted above, staff expects it to reduce overall employment in California by a small amount. In the highest cost year, employment would be expected to decrease by about 1,000 jobs. This decrease would be spread throughout the economy and not just felt by the industries directly impacted by the regulation, such as construction. However, the California economy is adding new jobs at a rate of about 230,000 per year (DOF, 2007b). The proposed regulation would not eliminate the creation of new jobs in California, but it may slow the rate at which jobs are created.

In particular, the California construction industry is expected to add about 8,000 jobs per year from 2006 to 2014 (EDD, 2007). This increase is driven by the anticipated future need for construction projects in the state (and the labor to perform that work), which would not be impacted by the regulation. It is possible that because of the large cost imposed by this regulation, some businesses with affected fleets would be eliminated. It is also possible that some businesses would choose to consolidate (or merge), change owners, or relocate due to this regulation. However, staff expects that any dislocated employees of these companies would be able to find employment in an industry with an expanding workforce.

Because the regulation would increase the use of VDECS in off-road diesel vehicles in the State, the regulation would result in the creation of some new jobs. Staff estimates that over its course, the regulation would require the installation of over 125,000 VDECS. It is very likely that additional businesses would be created or existing businesses expanded to aid in the making, distribution, cleaning, and maintenance of these VDECS, resulting in an increase in job demand.

Also, because there would be an increase in demand for cleaner engines and vehicles, a similar increase in businesses and jobs selling, manufacturing, and installing these

vehicles and engines is expected. As it encourages some fleets to choose to rent vehicles rather than own them, the regulation may also provide new business to some rental companies, thereby also creating new jobs.

K. How cost effective would the regulation be and how does this compare to previous measures adopted by ARB?

The cost-effectiveness in terms of dollar per pound ($/lb) of emission reduction achieved is expected to be $37 to $43/lb PM and $2.1 to $2.5/lb NOx. This cost-effectiveness is within the range of cost-effectiveness of previous measures adopted by ARB. The cost-effectiveness of the PM emission reductions, on a per death avoided basis, is about 6 times lower than the U.S. EPA's benchmark for value of avoided death (which equates to about $248/lb). Therefore, the regulation is a cost-effective mechanism to reduce premature deaths that would otherwise be caused by diesel PM emissions without this regulation.

Table VII-4 below compares the estimated cost-effectiveness of the regulation to the estimated cost-effectiveness of other recently adopted in-use diesel measures. For comparison purposes, all cost-effectiveness estimates shown in Table VII-4 attribute part of the total regulation cost to PM reductions and part to NOx or hydrocarbon (HC) plus NOx reductions. Rules are ranked from lowest $/lb PM cost to highest. As Table VII-4 shows, the cost-effectiveness of the regulation would be within the range of measures previously adopted by ARB.

Table VII-4 – Cost-effectiveness Compared to Previously Adopted ARB Regulations

Rule	NOx ($/lb)	PM ($/lb)	Source of Estimate
Stationary Compression Ignition Engine ATCM	0.9*	$7.7	(ARB, 2003a)
Portable Engine ATCM	<$2	$8-$10	(ARB, 2004)
Cargo Handling ATCM	$1	$21	(ARB, 2005a)
Solid Waste Collection Vehicle ATCM	$1.8*	$32	(ARB, 2003b)
In-Use Off-Road Diesel Vehicle Regulation	***$2.1-2.5***	***$37-43***	***See Technical Support Document***
Public Fleets Rule	$10.9*	$160	(ARB, 2005e)

* Combined HC+NOx

L. Are there incentive funds available to help fleets comply with the regulation?

The opportunities for fleets to utilize incentive funds to comply with the regulation would be limited, and most fleets would still need to plan on paying for the majority of compliance costs with their own funds. California has the largest clean air incentive program in the nation, the Carl Moyer Program, with over $140 million available each year primarily through the local air districts. In addition, ARB is in the process of awarding a one-time $25 million grant program to public agencies for the purchase of low-polluting construction vehicles, which would help public agencies begin to clean their fleets in advance of the proposed regulation.

