Appendix IV-B

Air Quality Management Plan

Proposed 8-Hour Ozone Measures

February 2013

South Coast Air Quality Management District
Cleaning the air that we breathe...™

FINAL 2012 AQMP
APPENDIX IV-B

PROPOSED 8-HOUR OZONE MEASURES

FEBRUARY 2013

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EXECUTIVE OFFICER:

BARRY R. WALLERSTEIN, D.Env.

CONTRIBUTORS

Barry R. Wallerstein, D.Env.
Executive Officer

Elaine Chang, DrPH
Deputy Executive Officer
Planning, Rule Development, & Area Sources

Chung S. Liu, D.Env.
Deputy Executive Officer
Science & Technology Advancement

Laki Tisopulos, Ph.D., P.E.
Assistant Deputy Executive Officer
Planning, Rule Development, & Area Sources

Henry Hogo
Assistant Deputy Executive Officer
Mobile Source Division
Science & Technology Advancement

Authors

Science & Technology Advancement

Randall Pasek, Ph.D., P.E., Planning and Rules Manager
Dean Saito, Planning and Rules Manager

Lori Berard, Air Quality Specialist
Phil Barroca, Air Quality Specialist
Richard Carlson, Air Quality Specialist
David Coel, Program Supervisor
Wei Li, Air Quality Specialist
Adewale Oshinuga, Program Supervisor

Reviewed By

Barbara Baird, District Counsel
Peter Greenwald, Sr. Policy Advisor
Matt Miyasato, Ph.D., Assistant Deputy Executive Officer,
Technology Advancement Office,
Science and Technology Advancement

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SECTION 1
INTRODUCTION

INTRODUCTION

The 2007 State Implementation Plan (SIP) for the 8-hour National Ambient Air Quality Standard (NAAQS) contains commitments for emission reductions from mobile sources that rely on advancement of technologies, as authorized under Section 182(e)(5) of the federal Clean Air Act. These measures, which have come to be known as the "black box," account for a substantial portion of the NOx emission reductions needed to attain the federal ozone standards – over 200 tons/day. The deadlines to reduce ozone concentrations in the region are 2023 (to attain the 80 ppb NAAQS) and 2032 (to attain 75 ppb NAAQS)[1]. Attaining these standards will require reductions in emissions of nitrogen oxides (NOx) well beyond reductions resulting from current rules, programs and commercially-available technologies.

Mobile sources emit over 80 percent of regional NOx and therefore must be the largest part of the solution. On-road truck categories are projected to comprise the single largest contributor to regional NOx in 2023. Other equipment involved in goods movement, such as marine vessels, locomotives and aircraft, are also substantial NOx sources.

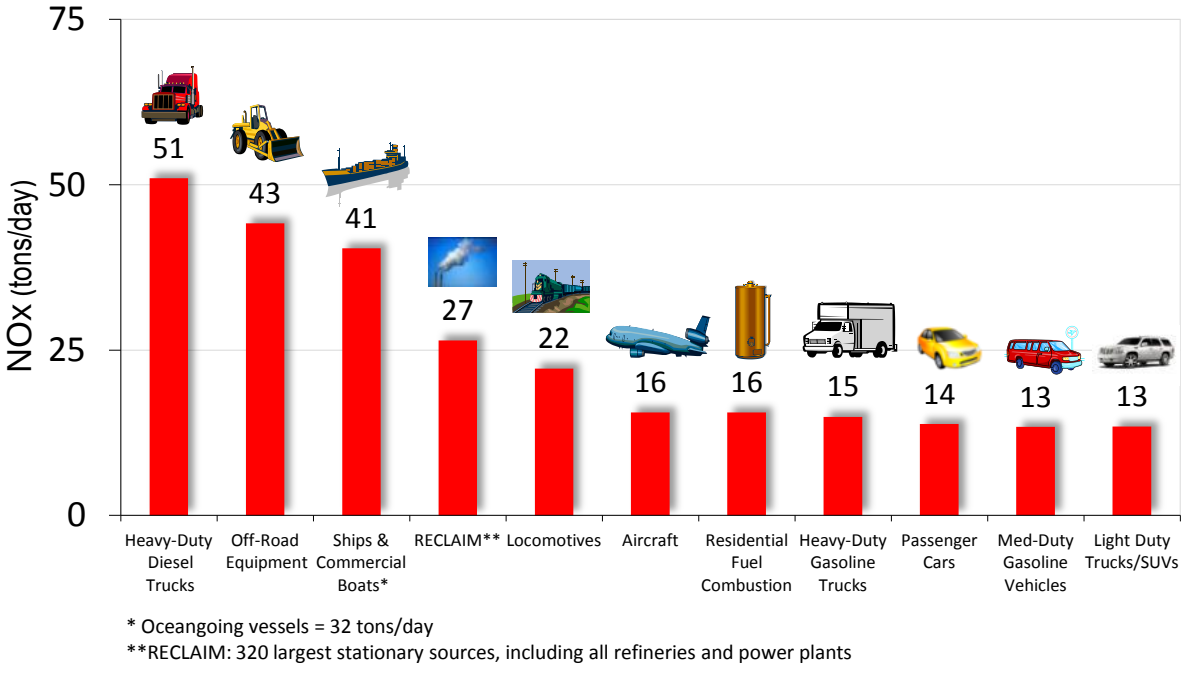

FIGURE IV-B-1
Top NOx Emissions Categories in 2023 in the South Coast Air Basin, Annual Average (tpd)

[1] The attainment deadline for the 75 ppb standard (adopted in 2008) has been established by U.S. EPA for extreme nonattainment areas by December 31, 2032.

