

## **CARB Analyses of Key Mobile Source Regulations & Programs Providing Emission Reductions**

### **I. INTRODUCTION**

Given the severity of California's air quality challenges and the need for ongoing emission reductions, the Air Resources Board (ARB) has implemented the most stringent mobile source emissions control program in the nation. ARB's comprehensive program relies on four fundamental approaches:

- stringent emissions standards that minimize emissions from new vehicles and equipment;
- in-use programs that target the existing fleet and require the use of the cleanest vehicles and emissions control technologies;
- cleaner fuels that minimize emissions during combustion; and,
- incentive programs that remove older, dirtier vehicles and equipment and pay for early adoption of the cleanest available technologies.

This multi-faceted approach has spurred the development of increasingly cleaner technologies and fuels and achieved significant emission reductions across all mobile source sectors that go far beyond national programs or programs in other states. These efforts extend back to the first mobile source regulations adopted in the 1960s, and predate the federal Clean Air Act Amendments (Act) of 1970, which established the basic national framework for controlling air pollution. In recognition of the pioneering nature of ARB's efforts, the Act provides California unique authority to regulate mobile sources more stringently than the federal government by providing a waiver of preemption for its new vehicle emission standards under Section 209(b). This waiver provision preserves a pivotal role for California in the control of emissions from new motor vehicles, recognizing that California serves as a laboratory for setting motor vehicle emission standards. Since then, the ARB has consistently sought and obtained waivers and authorizations for its new motor vehicle regulations. ARB's history of progressively strengthening standards as technology advances, coupled with the waiver process requirements, ensures that California's regulations remain the most stringent in the nation. A list of regulatory actions ARB has taken since 1985 is provided at the end of this analysis to highlight the scope of ARB's actions to reduce mobile source emissions.

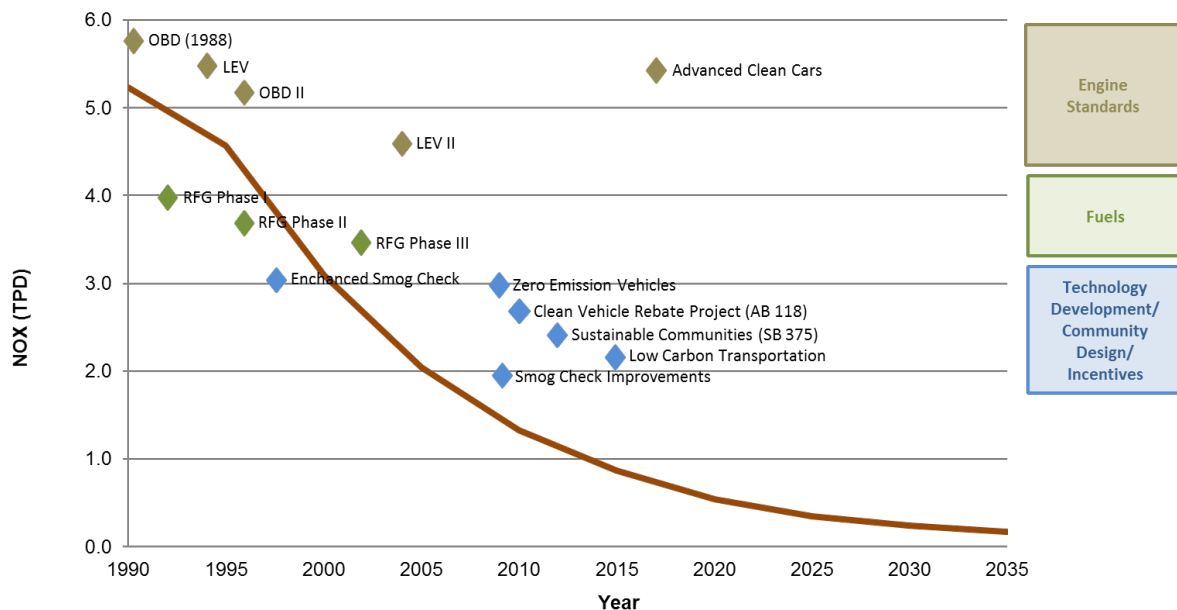
Recently, ARB adopted numerous regulations aimed at reducing exposure to diesel particulate matter and oxides of nitrogen, from freight transport sources like heavy duty diesel trucks, transportation sources like passenger cars and buses, and off-road sources like large construction equipment. Phased implementation of these regulations will produce increasing emission reduction benefits from now until 2024 and beyond, as the regulated fleets are retrofitted, and as older and dirtier portions of the fleets are replaced with newer and cleaner models at an accelerated pace.