Even so, this level of funding is far from sufficient to pay for all the reductions. The Carl Moyer Program will only pay for emission reductions that go beyond the requirements of the regulation and occur at least three years early. Because the compliance dates for large fleets would begin in 2010, the majority of large fleets would not be able to access Carl Moyer Program funds once the regulation is adopted. Because the compliance dates for medium fleets would begin in 2013, medium fleets would likely have two or three years to apply for incentive funds and still be able to claim a three year project life. After that, most medium fleets would also not be able to access Carl Moyer Program funds. However, many small fleets would be able to access Carl Moyer Program funds in advance of their first 2015 compliance date and would always be eligible for projects that achieve NOx reductions. Also, captive fleets in attainment areas, which would only be subject to the PM portion of the regulation, would be eligible for projects that achieve NOx reductions.

ARB recognizes that compliance with the proposed regulation may be financially challenging for owners of regulated vehicles. Fleets may need to borrow money to purchase retrofits, repowers, or to upgrade their vehicles. In addition to the Carl Moyer Program, to minimize the cost-impact of compliance, staff is consulting with other state agencies such as the Pollution Control Financing Authority in the State Treasurer's Office and private lenders to look for ways to leverage existing public programs and funding in the private sector, through potential programs such as government loan guarantees, interest rate buy down programs, etc. It is hoped that these efforts could make compliance with the regulation more affordable and access to capital more widely available. However, ARB does not currently have the funds to help create such programs, and thus their availability remains speculative at this time.

VIII. TECHNOLOGY AVAILABLE TO MEET REGULATORY REQUIREMENTS

A. What are verified diesel emission control systems and how do we know they really work?

The regulation would only require and give credit for diesel emission control systems that have been verified by ARB. ARB adopted a procedure to verify retrofit diesel emission control systems in 2003. Verification is an approval from ARB, which tells end users that the verified device achieves the advertised emission reductions and is durable. To be verified, retrofit devices must demonstrate the efficacy and durability of their products and provide a warranty. The warranty guarantees the retrofit's efficacy for 4 to 5 years and 2,600 to 4,200 operating hours, depending on engine size, and warrants that the retrofit will not cause engine damage.

ARB's verification procedure is a multi-level verification system consisting of three PM reduction levels and optional NOx reduction levels (see Table VIII-1). 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 five percent increments. This system has broadened both the spectrum of control technologies available to participate 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 retrofit exhaust aftertreatment devices.

Table VIII-1 - Levels of ARB Verification for Diesel Emission Control Systems

Category	PM Reduction
Level 1	≥ 25%
Level 2	≥ 50%
Level 3	≥ 85%, or 0.01 g/bhp-hr
Category	**NOx Reduction**
Optional	≥ 15%; in 5% increments

B. What exhaust retrofits would the regulation require?

The fleet average provisions of the regulation give credit for PM retrofits that achieve at least a 50 percent reduction in PM (i.e., Level 2 or 3) and for any verified NOx retrofit. Credit would not be given for Level 1 devices. The mandatory retrofit provisions of the regulation would require the use of the highest level verified device, which in most cases would be a diesel particulate filter (DPF). A DPF typically consists of a ceramic wall-flow monolith or a silicon carbide substrate that captures PM before it can be released to the atmosphere. The accumulated soot is then burned off (regenerated) either through an active or passive process. In passively regenerated DPFs, the substrate is coated with a catalyst that burns off the collected PM during "regeneration." In actively regenerated DPFs, an external source of heat such as an electrical heater or

fuel burner is used to oxidize the collected PM. It is likely that many of the diesel particulate filters used would need to be actively regenerated, either through plug-in or through an on-board fuel burner, because the exhaust temperatures in some off-road applications are not sufficient to support passive regeneration.

C. What devices have been verified for off-road applications?

Table VIII-2 shows the Level 2 and Level 3 diesel emission control systems have been verified for use in off-road diesel vehicles by ARB. There are currently level 3 PM retrofits for off-road vehicles verified by three manufacturers, and staff believes more would be likely to be verified (both in passive and active configurations) after a regulation is adopted and the market conditions for their use are better defined.

Table VIII-2 - Level 2 and 3 VDECS for Off-road Diesel Vehicles[6]

Product Name	Technology Type	PM Reduction	NOx Reduction	Applicability
Cleaire Horizon	DPF	85%	N/A	Conditionally verified for most Tier 1 off-road engines
Huss Umwelttechnik FS_MK	DPF	85%	N/A	Most off-road diesel engines through 2007 model year
Engine Control System Combifilter	DPF	85%	N/A	1996-2004 off-road engines
Engine Control System AZ Purimuffler/Purifier	Diesel oxidation catalyst (DOC) + Alt Fuel	50%	20%	1996-2002 off-road; Requires the use of PuriNOx fuel

D. Have these devices been demonstrated in off-road applications?

Around the world over the past several decades, various government agencies have begun to require the retrofit of in-use diesel engines, especially to reduce diesel PM. In the past 20 years, over 130,000 DPFs have been retrofitted on heavy-duty vehicles worldwide (MECA, 2006).