Preliminary District staff projections indicate that **the region must reduce regional NOx emissions by about 65 percent by 2023, and 75 percent by 2032, to attain the national ozone standards as required by federal law.**

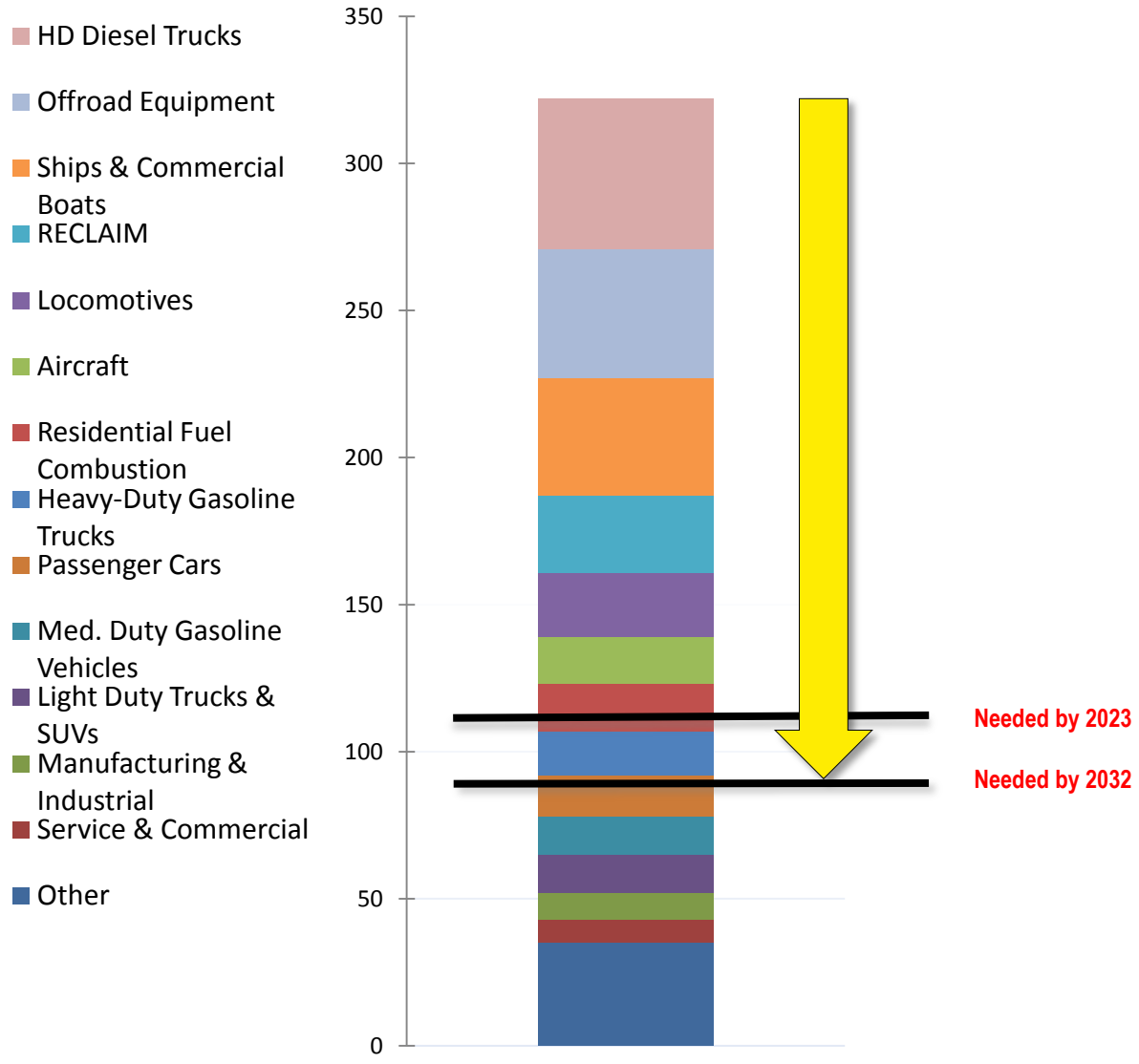

FIGURE IV-B-2

Needed NOx Emission Reductions to Achieve Federal 8-Hour Ozone Ambient Air Quality Standards

Since NOx emissions from most significant sources are already controlled by over 90%, **attainment of the ozone standards will require broad deployment of zero- and near-zero[2] emission technologies in the 2023 to 2032 timeframe.** On-land transportation sources such as trucks, locomotives and cargo handling equipment have technological potential to achieve zero- and near-zero emission levels. Current and potential technologies include hybrid-electric, hybrid with all electric range, battery-electric, and hydrogen fuel cell on-road vehicle technologies. New types of hybrids could also serve long-term needs while providing additional fuel diversity. These could include, for example, natural gas-electric hybrid technologies for on-road and other applications, particularly if coupled with improved aftertreatment technologies. Equipment powered solely by alternative fuels such as natural gas may also play a long-term role in some applications, if those applications are found to pose technological barriers to achieving zero- or near-zero emissions. Even in such applications, however, substantial additional emission reductions will be needed through development of new, advanced aftertreatment technologies. In addition, alternative fuels will likely play a transitional near-term role. Alternative fuels such as natural gas have historically helped the region make progress toward attaining air quality standards, and -- while not achieving zero- or near-zero NOx emission levels -- they are generally cleaner than conventional fuels. Given the region's need to attain air quality standards in a few short years, alternative-fueled engines will continue to play a role. Finally, we emphasize that air quality regulatory agencies have traditionally set policies and requirements that are performance-based and technology and fuel neutral -- a policy that the District intends to continue. In short, all technologies and fuels should be able to compete on equal footing to meet environmental needs.

While there has been much progress in developing and deploying transportation technologies with zero- and near-zero emissions (particularly for light-duty vehicles and passenger transit), additional technology development, demonstration and commercialization will be required prior to broad deployment in freight and other applications. This Appendix describes a path to evaluate, develop, demonstrate, fund and deploy such technologies for land-based transportation sources. It also proposes

[2] The term "near-zero emissions" refers to emissions approaching zero and will be delineated for individual source categories through the process of developing the Air Quality Management Plan/State Implementation Plan. Based on current analyses, on-land transportation sources will need to achieve zero emissions where possible, and otherwise will need to be substantially below adopted emission standards — including standards with future effective dates. Near-zero emissions technologies can help meet this need, particularly if they support a path toward zero emissions (e.g., electric/fossil fuel hybrids with all- electric range).

near-term measures to accelerate fleet turnover to the lowest emission units, and require deployment of zero-emission technologies where most feasible.