Further, ARB and the Sacramento Non-attainment Area district staff work closely on identifying and distributing incentive funds to accelerate cleanup of engines. Key incentive programs include: The Carl Moyer Program; the Goods Movement Program; the Lower-Emission School Bus Program; and the Air Quality Improvement Program (AQIP). These incentive-based programs work in tandem with regulations to accelerate deployment of cleaner technology.

## II. LIGHT-DUTY VEHICLES, EMISSIONS STANDARDS, AND CLEAN FUEL

### A. Emission Reduction

Figure 1 illustrates the trend in NOx emissions from light-duty vehicles and key programs contributing to those reductions. As a result of these efforts, light-duty vehicle emissions in the WNNA have been reduced significantly since 1990 and will continue to go down through 2024 due to the benefits of ARB’s longstanding light-duty mobile source program. From today, light-duty vehicle NOx emissions are reduced by about 60 percent in 2024. Key light-duty programs include Advanced Clean Cars, On-Board Diagnostics, Reformulated Gasoline, Incentive Programs, and the Enhanced Smog Check Program.



**Figure 1: Key Programs to Reduce Light-Duty NOx Emissions**

Since setting the nation’s first motor vehicle exhaust emission standards in 1966 that led to the first pollution controls, California has dramatically tightened emission standards for light-duty vehicles. Through ARB regulations, today’s new cars pollute 99 percent less than their predecessors did thirty years ago. In 1970, ARB required auto manufacturers to meet the first standards to control NOx emissions along with hydrocarbon emissions. The simultaneous

control of emissions from motor vehicles and fuels led to the use of cleanerburning reformulated gasoline (RFG) that has removed the emissions equivalent of 3.5 million vehicles from California's roads. Since ARB first adopted it in 1990, the Low Emission Vehicle Program (LEV and LEV II) and Zero-Emission Vehicle (ZEV) Program have resulted in the production and sales of hundreds of thousands of zeroemission vehicles (ZEVs) in California.

## **B. Advanced Clean Cars**

ARB's groundbreaking Advanced Clean Cars (ACC) program is now providing the next generation of emission reductions in California, and ushering in a new zero emission passenger transportation system. The success of these programs is evident: California is the world's largest market for Zero Emission Vehicles (ZEVs), with over 21 models available today, and a wide variety are now available at lower price points, attracting new consumers. As of January 2015, Californians drive 40 percent of all ZEVs on the road in the United States, while the U.S. makes up about half of the world market. This movement towards commercialization of advanced clean cars has occurred due to ARB's ZEV regulation, part of ACC, which affects passenger cars and light-duty trucks.

ARB's ACC Program, approved in January 2012, is a pioneering approach of a 'package' of regulations that - although separate in construction - are related in terms of the synergy developed to address both ambient air quality needs and climate change. The ACC program combines the control of smog, soot causing pollutants and greenhouse gas emissions into a single coordinated package of requirements for model years 2015 through 2025. The program assures the development of environmentally superior cars that will continue to deliver the performance, utility, and safety vehicle owners have come to expect.

The ACC program approved by ARB in January 2012 also included amendments affecting the current ZEV regulation through the 2017 model year in order to enable manufacturers to successfully meet 2018 and subsequent model year requirements. These ZEV amendments are intended to achieve commercialization through simplifying the regulation and pushing technology to higher volume production in order to achieve cost reductions. The ACC Program benefits will increase over time as new cleaner cars enter the fleet displacing older and dirtier vehicles.

