IX. ECONOMIC IMPACTS (REVISED)

In this chapter, we present the estimated costs and economic impacts associated with implementation of the proposed ATCM for stationary engines. The expected capital and recurring costs for potential compliance options are presented, as well as an analysis of the cost effectiveness of the ATCM. The cost effectiveness is calculated two ways, as the cost in dollars per pound of diesel PM reduced and also as the cost in dollars per pound of combined ROG + NOx reduced. The costs and associated economic impacts are presented for private companies, as well as governmental agencies.

A. Summary of the Economic Impacts

ARB staff estimates the cost of the ATCM to affected businesses and government agencies to be approximately 47 million dollars for the total capital costs. This corresponds to 8.4 million dollars annually over the useful lift of the control equipment. This cost represents the capital cost of equipment, purchased in 2005 and 2011 using 2002 dollars, annualized over the useful life of the emission control equipment plus the annual recurring costs or savings. ARB does not have data to determine multiple engine ownership and associated engine ages to accurately determine the retrofit phase in schedule. These costs were not brought back to net present value, and the diesel emission control equipment was not phased in over four years. Instead, we assumed the equipment to be purchased at the beginning of the ATCM implementation. This method results in a conservative cost estimate and was used to estimate near term (i.e., 1-3 years) fiscal impacts.

The useful life of the control equipment depends on the number of hours the engine is expected to operate annually. For prime engines, the useful life ranges from 4 to 25 years with a 10-year average. For emergency standby engines, the expected useful life is 25 years.

As shown in Table IX-1, the majority of the costs will be borne by prime engine owners, while in many cases, owners of emergency standby engines will have no cost or net savings due to the reduced operating hours. We estimate that only a small number of emergency standby engines will need to install diesel emission controls (DECS).

Table IX-1: Summary of Annual Costs for the Proposed ATCM

Engine Application	Category	Total Capital Cost	Annualized Capital Cost	Annual Recurring Costs ($)	Total Annualized Cost ($)
Emergency Standby	Private	$2,296,000	$163,000	-$123,000	$40,000
	State	$199,000	$14,000	-$111,000	-$97,000
	City	$370,000	$26,000	-$13,000	$14,000
	County	$192,000	$14,000	-$20,000	-$7,000
	Other Local	$397,000	$28,000	-$71,000	-$43,000
	Federal	$502,000	$36,000	-$22,000	$14,000
Prime	Private	$34,183,000	$5,979,000	$737,000	$6,716,000
	State	$556,000	$98,000	$11,000	$109,000
	City	$2,624,000	$464,000	$53,000	$516,000
	County	$1,330,000	$235,000	$27,000	$262,000
	Other Local	$1,441,000	$255,000	$29,000	$284,000
	Federal	$3,143,000	$556,000	$63,000	$619,000
Total		$47,233,000	$7,868,000	$560,000	$8,427,000

For businesses with a prime engine, the capital cost is expected to be within $14,000 to $173,000. The low end of the range reflects a smaller horsepower engine (e.g.,120 hp) equipped with a diesel particulate filter (DPF). At the upper end, we used a larger engine (e.g.,1500 hp) equipped with a diesel oxidation catalyst (DOC) initially, which is later replaced with a new Tier 4 engine in 2011. The estimated annual ongoing costs are comprised of two parts: (1) a reporting cost of about $100, and (2) a cost ranging from $12 to $2,900 (depending on size and hours of use) for annual maintenance of any DPFs that are used. For example, the costs for a typical prime engine (rated at 590 hp operated 1040 hours per year) with a DPF are about $22,400 for equipment and installation, $100 for reporting, and $550 per year for ash cleaning (Tripodi, 2003). The costs for the same engine with a DOC that is later replaced with a Tier 4 engine are about $60,850 ($6,150 in 2005 and $54,700 in 2011), with an annual reporting cost of $100.

For businesses with emergency standby engines, we expect most operators to reduce their annual hours of operation to avoid installation of DECS, which should result in cost savings due to a reduction in the annual diesel fuel usage. For example, an operator with one engine (520 hp) could reduce maintenance and testing usage from 35 to 20 hours, thereby saving about $760 annually. While most operators will likely reduce their hours of operation to meet the ATCM requirements, we estimate that about one percent of operators will need to install a DOC.

Overall, most affected businesses will be able to absorb the costs of the proposed regulation with no significant adverse impacts on their profitability. This finding is based on the staff's analysis of the estimated change in "return on owner's equity" (ROE). The

analysis found that the overall change in ROE ranges from negligible to a decline of about six percent. Generally, a decline of more than ten percent in ROE suggests a significant impact on profitability. Because the proposed ATCM would not alter significantly the profitability of most businesses, we do not expect a noticeable change in employment, business creation, elimination, or expansion, and business competitiveness in California. We also found no significant adverse economic impacts on any local or State agencies.

We estimate the overall cost effectiveness of the proposed ATCM to be about $15 per pound of diesel PM reduced, considering only the benefits of reducing diesel PM. Because the proposed ATCM will also reduce reactive organic gases (ROG) and NOx emissions, we allocated half of the costs of compliance against these benefits, resulting in cost effectiveness values of $8/lb of diesel PM and $1/lb of ROG plus NOx reduced.

With regard to mortality benefits, we estimate the cost of avoiding one premature death to be about $216,000 based on attributing half of the cost of controls to reduce diesel PM. Compared to the U.S. EPA's present assignment of $4.4 million as the value of an avoided death, this proposed ATCM is a very cost-effective mechanism for preventing premature deaths caused by diesel PM.

B. Legal Requirements

In this section, we explain the legal requirements that must be satisfied in analyzing the economic impacts of the ATCM.

Section 11346.3 of the Government Code requires State agencies to assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. The assessment shall include a consideration of the impact of the proposed regulation on California jobs, business expansion, elimination or creation, and the ability of California business to compete with businesses in other states.

Also, State agencies are required to estimate the cost or savings to any State or local agency and school district in accordance with instructions adopted by the Department of Finance (DOF). The estimate shall include any non-discretionary cost or savings to local agencies and the cost or savings in federal funding to the State.

Moreover, Health and Safety Code section 43013(c) prohibits regulatory actions affecting nonvehicle engines (e.g., stationary diesel engines) used in agricultural operations unless the ARB determines that the standards and other requirements in the ATCM are necessary, cost-effective, and technologically feasible for such engines.

Finally, Health and Safety Code section 57005 requires the Air Resources Board to perform an economic impact analysis of submitted alternatives to a proposed regulation before adopting any major regulation. A major regulation is defined as a regulation that will have a potential cost to California business enterprises in an amount exceeding ten

million dollars in any single year. Because the estimated cost of the ATCM does not exceed 10 million dollars in a single year, the proposed ATCM is not a major regulation.

The following is a description of the methodology used to estimate costs as well as ARB staff's analysis of the economic impacts on California businesses and State and local agencies.