The District staff believes that a combination of regulatory actions and public funding is the most effective means of achieving these emission reductions. Voluntary incentive programs such as the Carl Moyer Program can help to accelerate turnover to the cleanest commercially-available equipment. A majority of the on-road and off-road measures proposed are based on existing funding programs implemented by the District or the California Air Resources Board. However, several of the existing funding programs will sunset in the 2014 – 2015 timeframe. Continued funding beyond 2015 will be needed to reduce the emissions associated with the black box. Developing, demonstrating and deploying new technologies will require public/private partnerships and, in some cases, regulatory actions.

The measures described in this appendix are relatively small down payments on the total emission reductions needed to attain the current NAAQS for ozone. The measures in this section are feasible steps that must be commenced in the near-term to establish a path toward broader transition to the technologies that will be needed to attain federal air quality standards. Between now and 2015, the District will flesh out in greater detail the additional measures needed to attain the ozone NAAQS. The federal Clean Air Act requires the state to submit an ozone attainment plan for the 75 ppb ozone NAAQS by 2015. In addition, with the 2023 attainment deadline for the 80 ppb ozone NAAQS approaching, the District needs to specify plan measures to timely attain that standard, something which the District intends to also adopt as part of the 2015 plan update. Given the magnitude of needed emission reductions, and the time remaining until attainment deadlines, **it is important that progress and momentum to identify, develop and deploy needed technologies be sustained and accelerated.**

The District staff recognizes these are very difficult policy choices the Basin is facing. Transitioning over the next 10 to 20 years to cleaner transportation technologies will involve major costs and effects on the economy. However, adopting sufficient plan measures to attain the ozone air quality standard by 2024 is required by federal law, and failing to do so is, therefore, not an acceptable public policy. Such failure would also risk adverse health consequences highlighted in recent health studies, not to mention the potentially adverse economic impacts on the region due to potential federal sanctions. The following sections further describe the measures to help reduce the emissions associated with the black box.

SECTION 2

PROPOSED 8-HOUR OZONE MEASURES

INTRODUCTION

District staff analyzed the need to accelerate the penetration of cleaner engine technologies in various mobile source sectors. This Section describes the District staff's proposals for additional mobile source emission reductions towards achieving the 8-hour ozone ambient air quality standard by 2023 to be included in the 2012 Final AQMP. The early action measures presented in this appendix are based upon a variety of control technologies that are commercially available and/or technologically feasible to implement in the next several years. The focus of these measures includes accelerated retrofits or replacement of existing vehicles or equipment, acceleration of vehicle turnover through voluntary vehicle retirement programs, and greater use of cleaner fuels in the near-term. In the longer-term, in order to attain the federal ozone ambient air quality standard, there is a need to increase the penetration and deployment of near-zero and zero-emission vehicles such as plug-in hybrids, battery-electric, and fuel cells; further the use of cleaner fuels (either alternative fuels or new formulations of gasoline and diesel fuels); and obtain additional emission reductions from aircraft engines.

PROPOSED MEASURES

Ten early action measures are proposed by the District staff for mobile sources and seven additional early action measures are proposed to accelerate near-zero and zero-emission technologies for goods movement related sources. The early action mobile source measures call for greater emission reductions through significant increase in the turnover of older vehicles to the cleanest vehicles currently available with an emphasis on zero-emission vehicles. In addition, actions are identified for earlier deployment of near-zero and zero-emission technologies in the goods movement sector. A summary of the 17 measures is provided in Table 1.

TABLE IV-B-1

Proposed Mobile Source Implementation Measures

ON-ROAD MOBILE SOURCE MEASURES	
Number	**Title**
ONRD-01	Accelerated Penetration of Partial Zero-Emission and Zero-Emission Vehicles [VOC, NOx, CO]
ONRD-02	Accelerated Retirement of Older Light- and Medium-Duty Vehicles [VOC, NOx, CO]
ONRD-03	Accelerated Penetration of Partial Zero-Emission and Zero-Emission Light-Heavy- and Medium-Heavy-Duty Vehicles [NOx, PM]
ONRD-04	Accelerated Retirement of Older On-Road Heavy-Duty Vehicles [NOx, PM]

TABLE IV-B-1 (concluded)

Proposed Mobile Source Implementation Measures

ON-ROAD MOBILE SOURCE MEASURES	
Number	**Title**
ONRD-05	Further Emission Reductions from Heavy-Duty Vehicles Serving Near-Dock Railyards [NOx, PM]
OFF-ROAD MOBILE SOURCE MEASURES	
Number	**Title**
OFFRD-01	Extension of the SOON Provision for Construction/Industrial Equipment [NOx]
OFFRD-02	Further Emission Reductions from Freight Locomotives [NOx, PM]
OFFRD-03	Further Emission Reductions from Passenger Locomotives [NOx, PM]
OFFRD-04	Further Emission Reductions from Ocean-Going Marine Vessels While at Berth [All Pollutants]
OFFRD-05	Emission Reductions from Ocean-Going Marine Vessels [NOx, PM]
ACTIONS TO DEPLOY ADVANCED CONTROL TECHNOLOGIES	
Number	**Title**
ADV-01	Actions for the Deployment of Zero- and Near-Zero Emission On-Road Heavy-Duty Vehicles [NOx, PM]
ADV-02	Actions for the Deployment of Zero-Emission and Near-Zero Emission Locomotives [NOx, PM]
ADV-03	Actions for the Deployment of Zero- Emission and Near-Zero Emission Cargo Handling Equipment [NOx, PM]
ADV-04	Actions for the Deployment of Cleaner Commercial Harbor Craft [NOx, PM]
ADV-05	Actions for the Deployment of Cleaner Ocean-Going Marine Vessels [NOx, PM]
ADV-06	Actions for the Deployment of Cleaner Off-Road Equipment [NOx, PM]
ADV-07	Actions for the Deployment of Cleaner Aircraft Engines [NOx, PM]

On-Road Mobile Source Measures

The District staff is proposing five on-road mobile source control measures. The focus of the first two measures is on-road light- and medium-duty vehicles operating in the South Coast Air Basin. By 2023, it is estimated that about 12 million vehicles will be operating in the Basin. The first measure would implement programs to accelerate the penetration and deployment of partial zero-emission and zero-emission vehicles in the light- and medium-duty vehicles categories. The second control measure would seek to accelerate retirement of older gasoline- and diesel-powered vehicles up to 8,500 gross

vehicle weight (GVW). These vehicles include passenger cars, sports utility vehicles, vans, and light-duty pick-up trucks.