## **C. On Board Diagnostics**

California's first OBD regulation required manufacturers to monitor some of the emission control components on vehicles starting with the 1988 model year. In 1989, ARB adopted OBD II, which required 1996 and subsequent model year passenger cars, light-duty trucks, and medium-duty vehicles and engines to be equipped with second generation OBD systems. OBD systems are designed to identify when a vehicle's emission control systems or other emission-related computer-controlled components are malfunctioning, causing emissions to be elevated above the vehicle manufacturer's specifications. ARB subsequently strengthened OBD II

requirements and added OBD II specific enforcement requirements for 2004 and subsequent model year passenger cars, light-duty trucks, and medium-duty vehicles and engines.

#### **D. Reformulated Gasoline**

Since 1996, ARB has been regulating the formulation of gasoline resulting in California gasoline being the cleanest in the world. California's cleaner-burning gasoline regulation is one of the cornerstones of the State's efforts to reduce air pollution and cancer risk. Reformulated gasoline is fuel that meets specifications and requirements established by ARB. The specifications reduced motor vehicle toxics by about 40 percent and reactive organic gases by about 15 percent. The results from cleaning up fuel can have an immediate impact as soon as it is sold in the State. Vehicle manufacturers design low-emission emission vehicle to take full advantage of cleaner-burning gasoline properties.

#### **E. Incentive Programs**

There are a number of different incentive programs focusing on light-duty vehicles that produce extra emission reductions beyond traditional regulations. The incentive programs work in two ways, encouraging the retirement of dirty older cars and encouraging the purchase of a cleaner vehicle.

Voluntary accelerated vehicle retirement or "car scrap" programs provide monetary incentives to vehicle owners to retire older, more polluting vehicles. The purpose of these programs is to reduce fleet emissions by accelerating the turnover of the existing fleet and subsequent replacement with newer, cleaner vehicles. Both State and local vehicle retirement programs are available.

California's voluntary vehicle retirement program is administered by the Bureau of Automotive Repair (BAR) and provides \$1,000 per vehicle and \$1,500 for low-income consumers for unwanted vehicles that have either failed or passed their last Smog Check Test and that meet certain eligibility guidelines. This program is referred to as the Consumer Assistance Program.

The Enhanced Fleet Modernization Program (EFMP) was approved by the AB 118 legislation to augment the State's existing vehicle retirement program. Approximately \$30 million is available annually through 2015 to fund the EFMP via a \$1 increase in vehicle registration fees. ARB developed the program in consultation with BAR. The program is jointly administered by both BAR for vehicle retirement, and local air districts for vehicle replacement.

Other programs, in addition to vehicle retirement programs, help to clean up the lightduty fleet. The AQIP, established by AB 118, is an ARB voluntary incentive program to fund clean vehicle and equipment projects. The Clean Vehicle Rebate Project (CVRP) is one of the current projects under AQIP. CVRP, started in 2009, is designed to accelerate widespread commercialization of zero-emission vehicles and plug-in hybrid electric vehicles by providing consumer rebates up to

\$2,500 to partially offset the higher cost of these advanced technologies. The CVRP is administered statewide by the California Center for Sustainable Energy. In Fiscal Years 2009-2012, \$26.1 million, including \$2 million provided by the California Energy Commission, funded approximately 8,000 rebates. In June 2012, the ARB allocated up to \$15-21 million to the CVRP as outlined in the AQIP FY2012-2013 Funding Plan.

### III. HEAVY-DUTY TRUCKS, EMISSION STANDARDS, AND CLEAN FUEL

#### A. Emission Reduction

Figure 2 illustrates the trend in NOx emissions from heavy-duty vehicles and key programs contributing to those reductions. As a result of these efforts, heavy-duty vehicle emissions in the Sacramento Metropolitan Non-attainment Area have been reduced significantly since 1990 and will continue to go down through 2024 due to the benefits of ARB’s longstanding heavy-duty mobile source program. From today, heavy-duty NOx emissions are reduced by about 50 percent in 2024. Key programs include Heavy-Duty Engine Standards, Clean Diesel Fuel, Truck and Bus Regulation and Incentive Programs.