C. Methodology for Estimating Costs Associated with Implementation

In this section, we describe how we estimated the number and types of engines and the costs of bringing these engines into compliance with the proposed ATCM. We separately analyzed the costs on new prime engines, new emergency standby engines, existing (in-use) prime engines, and existing (in-use) emergency standby engines. The basic methodology in this section is used in subsequent sections of the report to analyze the costs to private companies and governmental agencies.

Businesses and federal, State, and local public agencies with stationary diesel-fueled engines in California will incur compliance costs as discussed below, to the extent that they have engines that must meet the performance standards in the regulation. Examples of these businesses and public agencies include hospitals, schools and universities, telecommunications providers, oil refineries, power generation facilities, banks, hotels/motels, retail stores, correctional facilities, military installations, waste and recycling facilities. The compliance costs will vary depending on the number and operating parameters of the stationary engines operated and the approach taken to comply with the proposed ATCM.

Surveys of Engine Population

To assist in evaluating the cost impacts from the proposed ATCM, ARB staff conducted two surveys (ARB Survey) of businesses and public agencies that operate stationary engines. As described in Chapter III, the ARB Survey collected data on the number, type, application, and ownership for emergency standby and prime stationary engines operated in California. The engine population and operating characteristics reported in the ARB Survey was assumed to be representative of the total engine population subject to the ATCM. The cost analysis was performed on the population of engines reported in the ARB Survey and scaled to the total number of engines in the emissions inventory to determine the total costs of the proposed ATCM. The level of control needed to demonstrate compliance with the ATCM was based on the horsepower, age, emission rate, and hours of operation for each engine reported in the ARB Survey.

Based on the survey results, the ARB staff estimates approximately 4,280 private companies having an estimated 9,900 emergency standby engines and 1,040 prime engines will be subject to this regulation. Approximately 6.5 percent (280) of the estimated total number of businesses could be considered small businesses based on annual gross receipts of $10,000,0000 or less (per California Government Code Section 14837(d)(1)). Federal, State, and local public agencies will also be affected by

the ATCM. Based on the ARB Survey, ARB staff estimates there are approximately 280 prime engines and 9,900 emergency standby engines operated by public agencies.

Capital and Recurring Costs

The cost evaluation considers both capital and on-going or recurring operating costs. Capital costs include equipment purchase, installation (i.e., piping, insulation, electrical, foundations and supports, engineering design, start-up), emissions testing and permit modification costs. The capital investment costs for purchase and installation of DECS were determined from actual costs of installing DECS on stationary diesel-fueled engines in California over the last 2-4 years (see Appendix I). A simple linear regression was used to project the costs to other engines based on their horsepower size. Based on this analysis, we estimate the cost to install a diesel particulate filter at $38 per horsepower, a diesel oxidation catalyst at $10.40 per horsepower, and a new engine at $92.65 per horsepower.

Other capital costs associated with compliance with the ATCM are emissions testing ($5,000 to $17,000 per source test) (Miller,2003), installation of hour meters ($25 per meter) (Hardy Diesel), and for modifications to existing permits ($1,000 when control equipment is installed and $124 when only the operating hours are adjusted). With respect to emissions testing, ARB staff believes that many engine owners will have access to data on expected engine emission rates for engines with model years 1988 and newer from the engine manufacturer. To be conservative, ARB staff assumed 50 percent of the prime engine population may need additional source testing to establish either baseline or after control PM emission rates.

Most diesel engines have an hour meter as standard equipment; however, there may be some engines that will need to install an hour meter to comply with the ATCM. If an hour meter is needed, the cost of purchase and installation of an hour meter is fairly minor. A quartz hour meter can be purchased for $25.00. The hour meter may also be useful to properly maintain the engine and thus save the owner/operator money. ARB staff assumed about 5 percent of the engines would need to install an hour meter.

Operating or recurring costs include expenditures for recordkeeping and reporting, periodic maintenance of DECS, and incremental fuel costs. We assumed annual costs of $100 per emergency standby stationary engine for owners to assemble the data and report to the district when required. ARB staff believes this is a conservative assumption since many companies already keep these records or have set schedules that allow readily-calculated annual maintenance and testing hours. In most all cases, prime stationary engines are already required by permit to maintain records on hours of operation. Therefore, we attributed no additional costs for recordkeeping for prime engines.

Maintenance costs include the removal of ash from DPFs; removal of ash is not an issue with DOCs. Based on discussions with manufacturers of DPFs, ARB staff

estimated the cost for DPF maintenance (ash removal and disposal) to be about $1.33 per horsepower for every 1,500 hours of operation. (Tripodi, *supra*)

Fuel costs may be lower under the ATCM in cases where operators of emergency standby engines choose to reduce annual operation to avoid the need to install a DECS. In these cases, the proposed ATCM will likely result in cost savings. Another factor that was considered is the slightly higher fuel cost for engines with diesel particulate filters or oxidation catalysts that require the use of low sulfur diesel fuel (less than 15 ppm sulfur) prior to July 1, 2006. After July 1, 2006, this added cost should disappear, because the recently amended California diesel fuel regulations mandate the use of low sulfur fuel for all on-and off-road diesel vehicles and stationary engines, resulting in widespread availability of the fuel.

ARB staff performed the cost analysis relative to the year 2002 (current value of the control costs), and unless otherwise stated, all costs are given in 2002 dollars. Using an annual discount rate of seven percent with an inflation rate of two percent, ARB staff determined annual costs over the life of the DECS (25 years assumed for emergency backup engines, 10 years for prime engines). Where future costs are mentioned in the cost effectiveness and mortality sections, they have been adjusted to 2002 dollars using well-established economic principles.

All cost estimates are based on currently available technology as described below; staff believes it is likely that the costs will decrease as technology improves and production and sales volumes increase. Additional details on the cost analysis can be found in Appendix I.

D. Potential Compliance Options and Related Capital and Recurring Costs

The costs associated with compliance will vary depending on whether: (1) the engine must meet the requirements for a new engine or an in-use engine and (2) if the engine is a prime engine or an emergency stand-by engine. Briefly summarized below is a discussion of the potential compliance options for typical prime and emergency standby engines, the estimated capital and recurring costs associated with each compliance, and the assumptions used in the cost analysis. Tables IX-2 and IX-3 provide a summary of the major assumptions used in these analyses.

New Prime Engines

For new prime engines, the ATCM requires the engine to meet a PM emissions rate of 0.01g/bhp-hr. Because 0.01 g/bhp-hr engines are not expected to be available “off the shelf” until 2011, new engine purchasers would need to buy engines that are certified to 0.15 g/bhp-hr or less and install a diesel particulate filter (DPF) on the engine to lower the emissions to 0.01 g/bhp-hr. Beginning in 2011, U.S. EPA is expected to require new engines to meet the 0.01 g/bhp-hr emissions level. (see U.S. EPA’s proposed rulemaking on the “*Control of Emissions of Air Pollution from Nonroad Diesel Engines and Fuel*,” as published in the Federal Register (68 FR 28328, May 23, 2003)).