The remaining three measures focus on heavy-duty vehicles. The first of these measures seeks additional emission reductions from the early deployment of partial zero-emission and zero-emission light- and medium-heavy-duty vehicles with gross vehicle weights between 8,501 pounds to 26,000 pounds. The fourth control measure for heavy-duty vehicles seeks additional emissions reductions from older, pre-2010 heavy-duty vehicles beyond the emission reductions targeted in CARB's Truck and Bus Regulation. Additional emission reductions could be achieved if an additional percentage of the oldest, pre-2010 heavy-duty vehicles, not subject to the Truck and Bus Regulation, are targeted. The fifth on-road measure seeks emission reductions at near-dock railyards through the deployment of zero-emission heavy-duty vehicles.

Off-Road Mobile Source Measures

The District staff is proposing five control measures that seek further emission reductions from off-road mobile sources and industrial equipment. Transportation sources such as aircraft, locomotives, and marine vessels are associated with anticipated economic growth not only in the Basin, but also nationwide. These sources are principally regulated by federal and state agencies. Certain local actions can result in emission reductions beyond the emissions standard setting authority of the state and U.S. EPA. The first measure calls for the continuation of the Surplus Off-Road Opt-In for NOx (SOON) provision of the statewide In-Use Off-Road Diesel-Fueled Fleets Regulation beyond 2014. The SOON provision implemented to-date has realized additional NOx reductions beyond the statewide regulation. The second and third measures call for additional emission reductions from freight and passenger locomotives. The fourth measure seeks additional emission reductions from ocean-going vessels while at berth. The fifth early action measure recognizes the efforts that the Ports of Los Angeles and Long Beach are implementing to incentivize cleaner Tier 2 and Tier 3 ocean-going vessels to call at the ports.

Actions to Deploy Advanced Control Technologies

The District staff is proposing seven additional measures to deploy the cleanest control technologies as early as possible and the development and deployment of near-zero and zero-emission technologies. Many of these actions have already begun. However, additional research and development will be needed that will lead to commercial deployment of control technologies that achieve emission levels below current adopted

emission standards. Other near-zero and zero-emission technologies that are commercially available will require infrastructure development to facilitate their deployment.

The term "near-zero" technology is not defined in these actions. The term's specific meaning could depend on the source category and feasible technologies. The actions needed to deploy zero-emission technologies, "near-zero" emission technologies, and the next generation of cleaner combustion engines will be discussed in the development of the proposed control measures in future AQMPs. To initiate the development of cleaner engines (either through in-cylinder or aftertreatment controls or in combination with hybrid systems that lead to further criteria pollutant emission reductions), District staff is proposing that optional NOx standards be adopted. Having such optional standards will facilitate the early development of cleaner technologies and to deploy these technologies as soon as possible. Several of the technologies to achieve emission levels lower than current standards, or zero-emission levels, are currently available and are potentially transferrable to various vehicle vocations and in-use applications. However, further research and demonstration of many of these technologies is needed to evaluate their performance prior to commercialization.

The District staff, U.S. Department of Energy, U.S. Environmental Protection Agency, Federal Aviation Administration, California Air Resources Board, California Energy Commission, engine manufacturers, advanced engine control developers, and electric hybrid system developers have been discussing potential technologies to further reduce engine exhaust emissions or eliminate exhaust emissions entirely. Public forums such as technology symposiums will be used to solicit public input on technology development as part of the proposed actions.

FORMAT OF IMPLEMENTATION MEASURES

Included in each control measure description is a title, summary table, description of source category (including background and regulatory history), proposed method of control, estimated emission reductions, discussion of rule compliance, identification of test methods, estimated cost effectiveness, and references. The type of information that can be found under each of these subheadings is described below.

Implementation Measure Number

Each measure is identified by a measure number such as "CM #ONRD-04" located at the upper right hand corner of every page. "CM #" is the abbreviation for the "control measure number" and is immediately followed by the year of the AQMP revision.

The next three- to five-letter designation represents the abbreviation for a source category or specific programs. For example, "ONRD" is an abbreviation for "On-Road Mobile Sources." The following provides a description of the abbreviations for each of the measures.

- ONRD On-Road Mobile Sources for the South Coast Air Basin
- OFFRD Off-Road Mobile Sources for the South Coast Air Basin
- ADV Actions to Deploy Advanced Control Technologies

Summary Table

Each measure contains a table that summarizes the measure and is designed to identify the key components of the measure. The table contains a brief explanation of the source category, control method, emission reductions, control costs, and implementing agency.

Description of Source Category

This section provides an overall description of the source category and the intent of the early action measure. The source category is presented in two sections, background and regulatory history. The background has basic information about the control measure such as the number of sources in the Basin, description of emission sources, and targeted pollutants.

The regulatory history contains information regarding existing regulatory control of the source category such as applicable state or federal rules or regulations and whether the source category was identified in the 2007 or prior AQMPs.

Proposed Method of Control

The purpose of this section is to describe the actions over the next several years and beyond. Relative to the "ADV" measures, this section reflects actions to be taken to further develop zero- and near-zero emission technologies or advanced control technologies that will lead to further emission reductions.