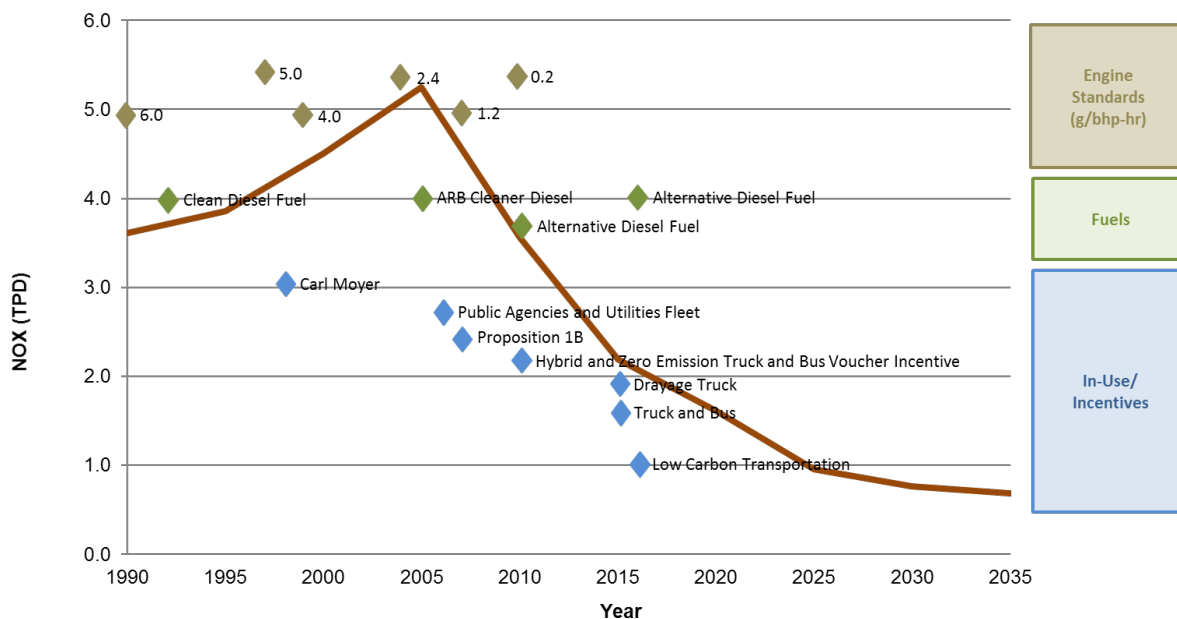


Figure 2: Key Programs to Reduce Heavy-Duty Emissions

#### B. Heavy-Duty Engine Standards

Since 1990, heavy-duty engine NOx emission standards have become dramatically more stringent, dropping from 6 grams per brake horsepowerhour (g/bhp-hr) in 1990 down to the current 0.2 g/bhp-hr standard, which took effect in 2010. In addition to mandatory NOx

standards, there have been several generations of optional lower NOx standards put in place over the past 15 years. Most recently in 2015, engine manufacturers can certify to three optional NOx emission standards of 0.1 g/bhp-hr, 0.05 g/bhp-hr, and 0.02 g/bhp-hr (i.e., 50 percent, 75 percent, and 90 percent lower than the current mandatory standard of 0.2 g/bhp-hr). The optional standards allow local air districts and ARB to preferentially provide incentive funding to buyers of cleaner trucks, to encourage the development of cleaner engines.

### **C. Clean Diesel Fuel**

Since 1993, ARB has required that diesel fuel have a limit on the aromatic hydrocarbon content and sulfur content of the fuel. Diesel powered vehicles account for a disproportionate amount of the diesel particulate matter which is considered a toxic air contaminant. In 2006, ARB required a low-sulfur diesel fuel to be used not only by on-road diesel vehicles but also for off-road engines. The diesel fuel regulation allows alternative diesel formulations as long as emission reductions are equivalent to the ARB formulation.