We assumed the capital costs attributable to the ATCM are the costs of purchase and installation of the DPF on new engines put into service prior to 2011. Additional costs include emissions testing for half the engines, incremental fuel costs associated with the purchase of low sulfur fuel in 2005, and reporting and recordkeeping as discussed below. No permit costs were assumed because a new engine would require a permit regardless of whether the ATCM were in place or not. We assumed no additional cost due to the ATCM beginning in 2011, since U.S. EPA is expected to require manufacturers to produce engines to meet the standards in the ATCM.

New Emergency Standby Engines and New Agricultural Engines

The ATCM requires new emergency standby engines and any new agricultural engine to meet PM emissions standards of 0.15 g/bhp-hr in 2005. As discussed in Appendix F, Basis for the Diesel PM Standards, there are engines in all horsepower ranges greater than 50 hp that can be purchased off the shelf at this emission limit. Therefore, we assumed there will be no capital costs attributable to the ATCM for this category of engines.

However, we did account for the costs of annual recordkeeping and reporting of hours of operation required for owners of non-agricultural emergency standby engines. For agricultural engines, the ATCM requires sellers of stationary agricultural engines to report annual sales. In the cost analysis, ARB staff assumed annual costs of $100 per distributor to assemble the data and report to the district when required. It was assumed there were 20 distributors.

In-Use Prime Engines

Certified existing prime engines (generally engines manufactured in 1996 or later) are required to either reduce diesel PM emissions by at least 85 percent or meet an emissions standard of 0.01g/bhp-hr in the 2005-2009 timeframe. In most cases, we expect that engine operators will choose to retrofit their engine with emission control technology to reduce diesel PM emissions by 85 percent. Based on the current availability of emission control technologies for diesel engines, we expect most operators to install a diesel particulate filter, for which the associated capital costs are summarized in Table IX-2.

For non-certified engines, where it is not possible to install a DPF due to technical issues, the proposed ATCM allows for installation of a DOC in 2005, followed by replacement of the engine with a new Tier 4 engine in the 2011-2013 timeframe. The capital costs in this case include the cost for the DOC and the purchase of a new engine in 2011. We assumed approximately 10% of the engines would have been at the end of their useful life in 2011 and did not attribute any new engine costs for these engines to the ATCM. Additional costs include annual maintenance costs associated with DECS.

We estimate that retrofitted DECS will last for 8400 hours of use (twice the typical warranty period required by the Verification Procedure). This is based on our

assumption that prime engines run an average of 1040 hours a year, with a range of 70 to 2200 hours per year (Diesel Risk Reduction Plan, October 2000). DECS installed on these engines could last from 4 to 25 years. To be conservative, staff assigned 10 years as the average useful life of DECS installed on prime engines based on the population weighted useful life.

In-Use Emergency Standby Engines

There are a wide variety of compliance options available for in-use emergency standby engines, depending on the hours of operation needed for maintenance and testing and the emission rate of the engine. Because the ATCM proposes increasingly more stringent performance standards with increasing hours of operation for maintenance and testing, we expect that many operators will comply with the requirements by adjusting their hours for maintenance and testing to a level where additional controls are unnecessary. This compliance option will potentially result in net savings to the operator due to reduced annual fuel consumption.

ARB staff believes that the majority of owners of emergency standby engines will be able to limit the hours for maintenance and testing and avoid installing DECS. However, in some cases, an engine with a lower emissions rate will require the installation of an oxidation catalyst to allow routine maintenance and testing. In other situations, particularly for engines emitting more than 0.15 g/bhp-hr that require over 30 hours a year for maintenance and testing, the owner may need to install a diesel particulate filter or some other highly effective emission control device.

We estimate that DECS will last for 8,400 hours of use (twice the typical warranty period). Because emergency standby stationary engines run on average 30 hours a year (ARB Survey), DECS installed on these engines could last much more than 25 years. To be conservative, staff limited the DECS useful life to 25 years.

Stationary Engines = 50 hp

For new stationary engines rated at or below 50 horsepower, the ATCM requires compliance with the current model Off-Road Compression-Ignition Engine Standards (title 13, CCR, section 2423). Because these engines are widely available and required for use in off-road mobile or portable applications, we assumed no capital costs attributable to the ATCM.

Table IX-2 summarizes the estimated capital, operation and maintenance, reporting, and recordkeeping costs associated with the compliance options. In Table IX-3, the key cost assumptions used in the cost analysis are provided.

Table IX-2: Estimated Capital, Operation, and Maintenance Costs for Compliance with the Proposed ATCM

Compliance Option	DPF	DOC	New Engine	Reduce Hours or No Additional Controls Necessary
Capital Costs				
Equipment & Installation	$38/hp	$10.40/hp	$92.65/hp	0
Hour Meter	$25	$25	0	0
On-Going Costs / Operation and Maintenance				
Cleaning	$1.33 per hp for every 1,500 hours of operation	0	0	0
Current Diesel Fuel Cost[1]	$1.74/gal	$1.74/gal	$1.74/gal	$1.74/gal
Incremental Fuel Cost (2005)[2]	$0.15/gal	$0.15/gal	$0.15/gal	0
Reporting/ Record-keeping/Compliance				
Reporting and Record-keeping of Hours	$100/year-engine	$100/year-engine	$100/year-engine	$100/year-engine
District Permits[3] Emergency	$1,000	$1,000	$1,000	$124
District Permits[3] Prime	$1,000	$1,000	$1,000	N/A
Emissions Testing[4]	$5,000 -$17,000	$5,000 - $17,000	0	0

1. (EIA, 2003)
2. After July 1, 2006, California diesel fuel regulations mandate the use of low sulfur fuel (15 ppm sulfur) for on and off-road motor vehicles and stationary engines. We assumed this fuel would be available for stationary use as of the same date.
3. Local district permit costs vary widely depending on the district, the size of the engine, and the permit modification. Costs ranged from less than $100 to over $2,000. We assumed an average of $1,000 per permit modification for the cost analysis. For emergency standby engines that only adjust the hours of annual operation to comply with the ATCM, we assumed a lower permit fee of $124 to reflect the expected minimal engineering analysis that would need to be conducted to change the permit conditions.
4. We estimated the costs for emission testing to range from $5,000 to $17,000. The low end represents a single mode test in triplicate and the upper end a 3-mode test done in triplicate. To be conservative, for our cost estimate we assumed the higher costs. We believe, however, that in many cases, there will be alternative data available that can be used in lieu of emission testing (e.g., manufacturers' certification data).

Table IX-3 outlines the cost assumptions used in the cost analysis for the various engine categories affected by this ATCM.