Emissions Reduction

The emission reductions are estimated based on the baseline inventories prepared for the 2012 AQMP and are provided in the Control Measure Summary Table. The emissions data are based on the annual average inventory for all five criteria pollutants. The planning inventory adjusts the emissions by taking into consideration a source category's

seasonal variations. The emissions affecting ozone concentration (i.e., VOC and NO_x) are presented under the Summer Planning Inventory. The emissions section of the summary table includes the 2008 and 2023 inventories. The 2023 emission projections reflect implementation of adopted rules. Based on the expected reductions associated with implementing the measure, emissions data are calculated for 2023 assuming the implementation of the early actions in the absence of other competing measures.

The emission reductions listed in the summary table represent the current best estimates, which are subject to change as the actions are implemented. For three of the measures, ONRD-05, OFFRD-01, and OFFRD-02, emissions reductions are also reported based on the projected 2023 emissions inventory provided in the 2007 SIP since the reductions are associated with the Section 182(e)(5) emission reduction commitments in the 2007 SIP.

Rule Compliance

This section was designed to satisfy requirements in the 1990 Clean Air Act in which EPA has indicated that it is necessary to have a discussion of rule compliance with each control measure. This section discusses the recordkeeping and monitoring requirements envisioned for the control measure. In general, the District would continue to verify rule compliance through site inspections and submittal of compliance plans.

Test Methods

In addition to requiring recordkeeping and monitoring requirements, U.S. EPA has stated that "An enforceable regulation must also contain test procedures in order to determine whether sources are in compliance." This section of the measure write-up identifies appropriate approved District, ARB, and EPA source test methods, where currently available.

Cost Effectiveness

The Discounted Cash Flow (DCF) method is used to calculate the cost-effectiveness of each measure. As measures undergo the rule making process, more detailed control costs will be developed.

The cost effectiveness values contained herein may overestimate actual levels because of a number of factors. As additional information on costs and more accurate numbers of affected entities becomes available, the cost effectiveness will be revised and analyzed in the socioeconomic assessment report of the 2012 AQMP.

Implementing Agency

This section identifies the agency(ies) responsible for implementing the measure or may have an ability to implement the measure. Also included in this section is a description of any jurisdictional issues that may affect the measure's implementation. Relative to the "ADV" measures, entities identified in this section are envisioned to work collaboratively to advance the development and commercialization of zero- and near-zero emission technologies or advanced engine control technologies that will lead to further emission reductions. For measures that involve voluntary incentive programs, agency(ies) identified have historically implemented such programs or may be recipients of funds to implement such programs. It is envisioned that the same agencies will implement the measure if funds are available to the implementing agency.

References

This section identifies directly cited references, or those references used for general background information.

GROUP 1

ON-ROAD MOBILE SOURCE MEASURES

ONRD-01: ACCELERATED PENETRATION OF PARTIAL ZERO-EMISSION AND ZERO-EMISSION VEHICLES [VOC, NOX, CO]

CONTROL MEASURE SUMMARY		
SOURCE CATEGORY:	GASOLINE- AND DIESEL-POWERED ON-ROAD VEHICLES WITH GROSS VEHICLE WEIGHT RATING UP TO 8,500 LBS	
CONTROL METHODS:	INCENTIVES FOR PARTIAL ZERO-EMISSIONS VEHICLES AND ZERO-EMISSIONS VEHICLES	
EMISSIONS (TONS/DAY):		
ANNUAL AVERAGE	**2008**	**2023**
VOC INVENTORY	165.9	49.0
VOC REDUCTION		TBD*
VOC REMAINING		TBD
NOX INVENTORY	167.8	40.7
NOX REDUCTION		TBD*
NOX REMAINING		TBD
CO INVENTORY	1,641.9	462.6
CO REDUCTION		TBD*
CO REMAINING		TBD
PLANNING INVENTORY (SUMMER FOR VOC AND NOX; WINTER FOR CO)	**2008**	**2023**
VOC INVENTORY	169.9	51.1
VOC REDUCTION		TBD*
VOC REMAINING		TBD
NOX INVENTORY	149.4	36.3
NOX REDUCTION		TBD*
NOX REMAINING		TBD
CO INVENTORY	1,621.0	454.2
CO REDUCTION		TBD*
CO REMAINING		TBD
CONTROL COST:	TBD. MINIMUM INCENTIVES FUNDING - $5,000,000/YEAR	
IMPLEMENTING AGENCY:	CARB, SCAQMD	

* Emission reductions will be determined after projects are identified and implemented.

DESCRIPTION OF SOURCE CATEGORY

The purpose of this early action measure is to seek emission reductions from existing passenger cars, sports utility vehicles, and other light- and medium-duty vehicles through the increased use

of partial zero-emission and zero-emission vehicles that would provide substantial improvements in emissions performance beyond current conventional gasoline and diesel vehicle technologies. This measure would continue the use of voluntary incentive programs that would facilitate the commercial deployment of plug-in hybrid-electric, battery-electric, and fuel cell vehicles.

Background

Emissions from passenger vehicles continue to represent a significant portion of the emissions inventory in the South Coast Air Basin, adversely affecting regional air quality. The intent of this measure is to specifically mitigate impacts associated with passenger car emissions through early deployment of partial-zero- and zero-emission vehicles that are currently available commercially or expected to be offered commercially in the next two to three years.

Regulatory History

To address California's acute air quality problems, the federal Clean Air Act provides California the authority to adopt and enforce rules to control mobile source emissions within California. The California Air Resources Board (CARB) is the responsible agency to adopt emissions standards that are as stringent or more stringent than federal requirements.

Significant strides have been made in reducing emissions from motor vehicles through CARB's mobile source regulations that apply predominately to new vehicles. As a result, a "new" vehicle today is approximately 99% less polluting compared to a vehicle manufactured a couple of decades ago. However, on-road and off-road mobile sources account for about 70 percent of ozone precursor emissions in the State. Because of the large emissions contribution, requiring the use of advanced technology such as plug-in hybrid electric vehicle technology capable of zero-emission transportation is essential if clean air standards are to be realized, especially for in-use vehicles. In January 2012, CARB adopted amendments to the Low-Emission Vehicle (LEV) program and the Zero-Emission Vehicle (ZEV) regulation.