### **D. Cleaner In-Use Heavy-Duty Trucks (Truck and Bus Regulation)**

The Truck and Bus Regulation was first adopted in December 2008. This rule represents a multi-year effort to turn over the legacy fleet of engines and replace them with the cleanest technology available. In December 2010, ARB revised specific provisions of the in-use heavy-duty truck rule, in recognition of the deep economic effects of the recession on businesses and the corresponding decline in emissions.

Starting in 2012, the Truck and Bus Regulation phases in requirements applicable to an increasingly larger percentage of the truck and bus fleet over time, so that by 2023 nearly all older vehicles would need to be upgraded to have exhaust emissions meeting 2010 model year engine emissions levels. The regulation applies to nearly all dieselfueled trucks and buses with a gross vehicle weight rating (GVWR) greater than 14,000 pounds that are privately or federally owned, including on-road and off-road agricultural yard goats, and privately and publicly owned school buses. Moreover, the regulation applies to any person, business, school district, or federal government agency that owns, operates, leases or rents affected vehicles. The regulation also establishes requirements for any in-state or out-of-state motor carrier, California-based broker, or any California resident who directs or dispatches vehicles subject to the regulation. Finally, California sellers of a vehicle subject to the regulation would have to disclose the regulation's potential applicability to buyers of the vehicles. Approximately 170,000 businesses in nearly all industry sectors in California, and almost a million vehicles that operate on California roads each year are affected. Some common industry sectors that operate vehicles subject to the regulation include: for-hire transportation, construction, manufacturing, retail and wholesale trade, vehicle leasing and rental, bus lines, and agriculture.

ARB compliance assistance and outreach activities that are key in support of the Truck and Bus Regulation include:

- The Truck Regulations Upload and Compliance Reporting System, an online reporting tool developed and maintained by ARB staff;
- The Truck and Bus regulation’s fleet calculator, a tool designed to assist fleet owners in evaluating various compliance strategies;
- Targeted training sessions all over the State; and
- Out-of-state training sessions conducted by a contractor.

ARB staff also develops regulatory assistance tools, conducts and coordinates compliance assistance and outreach activities, administers incentive programs, and actively enforces the entire suite of regulations. Accordingly, ARB’s approach to ensuring compliance is based on a comprehensive outreach and education effort.

### **E. Incentive Programs**

There are a number of different incentive programs focusing on heavy-duty vehicles that produce extra emission reductions beyond traditional regulations. The incentive programs encourage the purchase of a cleaner truck.

Several State and local incentive funding pools have been used historically -- and remain available -- to fund the accelerated turnover of on-road heavyduty vehicles. Since 1998, the Carl Moyer Program (Moyer Program) has provided funding for replacement, new purchase, repower and retrofit of trucks. Beginning in 2008, the Goods Movement Emission Reduction Program funded by Proposition 1B has funded cleaner trucks for the region’s transportation corridors; the final increment of funds will implement projects in through 2018.

The Air Quality Improvement Program has funded the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) since 2010, and continued Northern Sierra Air Quality Management District participation is expected. ARB has also administered a Truck Loan Assistance Program since 2009.