Table IX-3: Key Cost Assumptions Used in the Cost Analysis

Category	Assumptions
New Prime	• New engines must install DPF between 2005-2011 • DPFs effective for twice the 4200 warranty hours (8400) or 25 years, which ever comes first • Off-the-shelf engines available in 2011 and no capital costs attributed to the ATCM after that date • 5 new prime engines/year • Additional cost for low sulfur fuel in 2005 only
New Emergency Standby/New Agricultural Engines	• Off-the-shelf engines that meet the emissions limit available concurrent with ATCM implementation • Approximately 200 new engines each year (½ ag and ½ non-ag) • No capital cost attributed to the ATCM
In-Use Prime	• 80 percent of engines install DPF • 20 percent of engines initially install a DOC and later replaced with new Tier 4 engine in 2011 – Costs assume that 10% would need a new engine anyway • DPFs and DOCs effective for twice the 4200 warranty hours (8400) or 25 years, which ever comes first • Expected life of the DECS averages 10 years (range from 4 to 25) • Discount Rate: 7%, Inflation Rate: 2% • 5% of engines of engines installing a DPF may need to install hour meters because of the ATCM requirement
In-Use Emergency Standby	• 90% of older engines operating over 20 hours per year will reduce hours of operation to below 20 hours per year and avoid controls • Engines capped at 30 hours per year. • Additional cost for low sulfur fuel in 2005 only for those engines with DPFs • 5% of engines need to install hour meters because of the ATCM requirement • DPFs and DOCs effective for twice the 4200 warranty hours or 25 years, which ever comes first • Expected life of the DECS averages 25 years • Discount Rate: 7%, Inflation Rate: 2%
All Engines	• Total capital costs are annualized over the lifetime of the DECS using an annual 7% discount rate and 2% inflation rate • The annual costs are the sum of the annualized capital costs and the annual maintenance and operation costs. • The ARB Survey data is representative of the current California stationary engine population

E. Estimated Costs to Businesses

Here, we estimate the costs and economic impacts on businesses. The analysis estimates the overall total statewide cost to businesses and the total costs to different sectors of the industry. We also estimate the overall impact on business competitiveness, employment, and other business impacts as required by state law.

We estimate the statewide total costs to businesses to be approximately $36.5 million dollars, which equates to annualized costs of about $6.8 million per year. The total statewide cost to businesses is derived from the combined capital and installation costs, using 2002 capital cost values, and equipment lifetime operating and maintenance costs associated with compliance with the regulation. We evaluated the costs for both in-use and new, and prime and emergency standby, stationary diesel-fueled CI engines.

Using the available information from the ARB Survey on the engine population and current in-use and expected PM emission rates, staff determined the percent of engines that would potentially incur capital costs (either from installing a DECS or purchasing a new engine) when complying with the proposed regulation. As shown in Table IX-4, for California businesses, approximately 1,200 engines may require some type of DECS emission control system to meet the performance standards proposed in the regulation.

Table IX-4: Estimated Number of Privately Owned Stationary Diesel-Fueled CI Engines in California Potentially Requiring Installation of Diesel Emission Control Systems

Engine Application		Emission Control Systems			
Emergency Standby	**Model Year**	**Diesel Particulate Filter**	**Diesel Oxidation Catalyst**	**New Tier 4 Engine in 2011**	**None Needed**
	1988 – 2002	0	0		6,420
	Pre 1988	0	167		3,330
Prime	All	835	209	209	0

The total statewide costs to businesses were then estimated by adding the 2002 value of the capital costs and operating and maintenance costs for the life of the equipment. For both emergency and non-agricultural prime engines, the total capital cost was estimated to be $36.5 million with an annualized cost of $6.8 million. A summary of the expected costs is presented in Table IX-5.

Table IX-5: Estimated Statewide Costs for Businesses

Equipment		Total Capital Cost ($)	Annualized Capital Cost ($)	Annual Recurring Costs / Savings ($)	Total Annualized Cost ($)
In-use	Prime	$ 33,653,000	$ 5,966,000	$ 674,000	$ 6,640,000
	E/S	$ 2,296,000	$ 163,000	$ -130,000	$ 32,800
New	Prime	$ 530,000	$ 75,000	$ 400	$ 75,800
	E/S	0	0	$ 7,400	$ 7,400
Total		$ 36,479,000	$ 6,204,000	$ 551,800	$ 6,755,000

Costs to a Typical Business

Most business in California do not own any diesel-fueled stationary engines. For those businesses that do have engines, the cost will vary depending on the number of engines operated and the engine activity and operating parameters. To provide some perspective on the costs that may be incurred by a business, ARB staff estimated the costs to comply with the ATCM for a typical business with one engine. For prime engines, we used the average horsepower for prime engines reported in the emissions inventory (590 hp), and for emergency standby engines we used the average horsepower of the engines reported in the ARB Survey (700 hp). As shown in Table IX-6, most businesses that own an emergency standby diesel-fueled engine will not need to install DECS, and for those that do, the majority can use the less expensive diesel oxidation catalyst. If a business owns a prime diesel-fueled engine, then retrofit with a DPF or DOC is necessary.

Table IX-6: Estimated Costs per Engine for a Typical Business

Category	Activity	% of all Private Engines	Typical Engine Size (hp)	Capital Cost per Engine	Annualized Capital Costs	Recurring Costs	Total Annual Costs ($)
Emergency Standby	Reduce Hours	88.8%	700	$100	$0	$100	$100
	DOC	1.5%	700	$7,280	$517	$100	$617
Prime	DPF	7.7%	590	$22,420	$2,903	$550	$3,453
	DOC and	1.9%	590	$6,136	$1,417	$0	$1,417
	Replace in 2011			$54,664	$3,879	$0	$3,879

The estimated capital cost to a business with a typical size emergency standby engine could range from $100 to $7,280 per engine. The low end of the cost range reflects reporting costs for businesses that will not have to install a DECS (no equipment cost). The upper end reflects businesses that will retrofit emergency standby engines with DOCs at an average capital cost of $7,280 each. The estimated capital cost to a typical business with a prime engine is $22,400 for the installation of a DPF. For those

businesses with prime engines needing to install a DOC and then later replacing that engine with a new Tier IV engine in 2011, the estimated capital cost is $60,800 ($6,136 for DOC + $54,664 for new engine). For engines with a DPF, there will be an additional annual cost of approximately $550 for maintenance.

Based on the ARB Survey, for those businesses that do have either emergency standby or prime stationary diesel-fueled engines, the average business owns 2.5 emergency standby engines of 700 horsepower, and three prime engines of 590 horsepower.[1] The typical small business that owns an emergency standby engine has 1.5 emergency standby engines. The typical small business owning prime engines has 1.75 prime engines. The costs for typical businesses and typical small businesses can be estimated by multiplying the cost per engine values, present in Table IX-6 above, by the typical number of engine per business. Additional information on the impacts to businesses can be found in Appendix I.

Costs and Impacts to Various Industry Sectors

ARB staff categorized the emergency standby stationary diesel-fueled engines owned by businesses and reported in the ARB Survey into nine categories. These categories are hospitals, power generation, telecommunications, broadcasting, hotels, petroleum refiners, food processing, and private other. The category 'private other' is made up of a wide variety of businesses or agencies that do not fit within the other categories. Some examples of 'private other' engines include malls, mail-order retailers, retirement homes, condominiums, corporate headquarters, parcel delivery hubs, freight, research facilities, ports, airports, manfacturing, mining, financial, mills, pharmaceutical companies, ski resorts, aquariums, and museums. Because prime engines were reported by a very diverse range of businesees, we did not try to subcategorize these engines.