The Europeans have taken the lead in requiring DPF retrofits of construction vehicles. European interest in diesel retrofits was spurred in the early 1990s when large-scale tunnel projects in Switzerland, Austria, and Germany using heavy diesel equipment were planned. The Europeans formed the VERT project to find technologies that could allow heavy diesel equipment to be used in confined spaces, and have subsequently began to require diesel retrofits widely on construction projects. Approximately 35,000 DPFs have been installed on all varieties of construction vehicles used on large construction projects in Switzerland and in confined spaces in Germany.

[6] Current verifications as of April 6, 2007

The European experience is slowly being duplicated in the U.S. through a variety of projects and rules. To date, the largest construction retrofit projects have been on the East Coast. In Boston, on the Central Artery/tunnel Project and in New Haven, on the Interstate 95 New Haven Harbor Crossing Corridor, 200 to 300 pieces of construction vehicles have been retrofitted with diesel oxidation catalysts (DOCs). DOCs will be retrofitted on approximately 290 pieces of construction equipment in Chicago on the Dan Ryan Expressway. For the reconstruction of the World Trade center, low-sulfur diesel fuel was used, and eight pieces of construction equipment were retrofit with DOCs or DPFs. For the Croton project, a North Bronx, New York, drinking water construction project that began in 2005 and is continuing, over 25 pieces of construction equipment including loaders, excavators, dozers, drill rigs, and off-road trucks were retrofit with DPFs. The filters were from four different retrofit manufacturers and included actively and passively regenerated models. In 2006, twelve construction vehicles including a compactor, excavator, and off-road vehicles were retrofit with diesel particulate filters during construction of a new runway at the Los Angeles International Airport.

Laws, regulations, and rules are being promulgated that require retrofitting construction equipment. German and Swiss legislation has stimulated thousands of retrofits to date. In the U.S. various jurisdictions including New York City, Connecticut, Massachusetts, and New York State are requiring some level of retrofits on construction equipment.

The ARB recognizes the need for more verified diesel emission control devices for off-road applications. Therefore, staff has been collaborating with the Mobile Source Air Pollution Reduction Review Committee (MSRC) of the South Coast Air Quality Management District (SCAQMD) to develop and implement the “Showcase Program”. The Showcase Program, which has been funded in the so far with $1,000,000 from MSRC, will pay for the cost and installation of retrofit devices in the South Coast Air Quality Management District. It is designed to encourage owners of off-road diesel construction equipment to work with diesel emission control system manufacturers to retrofit their engines with diesel emission control devices. The goal of the program is to demonstrate new emission control systems that will earn ARB-verified status, while achieving significant near-term emission reductions of both PM and NOx. Participation in the Showcase Program is open to private construction companies, public agencies, local governments, and other owners of off-road diesel construction equipment in the SCAQMD.

E. Are engine repowers really possible?

Repowering a vehicle, i.e., replacing an existing engine with a newer and cleaner engine, is often possible, but is not always feasible. Some vehicle manufacturers already have standard engine kits designed to replace older engines in existing machines. The State’s Carl Moyer program has funded 4,500 engine repowers in various vehicle types, including over 300 off-road vehicles such as scrapers, wheel loaders, compactors, tractors, excavators, and rough terrain forklifts (ARB, 2007b).

For most off-road vehicles, repowering from a pre-controlled Tier 0 engine to a Tier 1 certified engine is relatively straightforward because the engine block has the same dimensions and major changes are only required to exhaust lines. Repowering to a Tier 2 engine is generally more complicated and costly, and may not be feasible for some vehicles. It often requires components in the engine compartment to be changed out or added, and some parts such as brackets and supports may need to be fabricated. Repower to Tier 3 is often more complex and costly but has already been accomplished in a number of applications. It is unlikely that repowering to Tier 4 engines will be feasible because of size and exhaust after treatment constraints.