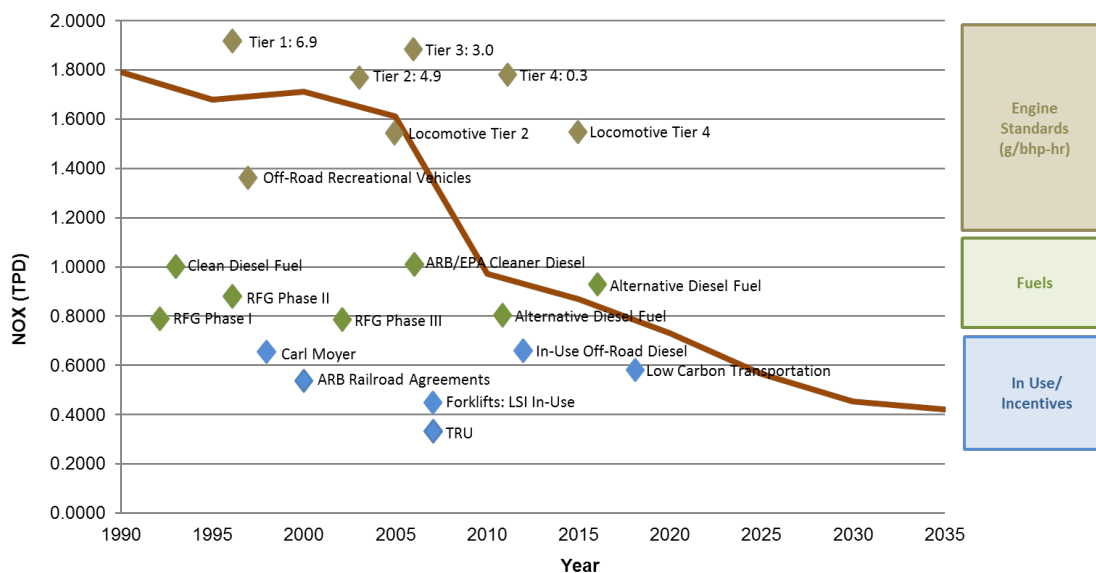
## **IV. OFF-ROAD SOURCES, EMISSION STANDARDS, AND CLEAN FUEL**

### **A. Emission Reduction**

Off-road sources encompass equipment powered by an engine that does not operate on the road. Sources vary from ships to lawn and garden equipment and for example, include sources like locomotives, aircraft, tractors, harbor craft, off-road recreational vehicles, construction equipment, forklifts, and cargo handling equipment.

Figure 3 illustrates the trend in NOx emissions from off-road equipment and key programs contributing to those reductions. As a result of these efforts, off-road emissions in the WNNA have been reduced significantly since 1990 and will continue to go down through 2024 due to the

benefits of ARB’s and U.S. EPA longstanding programs. From today, off-road NOx emissions are reduced by about 25 percent in 2024. Key programs include Off-Road Engine Standards, Locomotive Engine Standards, Clean Diesel Fuel, Cleaner In-Use Off-Road Regulation and In-Use LSI Fleet Regulation.



**Figure**

### 3: Key Programs to Reduce Off-Road Emissions

#### B. Off-Road Engine Standards

The Clean Air Act preempts states, including California, from adopting requirements for new offroad engines less than 175 HP used in farm or construction equipment. California may adopt emission standards for in-use off-road engines pursuant to Section 209(e)(2), but must receive authorization from U.S. EPA before it may enforce the adopted standards.

The Board first approved regulations to control exhaust emissions from small off-road engines (SORE) such as lawn and garden equipment in December 1990 with amendments in 1998 and 2003. These regulations were implemented through three tiers of progressively more stringent exhaust emission standards that were phased in between 1995 and 2008.

Manufacturers of forklift engines are subject to new engine standards for both diesel and Large Spark Ignition (LSI) engines. Off-road diesel engines were first subject to engine standards and durability requirements in 1996 while the most recent Tier 4 Final emission standards were phased in starting in 2013. Tier 4 emission standards are based on the use of advanced after-treatment technologies such as diesel particulate filters and selective catalytic reduction. LSI



engines have been subject to new engine standards that include both criteria pollutant and durability requirements since 2001 with the cleanest requirements phased-in starting in 2010.

### **C. Locomotive Engine Standards**

The Clean Air Act and the U.S. EPA national locomotive regulations expressly preempt states and local governments from adopting or enforcing “any standard or other requirement relating to the control of emissions from new locomotives and new engines used in locomotives” (U.S. EPA interpreted new engines in locomotives to mean remanufactured engines, as well). U.S. EPA has approved two sets of national locomotive emission regulations (1998 and 2008). In 1998, U.S. EPA approved the initial set of national locomotive emission regulations. These regulations primarily emphasized NO<sub>x</sub> reductions through Tier 0, 1, and 2 emission standards. Tier 2 NO<sub>x</sub> emission standards reduced older uncontrolled locomotive NO<sub>x</sub> emissions by up to 60 percent, from 13.2 to 5.5 g/bhphr.