The methodology used to estimate the costs in Table IX-7 is the same as that used to estimate the total statewide costs of the ATCM in Section D, except that the individual industry sectors were analyzed separately. The industry sectors are derived from the businesses responding to our survey. Based on the information in the ARB survey and applying the assumptions outlined in Table IX-3, there were actual cost savings to the telecommunication industry due to the reduction in the annual hours of operation for maintenance and testing of emergency standby engines.

[1] We believe this may be an overestimate of the number of engines owned by a typical business. Some of the telecommunication businesses own hundreds of engines, which may have biased the average.

Table IX-7: Distribution of Total Costs by Businesses Category

Business Category	Estimated Total Capital Costs	Annualized Capital Cost	Annual Recurring Costs ($)	Total Annualized Cost ($)
Emergency Standby Applications				
Hospitals	$ 200,916	$ 14,255	$ 4,628	$ 18,884
Power Generation	$ 74,810	$ 5,942	$ - 2,769	$ 4,957
Telecommunications	$ 155,710	$ 11,555	$ - 12,418	$ 2,607
Broadcasting	$ 95,850	$ 7,296	$ - 4,625	$ 2,671
Hotels	$ 101,830	$ 8,239	$ - 50	$ 10,662
Petroleum Refiners	$ 97,160	$ 7,845	$ - 3,025	$ 4,820
Food Processing	$ 62,200	$ 5,174	$ - 1,570	$ 3,604
Other[2]	$ 741,850	$ 57,138	$ - 44,970	$ 12,168
Prime Applications				
Prime [3]	$ 36,797,505	$ 6,040,991	$ 674,483	$ 6,715,474
Total	$ 38,327,831	$ 6,158,436	$ 609,684	$ 6,775,846

1. We are assuming that all hospitals and health care facilities will reduce maintenance and testing to less than 20 hours a year pending legislative approval of AB 390. The 458,887 is the estimated reporting and recordkeeping costs for a 25 year period.
2. Examples " other" business types using emergency standby engines include but are not limited to the following: retail, office buildings/property management, airports, ski resorts, and factories.
3. The use of prime engines was not easily categorized by business type. A wide variety of business types use prime engines including: private waste and sanitation facilities, power generation, food processing, petroleum refiners, construction, sand and gravel facilities, shipyard, mountain resorts, recycling, landfill, and composting facilities.

Potential Business Impacts

In this section, we analyze the potential impacts of the estimated costs of the proposed ATCM on business enterprises in. Section 11346.3 of the Government Code requires that, in proposing to adopt or amend any administrative regulation, state agencies shall assess the potential for adverse economic impact on California business enterprises and individuals. The assessment shall include a consideration of the impact of the proposed or amended regulation on the ability of California businesses to compete with businesses in other states, the impact on California jobs, and the impact on California business expansion, elimination, or creation.

This analysis is based on a comparison of the annual return on owner's equity (ROE) for affected businesses before and after the inclusion of the equipment costs, associated recurring costs, and fees. The analysis also uses publicly available information to assess the impacts on competitiveness, jobs, and business expansion, elimination, or creation.

ARB staff does not have access to financial records for most of the privately-owned companies that responded to the ARB Survey. However, the small business status of the survey respondents was determined by including a query on the ARB Survey for the respondent to indicate if their business was a small business (annual gross receipts of $10,000,000 or less per Government Code section 14837 (d)(1)). Based on the ARB Survey responses, staff identified approximately 6.5 percent of the businesses (~280 statewide) as small businesses. These small businesses account for 3.7 percent of the emergency standby engines owned by California businesses (~354 engines statewide). The ARB Survey responses also indicate 38 percent of the businesses that own prime engines are would qualify as small businesses, representing 26 percent of the prime engines.

The types of businesses that may be impacted include private schools and universities, private water treatment facilities, hospitals, office buildings, power generation, communications, broadcasting, building owners, banks, hotel/motels, refiners, resorts, recycling centers, quarries, wineries, dairies, food producing and packaging, manufacturing, landfills, and retail stores. Based on the ARB Survey, staff estimates approximately 4,280 companies, having an estimated 9,900 emergency standby stationary engines and 1,040 prime engines, will be affected by this regulation. The vast majority of the engines requiring a retrofit or replacement are prime engines. The affected businesses fall into different industry classifications, as shown in Table IX-8.

Table IX-8: List of Industries with Affected Businesses

SIC Code	Industry
0723	Agricultural Services
1311	Crude Petroleum And Natural Gas
1389	Oil and Gas Field Services
1429	Crushed and Broken Stone
1442	Construction Sand And Gravel
1542	General Contractors-Nonresidential Buildings, Other Than Industrial
2048	Prepared Feeds and Feed Ingredients for Animals and Fowls
2421	Sawmills and Planing Mills, General
2951	Asphalt Paving Mixtures and Blocks
3272	Concrete Products, Except Block and Brick
3273	Ready-Mixed Concrete
3479	Coating, Engraving, and Allied Services
3711	Motor Vehicles and Passenger Car Bodies
3731	Ship Building and Repairing
4491	Marine Cargo Handling
4581	Airports, Flying Fields, and Airport Terminal Services
4911	Electric Services
4931	Electric & Other Services Comb
4953	Refuse Systems
5093	Scrap and Waste Materials
5932	Used Merchandise Stores
6531	Real Estate Agents and Managers
7353	Heavy Construction Equipment Rental and Leasing
7699	Repair Shops and Related Services, Not Elsewhere Classified

The approach used in evaluating the potential economic impact of the proposed ATCM on California businesses is as follows:

(1) All affected businesses are identified from responses to the ARB surveys. Standard Industrial Classification (SIC) codes identified by these businesses are listed in Table IX-8 above.

(2) Annual costs for the ATCM are estimated for each of these businesses based on the assumptions previously discussed.

(3) The total annual cost for each business is adjusted for both federal and states taxes.

(4) These adjusted costs are subtracted from net profit data and the results used to calculate the Return on Owners' Equity (ROE). The resulting ROE is then compared with the ROE before the subtraction of the adjusted costs to determine the impact on

the profitability of the businesses. A reduction of more than 10 percent in profitability is considered to indicate a potential for significant adverse economic impacts. This threshold is consistent with the thresholds used by the U.S. EPA and others.

Using Dun and Bradstreet financial data from 1999 to 2001, staff calculated the ROEs, both before and after the subtraction of the adjusted annual costs, for the typical businesses from each industry category. These calculations were based on the following assumptions.

- All affected businesses are subject to federal and state tax rates of 35 percent and 9.3 percent, respectively.

- Affected businesses neither increases the prices of their products nor lowers their costs of doing business through cost-cutting measures because of the ATCM.

These assumptions, though reasonable, might not be applicable to all affected businesses.

California businesses are affected by the proposed annual cost of the ATCM to the extent that the implementation of the proposed ATCM reduces their profitability. Using ROE to measure profitability, we found that the ROE range for typical businesses from all industry categories would have declined by about 0.01 to 6 percent in 2006. This represents a small decline in the average profitability of the affected businesses. Overall, most affected businesses will be able to absorb the costs of the proposed ATCM with no significant impacts on their profitability.