Repowers would only be used if this option costs less than buying a replacement vehicle.

F. Are NOx exhaust retrofits feasible?

Staff estimates that between 20 and 25 percent of off-road vehicles could be suitable for the use of combined PM and high efficiency NOx exhaust retrofit systems, such as those using selective catalytic reduction. In the off-road emissions inventory, over half the total horsepower in the State is represented by engines with less than 120 horsepower. These engines are not likely to be appropriate for use of NOx exhaust retrofit systems because of engine compartment size limitations, and the costs for such systems relative to engine and vehicle replacement options.

The remaining engines greater than 120 hp in the fleet are potential candidates for high efficiency NOx systems. However, exhaust temperatures (or duty cycle limitations) will likely dictate the actual suitability of certain vehicles to use selective catalytic reduction or other technologies. In general, high efficiency NOx control systems will need to operate in temperature regimes similar to those required for passive DPF systems. Staff estimates that only about 30 percent of off-road vehicles greater than 120 hp would have exhaust temperature characteristics suitable for passive DPF systems.

G. Would enough used vehicles be available to help satisfy the regulation requirements?

Staff anticipates that fleets would comply with the regulation by a variety of methods. Increases in demand to meet the NOx requirements would likely be satisfied through a combination of engine repowers, purchase of new vehicles, purchase of used vehicles, and/or installation of NOx retrofits.

The turnover requirements imposed by the regulation would require a maximum of 8 percent of the statewide fleet's horsepower to turn over per year until 2015. The baseline natural rate of turnover of the statewide fleet is about 5 percent per year. Thus, the regulation would at most require 3 percent more turnover per year than normal. After 2015, although individual fleets would have to turn over as much as 10 percent of their horsepower per year, most fleets would meet the fleet averages and few would need to do the maximum turnover. The regulation affects about 180,000 vehicles, so an increase in demand for Tier 2 or better vehicles and engines in California would represent about 5,400 vehicles per year.

Staff compared the number of used off-road vehicles recently for sale on two used equipment websites on a single day. On these two sites, there were over 80,000 vehicles for sale and over 30,000 of them were 2003 model year or newer (likely Tier 2 or better) (Ritchie Brothers, 2007; Machinery Trader, 2007). By the time the first requirements for accelerated turnover take effect in 2010, there is likely to be an even greater number of Tier 2 or better used vehicles available. Based on this evaluation, it appears likely that there would be a sufficient number of used vehicles available to meet the increased demand due to the regulation.

H. Would enough new vehicles be available to satisfy the regulation requirements?

Staff believes enough new vehicles would be available to satisfy the regulation requirements. As stated above, the regulation would increase demand for vehicles by at most about 5,400 vehicles per year. This demand in the context of the national and international market for off-road diesel vehicles is small. In 2005, there were over 329,000 new off-road construction vehicles sold in the United States. If all fleets were to comply with the regulation by buying new vehicles, the increase in demand for new vehicles in California would represent less than 3 percent of national sales.

Further, the regulation contains provisions so that fleets are not penalized if manufacturer delays prevent them from acquiring the equipment or vehicles they need to comply. Also, the proposed regulation contains special provisions that would exempt from the mandatory turnover requirements specialty equipment for which repowers and used vehicle replacements are not available.

IX. PUBLIC OUTREACH

A. What outreach did staff do to inform the public about the regulation and solicit input on its development?

Staff has been notifying affected industry and other interested parties regarding the proposed regulation and soliciting input regarding its development for two and half years. Table IX-1 below summarizes the outreach efforts, and the discussion below provides further details. Staff has made dozens of changes to the regulation at the request of stakeholders, including incorporating fleet average requirements, additional flexibility, and other elements to improve the clarity and effectiveness of the regulation. Staff also made extensive updates to the emission inventory as a result of information and feedback from stakeholders at a special workgroup meeting focused on emissions inventory issues.