In addition, CARB implements a "Clean Vehicle Rebate Project" (CVRP) that provides individual vehicle incentives of up to $2,500 for full zero-emission vehicles; $1,500 for plug-in hybrid vehicles; $900 for neighborhood electric vehicles; and $900 for zero-emission motorcycles. For the 2011/2012 fiscal year, a total of $15 million was allocated statewide.

PROPOSED METHOD OF CONTROL

This measure proposes to continue the CVRP through 2023 with a minimum number of 1,000 vehicles per year to be incentivized through the CVRP. The proposed incentives would be up to $5,000 per vehicle. As part of this action, additional funding opportunities will be sought.

EMISSIONS REDUCTION

Emission reductions are not estimated at this time and will depend on the actual number of vehicles participating in the program.

RULE COMPLIANCE AND TEST METHODS

Not applicable.

COST EFFECTIVENESS

This proposed control measure will affect light- and medium-duty vehicles with gross vehicle weight ratings up to 8,500 lbs. The estimated funding level is $5 million per year to incentivize a minimum of 1,000 vehicles per year.

The cost effectiveness of this control measure has not been estimated at this time. The cost effectiveness will be affected by any changes to the per-vehicle incentive levels or if total funding levels are not realized.

IMPLEMENTING AGENCY

CARB is currently implementing the AB118 CVRP. This early action measure would continue the implementation of the CVRP.

REFERENCES

CARB (2012). Advanced Clean Cars Program Adoption.

CARB (2011). Grant Proposal Solicitation Air Quality Improvement Program (AQIP) Clean Vehicle Rebate Project.

ONRD-02: ACCELERATED RETIREMENT OF OLDER LIGHT-DUTY AND MEDIUM-DUTY VEHICLES [VOC, NOX, CO]

CONTROL MEASURE SUMMARY		
SOURCE CATEGORY:	GASOLINE- AND DIESEL-POWERED LIGHT- AND MEDIUM-DUTY VEHICLES UP TO 8,500 LBS GROSS VEHICLE WEIGHT	
CONTROL METHODS:	INCENTIVES PROGRAM FOR THE VOLUNTARY EARLY RETIREMENT OF OLDER LIGHT- AND MEDIUM-DUTY VEHICLES	
EMISSIONS (TONS/DAY):		
ANNUAL AVERAGE	**2008**	**2023**
VOC INVENTORY	165.9	49.0
VOC REDUCTION		TBD*
VOC REMAINING		TBD
NOX INVENTORY	167.8	40.7
NOX REDUCTION		TBD*
NOX REMAINING		TBD
CO INVENTORY	1,641.9	462.6
CO REDUCTION		TBD*
CO REMAINING		TBD
SUMMER PLANNING INVENTORY	**2008**	**2023**
VOC INVENTORY	169.9	51.1
VOC REDUCTION		TBD*
VOC REMAINING		TBD
NOX INVENTORY	149.4	36.3
NOX REDUCTION		TBD*
NOX REMAINING		TBD
CO INVENTORY	1,621.0	454.2
CO REDUCTION		TBD*
CO REMAINING		TBD
CONTROL COST:	UP TO $2,500 PER VEHICLE RETIRED INCLUDING INCENTIVE REPLACEMENT VOUCHER. ESTIMATED PUBLIC FUNDING – $5,000,000/YEAR	
IMPLEMENTING AGENCY:	CARB, BUREAU OF AUTOMOTIVE REPAIR, SCAQMD	

* Emission reductions will be determined after projects are identified and implemented.

DESCRIPTION OF SOURCE CATEGORY

The purpose of this control measure is to implement a strategy to accelerate retirement of older gasoline- and diesel-powered vehicles up to 8,500 lbs. gross vehicle weight (GVW). These vehicles include passenger cars, sports utility vehicles, vans, and light-duty pick-up trucks.

Background

Light-duty vehicles are major contributors of air pollutants in the South Coast Air Basin. While vehicle miles traveled increased more than 50 percent over the last 20 years, vehicle emissions have dropped by a factor of almost three due to increasingly stringent vehicle emission standards. Yet, the light- and medium-duty vehicle fleet continues to contribute more than a third of the Basin's total emissions of ozone and particulate matter forming pollutants in part due to high emitting vehicles.

Motor vehicle emissions progressively increase as vehicles age and accumulate mileage. The causes of these emissions increases are numerous, but can be broadly categorized in terms of normal deterioration of properly-functioning on-board emission control system components, emission control system malfunctions due to design flaws and/or lack of proper maintenance, and tampering. In recognition that emission reductions could occur through regular emission testing of vehicles and repair of those vehicles with high in-use emissions, Smog Check programs have been established in an attempt to ensure that vehicles stay clean as they age, but room for improvement in such programs exists. In addition, through the Bureau of Automotive Repairs (BAR) High Emitter profile, certain model year vehicles are considered inherently high emitters despite passing Smog Check.

Regulatory History

On September 23, 2004, the Governor signed AB 923 (Firebaugh) which resulted in a significant increase in incentive funding for programs that achieve emission reductions from vehicular sources and off-road engines. The legislation identified and emphasized that in-use higher-emitting vehicles are sources that need additional scrutiny and control in part because of their large contribution to the fleet's total emissions. To address this, the District is implementing, under the AB923 program, pilot programs to identify and retire high-emitting on-road vehicles. In addition, based on cost effectiveness guidelines, model year 1992 and older vehicles would be considered for early retirement.