Potential Impact on Business Competitiveness

The proposed ATCM may affect the ability of some California businesses that sell their products nationally to compete with businesses outside the State due to the slight increase in stationary diesel-fueled engine costs. However, most businesses affected by this proposed regulation compete in local markets and are not subject to competition from businesses located outside the State.

Emergency standby diesel-fueled engines are located in a wide variety of businesses. However, ARB staff estimates that only one percent of the emergency engines will require modifications that will result in costs to the engine owners. For owners of prime engines, we expect approximately 80 percent to install a DPF and 20 percent to install a DOC with the intent to replace with a new engine in 2011. Most of the affected businesses are large and are expected to be able to absorb the increased costs associated with the proposed ATCM with no significant impact on their ability to compete with non-California businesses (see analysis in Appendix I).

Potential Impact on Employment, Business Creation, Elimination or Expansion

The proposed ATCM is expected to have no noticeable impacts on employment and business' status. Businesses that manufacture, sell, install, repair, or clean diesel particulate emission control systems may experience an increase in demand for their products or services, resulting in an expansion of those businesses or the creation of new businesses. Staff believes used engine dealers would not be eliminated; instead, we believe the dealers would adapt to incorporate additional refurbishment and upgrading of the engines for resale.

ARB staff believes jobs will not be eliminated as a result of the ATCM, but it may lead to the augmentation or alteration of job duties, leading to no net result change in the number of jobs. For example, a mechanic who previously worked on muffler installation would now be installing a DECS. Staff believes additional training and emissions testing may be required for these additional duties, if not provided by the DECS manufacturers. To the extent that DECS are manufactured in California, some jobs may also be created. Some jobs will be created to install, repair, or clean DECS.

F. Potential Costs to Local, State, and Federal Agencies

In this section, we estimate the total costs to governmental agencies. The analysis also estimates the total costs to local, state, and federal agencies individually. As shown in Table IX-9, ARB staff estimates the total costs to public agencies to be approximately 8.1 million dollars, with annualized costs of approximately $1.7 million.

Table IX-9: Summary of Total Lifetime and Annualized Costs for Public Agency Compliance with the ATCM

Engine Application	Category	Total Capital Cost ($)	Annualized Capital Cost ($)	Annual Recurring Costs ($)	Total Annualized Cost ($)
Emergency Standby	State	$198,870	$14,110	-$110,820	-$96,710
	City	$370,000	$26,235	-$12,625	$13,610
	County	$191,850	$13,610	-$20,450	-$6,840
	Other Local	$396,590	$28,142	-$71,302	-$43,160
	Federal	$502,060	$35,624	-$22,084	$13,540
Prime	State	$555,892	$98,266	$11,135	$109,400
	City	$2,624,238	$463,897	$52,563	$516,460
	County	$1,330,292	$235,164	$26,646	$261,810
	Other Local	$1,441,043	$254,736	$28,864	$283,600
	Federal	$3,142,928	$555,587	$62,953	$618,540
Total		$10,753,762	$1,725,371	-$55,121	$1,670,250

Local Public Agencies

The majority of local governments provide services requiring the use of emergency engines to insure public safety or maintain essential services during emergencies. Examples include police departments, jails, fire departments, government data storage facilities, and sewage and water treatment facilities. In the event of power outages, floods or other emergencies, the emergency standby engines prevent disruptions in critical operations.

Based on the ARB Survey and the most current stationary engine emissions inventory, we estimate there are approximately 5,400 emergency standby engines and 170 prime engines owned and operated by local government agencies. As shown in Table IX-10, approximately 45 diesel backup engines and 167 diesel prime engines will incur capital costs associated with installation of a DECS. The remaining engines will incur minimal costs for reporting and record-keeping requirements proposed in the regulation.

Table IX-10: Estimated Number of Local Publicly Owned Stationary Diesel-Fueled CI Engines in California Potentially Requiring Installation of Diesel Emission Control Systems

Engine Application			Emission Control Systems			
	Category	Total Engine Population	Diesel Particulate Filter	Diesel Oxidation Catalyst	New Tier 4 Engine	None Needed
Emergency Standby	City	2,465		12		2,453
	County	923		8		915
	Other Local	2,044		25		2,019
	Total Local Standby	5,432		45		5,387
Prime	City	81	65	16	16	
	County	41	33	8	8	
	Other Local	45	36	9	9	
	Total Local Prime	167	134	33	33	

To estimate the expected costs of the proposed ATCM to local public agencies, we used the cost estimates and assumptions outlined in Tables IX-2 and IX-3 and the basic cost methodology discussed previously. Using these assumptions, the estimated average cost to retrofit or modify a emergency standby stationary diesel-fueled engine is about $5,600 for a city owned engine (average 450 hp) and $8,100 for a county owned engine (average 680 hp). The estimated total equipment and installation costs on local governments to modify prime and emergency standby stationary diesel-fueled engines will be approximately $6,354,000. The estimated discounted capital cost plus the annual additional operation and maintenance cost on local governments is approximately $1,021,000 annually. A brief summary of the estimated costs for local public agencies is presented in Table IX-11.

Table IX-11: Estimated Statewide Costs for Local Publicly Owned Stationary Diesel-Fueled CI Engines in California

Engine Application	Category	Total Capital Cost ($)	Annualized Capital Cost ($)	Annual Recurring Costs ($)	Total Annual Cost ($)
Emergency Standby	City	$370,000	$26,200	-$12,630	$13,600
	County	$191,900	$13,600	-$20,450	-$6,800
	Other	$396,600	$28,100	-$71,300	-$43,200
Prime	City	$2,624,200	$463,900	$52,600	$516,500
	County	$1,330,300	$235,200	$26,600	$261,800
	Other	$1,441,000	$254,700	$28,900	$283,600
Total		$6,354,000	$1,021,000	$3,700	$1,025,500

To estimate the fiscal impacts for fiscal year (FY) 2005-2006, we assumed that 25 percent of the total engines needing a retrofit would incur costs for that current year. As currently proposed, the regulation requires 1989 model year and pre-1989 model year engines to be in compliance by January 1, 2006; 1990 model year to 1995 model year engines to be in compliance by January 1, 2007; and 1996 and newer model year engines to be in compliance by January 1, 2008. In addition, owners of four or more engines have until January 1, 2009, to have all the engines in compliance with the performance standards specified in the regulation. Because we lacked detailed information on the age distribution of engines owned by local public agencies, we concluded a 25 percent compliance rate per year was reasonable. Using this assumption, we estimate the total cost for the 2005-2006 fiscal year is about 25 percent of the total annual cost, or $256,380.

There may also be other potential cost impacts. For example, for public agencies that contract with private companies, an increase in the contract cost may occur under the terms of the contract or at the renewal of the contract. Staff did not consider this a direct cost, and, therefore, did not include it in the cost to local government agencies.

The local air districts are responsible for enforcing this regulation. The enforcement of the engines affected by this regulation would probably take the form of a typical inspection. The typical inspection takes about one hour annually for a prime engine and about a half-hour every four years for an emergency engine. Based on the number of engines in the ARB Survey, the additional local costs on the air districts statewide will be approximately $362,000 per year for district enforcement.