Table IX-1 - Summary of Outreach Efforts for the Proposed Regulation

Outreach Effort	Number	Number and Description
Public Workshops	13	Workshops were held in 6 cities across the state between November 16, 2004 and March 1, 2007. Five of the workshops were broadcast via the internet so stakeholders could participate remotely. Over 1,000 people attended at least one of the workshops.
Public Workgroup Meetings	6	Meetings were held simultaneously in Sacramento and El Monte. Stakeholders could also participate via phone.
Mailings	Over 376,200 mailings sent in total	July 2005 mailing to 79,000 licensed contractors in classifications likely to own affected vehicles; February 2007 post card to all 290,000 licensed contractors; Additional mailings to over 4,000 landfills, recycling facilities, and mining facilities; 500 small airports; and 2,700 owners of registered portable equipment.
Calls and Emails	Over 85 contacts	Calls and follow-up emails with further information to dealers, affected companies, associations, and other organizations
Meetings and presentations	Over 45	Staff met with and gave presentations to over 45 interested stakeholders and organizations

The first public workshops concerning development of the regulation were held in November 2004. Since then, staff hosted 13 workshops and 6 public workgroup meetings. Workshops were held up and down the state – in Sacramento, Riverside, Los Angeles, El Monte, Fresno, and San Diego – and many of the workshops were broadcast via the internet so interested parties could participate remotely via computer. The most recent series of four workshops held in March 2007, were attended by over

1,000 people. Staff has also spoken to groups regarding the regulation in Lakeport, Calaveras County, Napa, Bakersfield, Walnut, Pleasanton, Redding, San Diego, Sierra County, Santa Rosa, West Covina, West Sacramento, Sacramento, Siskiyou County, Truckee, and Glenn County.

To facilitate communication with stakeholders, staff created an electronic listserve for the in-use off-road diesel vehicle regulation, and sent regular notices to it concerning regulation development. The email listserve for the regulation grew to nearly 3,000 members. Notices were sent to other email lists, including those for portable equipment owners, for the portable equipment air toxic control measure, for the cargo handling equipment and public fleets air toxic control measures, among others, also in an attempt to reach any and all who would be interested.

Staff also did a series of mass mailings regarding the regulation. Early in the process, staff sent information and surveys to 79,000 potential owners of vehicles affected by the regulation, as well as to over 4,000 mines and solid waste and recycling facilities. Most recently, in February 2007, staff sent a mailing to the nearly 300,000 licensed contractors in the State and one to the over 4,000 registered owners of portable equipment in the state.

Staff also called and sent emails and letters to as many industry associations as could be identified who might have members affected by the regulation. These included contractors associations, chambers of commerce, and organizations that represent engine manufacturers, equipment manufacturers, and drilling contractors. Staff also contacted owners of portable equipment, and public agency fleet managers, and as well as less obvious groups that represent unions, graveyards, amusement parks and fairs, among others.

Staff called dozens of off-road equipment dealers and gave them flyers to mail to their customers. Staff also worked with the trade group that represents independent sellers and dealers of diesel fuel to have them distribute flyers concerning the regulation to buyers of diesel fuel.

X. IMPLEMENTATION AND ENFORCEMENT

A. How would the regulation be implemented?

For the regulation to be fair to fleets that would spend considerable funds and effort to comply, fleets must be assured that their competitors would also be complying. For this to happen, there must be an effective outreach campaign and the regulation must be vigorously enforced. Staff recognizes that creating a level playing field for all affected fleets is important, and is committed to obtaining the resources necessary to do so.

If the proposed regulation is adopted, staff, in cooperation with affected industries, would develop and conduct an extensive outreach campaign to be sure affected parties are aware of their responsibilities under the regulation. This campaign would build on the outreach staff has already done throughout development of the proposed regulation. First, staff would continue to work with industry groups to inform their members about the regulation. Second, as we have for our existing fleet rules for transit buses and public fleets, staff plans to hold training workshops across the state and invite manufacturers of verified diesel emission control systems to share information about their products with affected fleets. Third, staff would provide training and educational materials at the workshops and on our website to help fleets understand the choices they would face with respect to finding the most cost-effective path to compliance. Staff will also operate a toll-free number set up to answer questions about the regulation (866-6DIESEL). Finally, staff would send electronic and hard-copy mailings to affected parties prior to the initial reporting dates in 2009 to inform fleet owners about their responsibility to report their vehicles.

Staff also plans to develop and provide electronic tools for compliance planning that would allow fleets to determine what retrofits are available for their vehicles, and to experiment with various possible compliance paths. In addition, staff plans to develop and provide electronic reporting forms that would allow fleets to report their vehicles on-line and demonstrate how they have met the fleet average or BACT requirements. For fleets that prefer, staff would also be prepared to receive reports in non-electronic format.