CARB adopted the Enhanced Fleet Modernization Program (EFMP) Regulation in June 2009. The regulation implements the voluntary vehicle scrap and replacement voucher provisions of AB 118 (Nunez). The legislation includes $30 million annually statewide for an Enhanced Fleet Modernization Program (EFMP). The EFMP augments the State's existing voluntary accelerated vehicle retirement program, referred to as the Consumer Assistance Program (CAP). The focus of the EFMP is to augment existing retirement programs and provide funding through vehicle replacement vouchers to retire the highest-polluting vehicles in the areas with the greatest air quality problems.

PROPOSED METHODS OF CONTROL

Currently, California vehicles less than 10,000 lbs. GVW are required to undergo Smog Check testing every two years or upon change of a vehicle's ownership. Recent studies have indicated that repairs performed in conjunction with the Smog Check Test Program do not last the entire biennial cycle and result in high-emitting vehicles being driven on California roadways. The current Consumer Assistance Program (CAP) operated by BAR encourages vehicle retirement for on-cycle (those vehicles within three months of their smog check test due dates) vehicles that cannot pass the Smog Check Test. Vehicles identified as high emitters that are off-cycle to the Smog Check Test are not eligible under the CAP program implemented by BAR and the State of California. This measure would give first priority to pre-1992 model year vehicles identified as high emitters and are off-cycle to California's Smog Check Program.

The early action is to retire at a minimum, 2,000 light- and medium-duty vehicles per year to 2023. The proposed incentives would be up to $2,500 which could include a replacement voucher under the AB 118 EFMP program.

EMISSIONS REDUCTION

Emission reductions are not estimated at this time and will depend on the actual number of vehicles participating in the program.

COST EFFECTIVENESS

The Carl Moyer $17,080 per ton threshold is used to calculate the cost-effectiveness of the vehicle retirement program. Because this program is solely reliant on a volunteer participation rate by the consumers, the exact cost effectiveness of the program is difficult to assess prior to the program implementation.

IMPLEMENTING AGENCY

The implementing agencies would be the South Coast Air Quality Management District under AB 923 and guidelines set forth by CARB for the Light-Duty Vehicle Program. In addition, the EFMP would be implemented by CARB and BAR with the District's administration of the replacement voucher provisions of the EFMP regulation.

REFERENCES

CARB (2009). AB118 Enhanced Fleet Modernization Program Regulation (Car Scrap).

CARB/BAR (2010). Evaluation of the California Smog Check Program Using Random Roadside Data.

ONRD-03: ACCELERATED PENETRATION OF PARTIAL ZERO-EMISSION AND ZERO-EMISSION LIGHT-HEAVY- AND MEDIUM-HEAVY-DUTY VEHICLES [NOX, PM]

SOURCE CATEGORY:	ON-ROAD LIGHT-HEAVY- AND MEDIUM-HEAVY-DUTY VEHICLES (8,501 LBS TO 26,001 GVWR)	
CONTROL METHODS:	ACCELERATED PENETRATION OF PARTIAL ZERO-EMISSION AND ZERO-EMISSION LIGHT-HEAVY- AND MEDIUM-HEAVY-DUTY VEHICLES	
EMISSIONS (TONS/DAY):		
ANNUAL AVERAGE	**2008**	**2023**
NOX INVENTORY	87.1	30.9
NOX REDUCTION		TBD*
NOX REMAINING		TBD
PM10 INVENTORY	1.3	0.30
PM10 REDUCTION		TBD*
PM10 REMAINING		TBD
PM2.5 INVENTORY	1.2	0.25
PM2.5 REDUCTION		TBD*
PM2.5 REMAINING		TBD
SUMMER PLANNING INVENTORY	**2008**	**2023**
NOX INVENTORY	81.6	29.1
NOX REDUCTION		TBD*
NOX REMAINING		TBD
CONTROL COST:	TBD. ESTIMATED PUBLIC FUNDING – $25 MILLION PER YEAR	
IMPLEMENTING AGENCY:	CARB AND SCAQMD	

* Emission reductions will be determined after projects are identified and implemented.

DESCRIPTION OF SOURCE CATEGORY

Background

Emissions from heavy-duty diesel mobile sources continue to represent a significant and increasing portion of the emissions inventory in the South Coast Air Basin, adversely affecting regional air quality. The two primary pollutants resulting from diesel fuel combustion are particulate matter (PM) and oxides of nitrogen (NOx). PM typically constitutes the visible emissions from diesel engine exhaust, and it contains over 40 known cancer-causing substances. In 1998, California identified diesel PM as a toxic air contaminant based on its potential to cause cancer. In March 2005, the District released a report titled, "The Multiple Air Toxic

Exposure Study in the South Coast Air Basin." This report concluded that about 85 percent of the carcinogenic risk associated with breathing ambient air can be attributed to diesel particulate emissions. Diesel engines also emit significant quantities of NOx, which is a precursor to ozone and secondary particulate matter formation. Additional control on diesel engine emissions is essential for attainment of ozone and PM ambient air quality standards, as well as mitigating its toxic air quality impact.

The intent of this measure is to seek greater emission reduction benefits through the early deployment of partial zero-emission and zero-emission light-heavy- and medium-heavy-duty vehicles with gross vehicle weight ratings (GVWR) from 8,501 lbs to 26,000 lbs.

Regulatory History

The regulation of emissions from heavy-duty diesel mobile emission sources is the responsibility of CARB and U.S. EPA. Specifically, heavy-duty vehicle engines are subject to specific emission standards pursuant to state and/or federal requirements. Emission standards for new diesel engines powering heavy-duty vehicles were first established for the 1973 model-year and have gradually increased in stringency over time. The current most stringent set of heavy-duty engine emission standards has been established by CARB and U.S. EPA for 2010 and subsequent model-years, which includes a 0.2 g/bhp-hr NO_x emission standard.

In December 2008, CARB adopted the Truck and Bus Regulation which applies to a significant number of heavy-duty vehicles with gross vehicle weight ratings of 14,001 lbs and greater. Heavier trucks (26,001 lbs and greater) must meet regulatory requirements beginning January 1, 2012. Lighter trucks (14,001 lbs to 26,000 lbs) must meet regulatory requirements beginning January 1, 2015.