Fiscal Effect on State Government

Several State agencies provide services requiring emergency backup diesel equipment for public safety. Examples of these operations include prisons, government data storage facilities, emergency flood control, and college campuses. Some agencies may also have prime engines such as wood chippers used for composting forest waste. Examples of the State agencies that potentially may be impacted by the ATCM include

the Department of Corrections, General Services, the University of California and the California State University systems, the Department of Water Resources, the Franchise Tax Board, and the Department of Fish and Game. Based on the ARB Survey, and as shown in Table IX-12, we estimate about 882 standby and 17 prime diesel engines operated by State agencies will be impacted by this regulation.

Table IX-12: Percentage of State Owned Stationary Diesel-Fueled CI Engines in California Potentially Requiring Installation of Diesel Emission Control Systems

Engine Application			Emission Control Systems			
Category		Total Engine Population	Diesel Particulate Filter	Diesel Oxidation Catalyst	New Tier 4 Engine	None Needed
Emergency Standby	State	882		9		873
Prime	State	17	14	3	3	

To estimate the expected costs associated with State agencies compliance with the regulation, we used the cost estimates and assumptions outlined in Tables IX-2 and IX-3 and the basic cost methodology discussed previously. As shown in Table IX-13, the proposed ATCM is expected to result in $754,500 initial capital cost to the State agencies. The fuel savings and retrofit costs of emergency standby engines are calculated over 25 years and the retrofit costs for prime engines are calculated over 10 years. The result is a low annual cost of $12,690.

A brief summary of the estimated costs for State agencies is presented in Table IX-13. Similar to the cost estimate for local public agencies, the expected costs for the FY 2005-2006 were estimated by assuming 25 percent of the engines would need to comply with the regulation in that year at a cost for equipment and installation of $189,000.

Table IX-13: Estimated Statewide Costs for State Owned Stationary Diesel-Fueled CI Engines in California

Engine Application	Total Capital Cost ($)	Annualized Capital Costs ($)	Annual Recurring Cost ($)	Total Annual Cost ($)
Emergency Standby	$198,900	$14,100	-$110,820	-$96,710
Prime	$555,900	$98,300	$11,140	$109,400
Total	$754,800	$112,400	-$99,680	$12,690

Fiscal Impact on Federal Agencies

Several federal agencies provide services requiring emergency backup diesel equipment for public safety. Examples of operations requiring emergency standby engines are prisons, government data storage facilities, and military bases. Examples of the federal agencies that potentially may be impacted by the ATCM include, the National Aeronautics and Space Administration (NASA), military bases, U.S. Park Service facilities, Federal Bureau of Prisons, and the Federal Aviation Administration. As shown in Table IX-14, we estimate approximately 3,594 emergency standby and 98 prime diesel engines operated by the federal government will be impacted by this regulation.

Table IX-14: Percentage of Federally Owned Stationary Diesel-Fueled CI Engines in California Potentially Requiring Installation of Diesel Emission Control Systems

Engine Application			Emission Control Systems				
Category		Total Engine Population	Diesel Particulate Filter	Diesel Oxidation Catalyst	New Engine + DPF	New Tier 4 Engine	None Needed
Emergency Standby	Federal	3,594		12			3,582
Prime	Federal	98	78	20		20	

Source: ARB Survey

To estimate the expected costs associated with federal agencies compliance with the regulation, we used the cost estimates and assumptions outlined in Tables IX-2 and IX-3 and the basic cost methodology discussed previously. As shown in Table IX-15, the estimated total capital costs of Federal agencies to comply with the regulation is $3,645,000, with annualized capital costs plus the annual operation and maintenance costs of about $632,000. The fuel savings and retrofit costs of emergency standby engines are calculated over 25 years, and the retrofit costs for prime engines are calculated over 10 years. Similar to the cost estimate for local public agencies, the expected costs for the FY 2005-2006 were estimated by assuming 25 percent of the engines would need to comply with the regulation in that year at a cost for equipment and installation of $911,250.

Table IX-15: Estimated Statewide Costs for Federally Owned Stationary Diesel-Fueled CI Engines in California

Engine Application	Total Capital Cost ($)	Annualized Capital Cost ($)	Annual Recurring Cost ($)	Total Annualized Cost ($)
Emergency Standby	$502,100	$35,600	-$22,100	$13,500
Prime	$3,142,900	555,600	$63,000	$618,500
Total	$3,645,000	$591,200	$40,900	$632,100

G. Summary of Total and Annual Costs for Compliance with the Proposed ATCM

In this section, the results shown in Tables IX-5 and IX-9 are summarized in Table IX-16 (i.e., the total cost of the ATCM to both private companies and governmental agencies). Based on these results, we estimate the total statewide capital costs for all affected entities in the State are $47 million, with an annualized cost of $8.4 million.

Table IX-16: Summary of Total Lifetime and Annualized Costs for Compliance with the Proposed ATCM

Engine Application	Category	Total Capital Cost	Annualized Capital Cost	Annual Recurring Costs ($)	Total Annualized Cost ($)
Emergency Standby	Private	$2,296,000	$163,000	-$123,000	$40,000
	State	$199,000	$14,000	-$111,000	-$97,000
	City	$370,000	$26,000	-$13,000	$14,000
	County	$192,000	$14,000	-$20,000	-$7,000
	Other Local	$397,000	$28,000	-$71,000	-$43,000
	Federal	$502,000	$36,000	-$22,000	$14,000
Prime	Private	$34,183,000	$5,979,000	$737,000	$6,716,000
	State	$556,000	$98,000	$11,000	$109,000
	City	$2,624,000	$464,000	$53,000	$516,000
	County	$1,330,000	$235,000	$27,000	$262,000
	Other Local	$1,441,000	$255,000	$29,000	$284,000
	Federal	$3,143,000	$556,000	$63,000	$619,000
Total		$47,233,000	$7,868,000	$560,000	$8,427,000

H. Cost Effectiveness

In this section, the cost-effectiveness of the ATCM is estimated. Cost effectiveness is expressed in terms of control costs (dollars) per unit of air emissions reduced (pounds). As described below, for example, the cost effectiveness for the proposed ATCM is determined by dividing the annualized capital costs plus the annual operation and maintenance costs by the annual pounds of diesel PM reduced. For the mortality cost-effectiveness, we presented the annualized capital costs and annual operation and maintenance costs in 2002 equivalent expenditure dollars.

The annualized capital costs and annual operation and maintenance have been represented differently for the cost effectiveness and mortality sections. ARB does not have data to determine multiple engine ownership and associated engine ages to accurately determine the retrofit phase in schedule. Therefore, the capital costs at the beginning of the ATCM implementation are phased in over four years to accommodate potential issues regarding the engine age and multiple engine ownership. Also, all costs are brought back to 2002 net present value to compare with other regulations. This method better represents when emission reductions will occur and more accurately represents costs further in the future.