B. How would the regulation be enforced?

Staff has the responsibility for enforcing the regulation. ARB inspectors may use a variety of opportunities to find and inspect off-road vehicles such as audits of facilities such as landfills, mines, and recycling facilities. They may also inspect construction sites or off-road vehicles they encounter being transported by truck, as well as complaints from the public.

The two keys to enforcement of the in-use off-road diesel vehicle regulation would be the annual reporting and the equipment identification number (EIN). The reporting would allow staff to determine if fleets have met the fleet average targets or complied with the BACT requirements. Fleets would be required to report information about each vehicle, its engine data, its model year, as well as the actions taken to comply with the

regulation such as any repowering or retrofitting done. For vehicles claimed as low-use, owners must report the hour-meter readings.

In addition, each vehicle would have its EIN displayed prominently on the side of the vehicle. When ARB inspectors are in the field, they would be able to link the vehicle EIN to whatever action was claimed for that vehicle. They would be able to tell if the vehicle does not have the proper engine installed, or is not outfitted with the retrofits claimed. Even though in most cases inspectors would never be able to view an owner's entire fleet, inspectors would be able to verify the accuracy of the reported information for whatever vehicles they encounter.

If ARB inspectors find vehicles that are subject to the regulation that are not labeled with an EIN, then that would be an immediate indication of noncompliance.

Enforcement of the idling portion of the regulation would be conducted similarly to enforcement of ARB's commercial vehicle and school bus idling rules, which rely on complaints from the public to trigger inspections by ARB field inspectors and further enforcement action.

C. What additional resources are needed for implementation and enforcement?

Because of the need to ensure a high level of compliance with the regulation, ARB would request additional staff to aid in outreach, education, and enforcement of the regulation. Staff would conduct outreach and education for fleet owners, develop and implement the reporting tools the regulation would rely upon, manage the reporting data, conduct inspections, and to research and prosecute enforcement cases.

XI. ALTERNATIVES CONSIDERED

A. What alternatives to the regulation were considered, and why were they rejected in favor of the proposed regulation?

Throughout the regulation development process, staff considered many possible regulation structures and regulatory elements. Staff incorporated many recommendations from stakeholders such as allowing fleet averaging, giving double credit for electric vehicles in some years, raising the annual hour threshold for low-use vehicles, including more horsepower groups in the calculation of the fleet average, and providing credit for early actions.

However, staff did not accept all suggestions from stakeholders because in developing the regulation, staff was striving to achieve the following goals:

- Achieve the maximum, fastest possible, reduction in diesel PM emissions;
- At the same time, maximize NOx reductions achieved by 2015 to aid in attainment of the PM2.5 standards in South Coast and San Joaquin Valley;
- Minimize the cost for fleets and, in particular, minimize the need for fleets to control equipment twice (for example, by having to turn it over twice during the course of the regulation);
- Achieve cost-effective emission reductions on a dollar per ton basis; and
- Staff sought to achieve these goals while keeping in mind the technology available today and likely to become available over the next decade.

The alternatives considered and reasons they were rejected in favor of the chosen NOx and PM fleet average approach are summarized in Table XI-1 below.

Table XI-1 - Alternative Regulation Structures Considered

Approach	Why Rejected
No action - allow natural turnover of the statewide fleet to gradually lower emissions over time.	Would not achieve the emission reductions as quickly as needed to meet the state's air quality commitments or public health goals.
Traditional Best Available Control Technology (BACT) PM retrofit rule – Like the solid waste collection vehicle rule, require fleets to phase-in a certain percent of PM retrofits per year until all vehicles are retrofit.	Would not offer fleets flexibility to choose the most cost-effective combination of retrofits, repowers, and accelerated turnover. Would not be guaranteed to achieve critically needed NOx reductions.
PM-only fleet average rule – Require fleets to meet a declining PM fleet average	Would achieve significantly less NOx reductions than a combined NOx and PM fleet average.
Mandatory phase-out of the dirtiest engines - Phase out Tier 0s by a certain date, Tier 1s by a later date, etc. and require exhaust retrofits	Could encourage acquisition or holding of Tier 0 and 1s before mandatory turnover starts, which could cause a loss of emissions benefits before the rule takes effect and which might achieve very little benefit in the early years of implementation. Lacks the flexibility of a fleet average to allow credit for strategies other than turnovers such as PM or NOx retrofits.
Mandatory NOx retrofit and PM retrofit – A traditional BACT rule with BACT defined as highest level NOx and PM retrofit.	Would achieve less NOx reductions in long-term because vehicles that are retrofit cannot be immediately turned over. There is also uncertainty regarding availability and feasibility of NOx retrofits. Higher cost than PM and NOx fleet average approach. Would eliminate fleet's ability to choose a cost-effective path to compliance.