In 2008, U.S. EPA approved a second set of national locomotive regulations. Older locomotives upon remanufacture are required to meet more stringent particulate matter (PM) emission standards which are about 50 percent cleaner than Tier 0-2 PM emission standards. U.S. EPA refers to the PM locomotive remanufacture emission standards as Tier 0+, Tier 1+, and Tier 2+. The new Tier 3 PM emission standard (0.1 g/bhphr), for model years 2012-2014, is the same as the Tier 2+ remanufacture PM emission standard. The 2008 regulations also included new Tier 4 (2015 and later model years) locomotive NO<sub>x</sub> and PM emission standards. The U.S. EPA Tier 4 NO<sub>x</sub> and PM emission standards further reduced emissions by approximately 95 percent from uncontrolled levels.

### **D. Clean Diesel Fuel**

Since 1993, ARB has required that diesel fuel have a limit on the aromatic hydrocarbon content and sulfur content of the fuel. Diesel powered vehicles account for a disproportionate amount of the diesel particulate matter which is considered a toxic air contaminant. In 2006, ARB required a low-sulfur diesel fuel to be used not only by on-road diesel vehicles but also for off-road engines. The diesel fuel regulation allows alternative diesel formulations as long as emission reductions are equivalent to the ARB formulation.

### **E. Cleaner In-Use Off-Road Equipment (Off-Road Regulation)**

The Off-Road Regulation which was first approved in 2007 and subsequently amended in 2010 in light of the impacts of the economic recession. These offroad vehicles are used in construction, manufacturing, the rental industry, road maintenance, airport ground support and landscaping. In December 2011, the OffRoad Regulation was modified to include on-road trucks with two diesel engines.

The Off-Road Regulation will significantly reduce emissions of diesel PM and NOx from the over 150,000 in-use offroad diesel vehicles that operate in California. The regulation affects dozens of vehicle types used in thousands of fleets by requiring owners to modernize their fleets by replacing older engines or vehicles with newer, cleaner models, retiring older vehicles or using them less often, or by applying retrofit exhaust controls.

The Off-Road Regulation imposes idling limits on off-road diesel vehicles, requires a written idling policy, and requires a disclosure when selling vehicles. The regulation also requires that all vehicles be reported to ARB and labeled, restricts the addition of older vehicles into fleets, and requires fleets to reduce their emissions by retiring, replacing, or repowering older engines, or installing verified exhaust retrofits. The requirements and compliance dates of the Off-Road Regulation vary by fleet size.

Fleets will be subject to increasingly stringent restrictions on adding older vehicles. The regulation also sets performance requirements. While the regulation has many specific provisions, in general by each compliance deadline, a fleet must demonstrate that it has either met the fleet average target for that year, or has completed the Best Available Control Technology requirements. The performance requirements of the Off-Road Regulation are phased in from January 1, 2014 through January 1, 2019.

Compliance assistance and outreach activities in support of the Off-Road Regulation include:

- The Diesel Off-road On-line Reporting System, an online reporting tool developed and maintained by ARB staff.
- The Diesel Hotline (866-6DIESEL), which provides the regulated public with questions about the regulations and access to ARB staff. Staff is able to respond to questions in English, Spanish and Punjabi.
- The Off-road Listserv, providing equipment owners and dealerships with timely announcement of regulatory changes, regulatory assistance documents, and reminders for deadlines.

## **F. LSI In-Use Fleet Regulation**

Forklift fleets can be subject to either the LSI fleet regulation, if fueled by gasoline or propane, or the off-road diesel fleet regulation. Both regulations require fleets to retire, repower, or replace higher-emitting equipment in order to maintain fleet average standards. The LSI fleet regulation was originally adopted in 2007 with requirements beginning in 2009. While the LSI fleet regulation applies to forklifts, tow tractors, sweeper/scrubbers, and airport ground support equipment, it maintains a separate fleet average requirement specifically for forklifts. The LSI fleet regulation requires fleets with four or more LSI forklifts to meet fleet average emission standards.