Expected Emission Reductions

We estimated the projected annual emission reductions under the ATCM as described in Appendix D. The following provides a summary of the annual statewide reductions that will result from the proposed ATCM.

The baseline and ATCM-controlled diesel PM emissions are calculated based on the statewide inventory. These results are shown in Table IX-17.

Table IX-17: Estimated Statewide Diesel PM Annual Emissions and Reductions

Year	Uncontrolled Emissions (tons/day)	Controlled Emissions* (tons/day)	Reduction Emissions* (tons/day)	Reduction Emissions (tons/yr)
2005	0.8680	0.4067	0.4613	168.4
2006	0.8134	0.3957	0.4177	152.5
2007	0.7786	0.3816	0.3970	144.9
2008	0.7414	0.3619	0.3795	138.5
2009	0.7054	0.3450	0.3604	131.5
2010	0.6452	0.3482	0.2970	108.4
2011	0.6334	0.3112	0.3222	117.6
2012	0.5974	0.2943	0.3031	110.6
2013	0.5614	0.2774	0.2840	103.7
2014	0.5254	0.2605	0.2649	96.7
2015	0.4791	0.2137	0.2654	96.9
2016	0.4534	0.2267	0.2267	82.7
2017	0.4174	0.2098	0.2076	75.8
2018	0.3814	0.1929	0.1885	68.8
2019	0.3454	0.1760	0.1694	61.8
2020	0.3246	0.1720	0.1526	55.7

*Expected emissions and emission reductions due to implementation of ATCM

Cost Effectiveness

To determine the cost-effectiveness of the proposed regulation, we divided the annualized costs and annual ongoing costs by the diesel PM emission reductions attributable to the ATCM. The resulting cost effectiveness in each year of implementation up to 2020 is listed in Table IX-18. The estimated overall annual cost effectiveness, weighted by annual PM reduced, is $15.4 per pound of diesel PM reduced, if all the costs of compliance are allocated to diesel PM reduction. The range is from $4 to $26 per pound of diesel PM reduction. This cost effectiveness is near the lower end of anticipated cost effectiveness for diesel PM controls.

Table IX-18: Summary of Annual Cost Effectiveness for the Proposed ATCM

Year	Sum Annual Costs ($)	Inventory Based PM Reduced	Cost Effectiveness	
		(tons/yr)	($/ton)	($/lb)
2005	$ 1,354,316	145	$ 8,043	$ 4.02
2006	$ 3,108,844	125	$ 20,391	$ 10.20
2007	$ 4,693,204	114	$ 32,388	$ 16.19
2008	$ 6,119,622	103	$ 44,179	$ 22.09
2009	$ 5,842,752	93	$ 44,416	$ 22.21
2010	$ 5,578,374	73	$ 51,459	$ 25.73
2011	$ 5,409,320	76	$ 45,996	$ 23.00
2012	$ 5,159,407	68	$ 46,636	$ 23.32
2013	$ 4,135,495	61	$ 39,895	$ 19.95
2014	$ 3,197,399	54	$ 33,069	$ 16.53
2015	$ 2,358,752	51	$ 24,349	$ 12.17
2016	$ 1,592,726	42	$ 19,248	$ 9.62
2017	$ 1,336,349	36	$ 17,636	$ 8.82
2018	$ 1,100,777	32	$ 15,999	$ 8.00
2019	$ 900,639	27	$ 14,566	$ 7.28
2020	$ 717,067	23	$ 12,874	$ 6.44
		Weighted Average =	$ 30,821	$ 15.41

Since the ATCM will also result in reductions in reactive organic gases (ROG) and oxides of nitrogen (NOx) emissions, staff conducted a second cost effectiveness analysis in which half of the cost of compliance was allocated to PM benefits and half the cost was allocated to ROG plus NOx benefits. This results in cost effectiveness values of $7.70/lb diesel PM, weighted by annual PM reduced, and $0.92/lb of ROG plus NOx, weighted by annual ROG plus NOx reduced. The resulting ROG plus NOx cost effectiveness for the combined standby and prime engines in the State are listed in Table IX-19. Based on their relative weights, the ROG and NOx cost effectiveness can be further expressed as $0.17 per pound ROG and $0.75 per pound NOx based on the respective weights. This cost effectiveness is near the lower end of anticipated cost effectiveness for diesel PM controls.

Table IX-19: Summary of Annual ROG Plus NOx Cost Effectiveness for the Proposed ATCM

Year	Sum of Annual[1] Costs ($)	Inventory Reduced			ROG+NOx Cost Effectiveness	
		ROG (tons/yr)	NOx (tons/yr)	ROG + NOx (tons/yr)	($/ton)	($/lb)
2005	$ 677,158	165	418	583	$ 1,162	$ 0.58
2006	$ 1,554,422	157	306	463	$ 3,358	$ 1.68
2007	$ 2,346,602	149	389	538	$ 4,360	$ 2.18
2008	$ 3,059,811	141	455	596	$ 5,131	$ 2.57
2009	$ 2,921,376	133	530	663	$ 4,407	$ 2.20
2010	$ 2,789,187	126	352	478	$ 5,839	$ 2.92
2011	$ 2,704,660	118	679	796	$ 3,396	$ 1.70
2012	$ 2,579,704	110	753	863	$ 2,989	$ 1.49
2013	$ 2,067,748	102	828	930	$ 2,224	$ 1.11
2014	$ 1,598,699	94	902	997	$ 1,604	$ 0.80
2015	$ 1,179,376	87	897	983	$ 1,199	$ 0.60
2016	$ 796,363	79	1,051	1,130	$ 705	$ 0.35
2017	$ 668,174	71	1,126	1,197	$ 558	$ 0.28
2018	$ 550,388	63	1,200	1,263	$ 436	$ 0.22
2019	$ 450,320	55	1,275	1,330	$ 339	$ 0.17
2020	$ 358,533	48	1,485	1,532	$ 234	$ 0.12
				Weighted Average =	$ 1,834	$ 0.92

[1] Annual costs is the sum of annualized capital costs and annual ongoing costs
Source: ARB Emissions Inventory, Off-Road Model

Cost-Effectiveness of the ATCM as Applied to Agricultural Operations

For several reasons, the ARB staff believes the ATCM is cost-effective for agricultural operations. First, the ATCM applies only to new diesel engines used in agricultural operations. Therefore, agricultural operations will not need to buy new compliant engines until they need such new engines. In that case, the agricultural operations would have replaced their existing engines with new engines irrespective of the ATCM. Second, the ATCM requires these new engines to meet a 0.15 g/bhp-hr diesel PM limit and the current off-road certification standards. As noted earlier in this chapter, such engines are readily available "off-the-shelf" and have been shown to be cost-effective. Third, the ATCM does not require retrofits on existing, in-use engines. Therefore, when agricultural operations decide to purchase new engines, they would be required to buy new engines that are already available "off-the-shelf" and cost-effective, which they would have done anyway irrespective of the ATCM. This is the basis for our finding that the cost attributable to the ATCM for agricultural operations is essentially zero for purchasing a new engine. And for these reasons, the ARB staff believes the ATCM is cost-effective for agricultural operations.

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