Overall, the NOx and PM fleet average approach, coupled with the minimum annual turnover/retrofitting alternative (i.e., the BACT requirements) was chosen as the best structure. It provides maximum flexibility for fleets to find their own, most cost-effective combination of retrofits, engine repowers, retirements, and accelerated turnover that would bring them to compliance. It allows fleets to make decisions concerning which vehicles they plan to keep for a long time versus those that are not worth repowering or retrofitting because they would be turned over soon. It also rewards fleets that start out cleaner (i.e., newer fleets or fleets that have already installed some exhaust retrofits) because they would have to do less to reach the fleet average targets. Finally, the option of complying with the BACT requirements (i.e., retrofit a certain percent and turn over a certain percent of fleet per year) allows fleets that start out very dirty or that

happen to own very long-lived vehicles and who cannot realistically meet the fleet average targets, especially in the early years of implementation, to have an affordable path to compliance. Staff also considered requiring higher turnover rates and more stringent NOx averages, but the higher costs would likely be more than the industry could bear.

During the course of the workshop process, construction industry representatives proposed alternative, much looser, fleet averages than those included in the proposed regulation. Staff evaluated these industry-proposed fleet averages but did not recommend them because, over the life of the regulation, they would achieve less than 20 percent of the PM reductions and less than 45 percent of the NOx reductions expected from ARB's proposal.

XII. REFERENCES

American Rental Association, 2007. *Economic Contribution of the Rental Industry to California*, American Rental Association, Moline, Illinois, January 25, 2007.

ARB, 2000. California Air Resources Board. *Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles*. October 2000.

ARB, 2003a. California Air Resources Board. *STAFF REPORT: INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING AIRBORNE TOXIC CONTROL MEASURE FOR STATIONARY COMPRESSION-IGNITION ENGINES*. Sept. 2003.

ARB, 2003b. California Air Resources Board. *STAFF REPORT: INITIAL STATEMENT OF REASONS SUPPLEMENTAL REPORT PROPOSED DIESEL PARTICULATE MATTER CONTROL MEASURE FOR ON-ROAD HEAVY-DUTY RESIDENTIAL AND COMMERCIAL SOLID WASTE COLLECTION VEHICLES*. August 8, 2003.

ARB, 2003b. California Air Resources Board. *ERRATA STAFF REPORT: INITIAL STATEMENT OF REASONS SUPPLEMENTAL REPORT PROPOSED DIESEL PARTICULATE MATTER CONTROL MEASURE FOR ON-ROAD HEAVY-DUTY RESIDENTIAL AND COMMERCIAL SOLID WASTE COLLECTION VEHICLES*, August 15, 2003. http://www.arb.ca.gov/regact/dieselswcv/dieselswcv.htm p. 1.

ARB, 2004. California Air Resources Board. *STAFF REPORT: INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING AIRBORNE TOXIC CONTROL MEASURE FOR DIESEL-FUELED PORTABLE ENGINES*. January 2004.

ARB, 2005a. California Air Resources Board. *Staff Report: Initial Statement of Reasons for Proposed Rulemaking Regulation for Mobile Cargo Handling Equipment at Ports and Intermodal Rail Yards*. October 2005. http://www.arb.ca.gov/regact/cargo2005/cargo2005.htm, p. VI-3

ARB, 2005b. California Air Resources Board. "Hot Spots" Public Notification, District Prioritization Scores and Risk Threshold Values, Last Updated on August 25, 2005. http://www.arb.ca.gov/ab2588/district_levels.htm

ARB, 2005c. California Air Resources Board. *DIESEL PARTICULATE MATTER EXPOSURE ASSESSMENT STUDY FOR THE PORTS OF LOS ANGELES AND LONG BEACH*, October 2005.

ARB, 2005d. California Air Resources Board. *AIR QUALITY AND LAND USE HANDBOOK: A COMMUNITY HEALTH PERSPECTIVE*, April 2005.

ARB, 2005e. California Air Resources Board. *STAFF REPORT: INITIAL STATEMENT OF REASONS PROPOSED DIESEL PARTICULATE MATTER CONTROL MEASURE FOR ON-ROAD HEAVY-DUTY DIESEL-FUELED VEHICLES OWNED OR OPERATED BY PUBLIC AGENCIES AND UTILITIES*. October 21, 2005.

ARB, 2006. California Air Resources Board. *Environmental Tobacco Smoke: A Toxic Air Contaminant.* October 18, 2006.

ARB, 2006. California Air Resources Board. *First Annual Update Solid Waste Collection Vehicles Status of Implementation*. June 2006. http://www.arb.ca.gov/msprog/swcv/regdocs.htm

ARB, 2007a. California Air Resources Board. TECHNICAL SUPPORT DOCUMENT: REGULATION FOR IN-USE OFF-ROAD DIESEL VEHICLES, April 2007.

ARB, 2007b. California Air Resources Board. The Carl Moyer Program 2006 Status Report. The Carl Moyer Memorial Air Quality Standards Attainment Program. January 2007. http://www.arb.ca.gov/msprog/moyer/status/status.htm

Delucchi, 2005. Mark A. Delucchi, Institute of Transportation Studies, University of California, Davis. *A Multi-Country Analysis of Lifecycle Emissions from Transportation Fuels and Motor Vehicles*. UCD-ITS-RR-05-10.

DOF, 2007a. California Department of Finance, from CALIFORNIA CONSTRUCTION AUTHORIZED BY BUILDING PERMITS, Updated February 28, 2007. http://www.dof.ca.gov/HTML/FS_DATA/LatestEconData/FS_Construction.htm

DOF, 2007b. California Department of Finance, Governor's Budget Forecast, November 2006. www.dof.ca.gov

EDD, 2007. California Employment Development Department, Labor Market Information Division. *California Employment by Selected Industry*, January 2007 data, http://www.labormarketinfo.edd.ca.gov/

Machinery Trader, 2007. Results of used equipment search on February 24, 2007. www.MachineryTrader.com

MECA, 2006. Manufactures of Emission Controls Association. Retrofitting Emission Controls on Diesel-Powered Vehicles, April 2006.

NCSA, 2005. National Center for Statistics and Analysis. California Toll of Motor Vehicle Crashes, 2005. http://www-nrd.nhtsa.dot.gov/departments/nrd-30/ncsa/STSI/6_CA/2005/6_CA_2005.htm

Ritchie Brothers, 2007. Results of used equipment search on February 24, 2007. www.rbauction.com

South Coast Air Quality Management District, 2004. *Guidance Document for Addressing Air Quality Issues in General Plans and Local Planning.*

XIII. LIST OF ACRONYMS

$/HP --- Dollars per Horsepower

$/Lb --- Dollars per Pound

ARB --- Air Resources Board

ATCM --- Air Toxic Control Measure

BACT --- Best Available Control Technology

CAA --- Clean Air Act

CEQA --- California Environmental Quality Act

CO_2 --- Carbon Dioxide

DOCs --- Diesel Oxidation Catalysts

DOF --- Department of Finance

DPF --- Diesel Particulate Filter

DRRP --- Diesel Risk Reduction Plan

E-DRAM --- Environmental-Dynamic Revenue Analysis Model

EIN --- Equipment Identification Number

GSE --- Ground Support Equipment

HC --- Hydrocarbon

HP --- Horsepower

HSC --- Health and Safety Code

MSRC --- Mobile Source Air Pollution Reduction Review Committee

NAAQS --- National Ambient Air Quality Standards

NCSA --- National Center for Statistics and Analysis

NEPA --- National Environmental Policy Act

NO_X --- Oxides of Nitrogen

PM --- Particulate Matter

PM2.5 --- Particles up to 2.5 microns in diameter

ROE --- Return on Owner's Equity

SCAQMD --- South Coast Air Quality Management District

SIPs --- State Implementation Plans

TAC --- Toxic Air Contaminant

TPD --- Tons per Day

U.S. EPA --- United States Environmental Protection Agency

VDECS --- Verified Diesel Emission Control System

VERT --- Verminderung der Emissionen von Real-Dieselmotoren in Tunnelbau, Curtailing Emissions from Diesel Engines in Tunnel Construction