Currently, heavy-duty diesel engine manufacturers are introducing electric-hybrid systems in medium-heavy-duty on-road vehicle applications. Such systems in conjunction with a 2010-compliant conventionally-fueled or alternative-fueled engine can potentially result in additional NOx emissions benefits. Many of the hybrid systems introduced to-date are for lighter vehicles with gross vehicle weight ratings from 8,501 to 26,000 lbs.

PROPOSED METHOD OF CONTROL

This measure seeks additional emission reductions through the early introduction of electric hybrid vehicles. The proposed actions would continue the state hybrid truck and bus voucher incentive project (HVIP) which accelerates the deployment of hybrid and zero-emission medium-heavy-duty vehicles in the South Coast Air Basin.

Incentives of up to $25,000 per vehicle are proposed with a minimum target of 1,000 hybrid and zero-emission vehicles funded each year to 2023. The proposed funding would place the highest priority towards zero-emission vehicles and hybrid vehicles with a portion of their operation in an "all electric range" mode.

EMISSIONS REDUCTION

Emission reductions are not estimated at this time and will depend on the actual number of vehicles participating in the program.

RULE COMPLIANCE AND TEST METHODS

Not Applicable.

COST EFFECTIVENESS

This proposed control measure will affect heavy-duty engine manufacturers, heavy-duty diesel truck owners, and heavy-duty diesel fleet operators. Costs of replacement engines vary depending on the specific model and vehicle application, and an evaluation would need to be conducted to determine the specific types of trucks and engine models that would be primarily affected by this measure, as well as prioritizing vehicle applications on a cost-effectiveness basis for engine or vehicle replacement. The proposed incentives of $25,000 per vehicle will help offset the capital cost of the vehicles.

IMPLEMENTING AGENCY

CARB, SCAQMD or U.S. EPA could jointly or separately implement incentive programs that would help offset the costs associated with new hybrid or zero-emission truck purchase, engine repower, and/or retrofit kit installation.

REFERENCES

SCAQMD (2005). Multiple Air Toxic Exposure Study, MATES-III.

CARB (2009). Air Quality Improvement Program - Hybrid Truck and Bus Voucher Incentive Program.

ONRD-04: ACCELERATED RETIREMENT OF OLDER ON-ROAD HEAVY-DUTY VEHICLES [NOX, PM]

SOURCE CATEGORY:	ON-ROAD HEAVY-DUTY DIESEL VEHICLES (26,001 LBS AND GREATER GVWR)	
CONTROL METHODS:	ACCELERATED REPLACEMENT OF EXISTING HEAVY-DUTY VEHICLES WITH VEHICLES MEETING 2010 STANDARDS AND RETROFITTING/REPOWERING EXISTING HEAVY-DUTY VEHICLES TO ACHIEVE LOWER EMISSION LEVELS	
EMISSIONS (TONS/DAY):		
ANNUAL AVERAGE	**2008**	**2023**
NOX INVENTORY	166.7	22.4
NOX REDUCTION		TBD*
NOX REMAINING		TBD
PM10 INVENTORY	6.2	0.60
PM10 REDUCTION		TBD*
PM10 REMAINING		TBD
PM2.5 INVENTORY	5.7	0.50
PM2.5 REDUCTION		TBD*
PM2.5 REMAINING		TBD
SUMMER PLANNING INVENTORY	**2008**	**2023**
NOX INVENTORY	158.1	20.9
NOX REDUCTION		TBD*
NOX REMAINING		TBD
CONTROL COST:	TBD. ESTIMATED PUBLIC FUNDING – $50 MILLION PER YEAR	
IMPLEMENTING AGENCY:	CARB AND SCAQMD	

* Emission reductions will be determined after projects are identified and implemented.

DESCRIPTION OF SOURCE CATEGORY

Background

Emissions from heavy-duty diesel mobile sources continue to represent a significant portion of the emissions inventory in the South Coast Air Basin, adversely affecting regional air quality. The two primary pollutants resulting from diesel fuel combustion are particulate matter (PM) and oxides of nitrogen (NOx). PM typically constitutes the visible emissions from diesel engine exhaust, and it contains over 40 known cancer-causing substances. In 1998, California identified diesel PM as a toxic air contaminant based on its potential to cause cancer. In March 2005, the District released a report titled, "The Multiple Air Toxic Exposure Study in the South

Coast Air Basin." This report concluded that about 85 percent of the carcinogenic risk associated with breathing ambient air can be attributed to diesel particulate emissions. Diesel engines also emit significant quantities of NOx, which is a precursor to ozone and secondary particulate matter formation. Additional control of diesel engine emissions is essential for attainment of ozone and PM ambient air quality standards, as well as mitigating its toxic air quality impact.

Over the past decade, warehouse and distribution centers have been steadily increasing in size and number throughout the region. The greatest growth in warehouses/distribution centers has been in the Riverside and San Bernardino areas. Based on the Southern California Association of Governments, by 2035 over 1 billion square feet of warehousing will be needed in the Southern California area to support goods movement activities (SCAG, 2010).

Distribution centers and/or warehouses are facilities that serve as a distribution point for the transfer of goods. Such facilities include cold storage warehouses, goods transfer facilities, and transloading facilities, where imported goods are sorted, tagged, repackaged and prepared for retail distributions. These operations involve trucks, trailers, shipping containers, and other equipment with diesel engines. A warehouse/distribution center can be comprised of multiple centers or warehouse/distribution centers within an area. The size can range from 100,000 square feet to well over a million square feet. Depending on the size and type, a warehouse/distribution center may have hundreds of diesel trucks a day that deliver, load, and/or unload goods, generally operating seven days a week. To the extent that these trucks are transporting perishable goods, they are equipped with diesel-powered transport refrigeration units (TRUs) or TRU generator sets. The activities associated with delivering, storing, and loading freight produce NOx and PM emissions, including diesel particulate matter (DPM).

The intent of this control measure is to seek additional emission reductions from existing heavy-duty vehicles with gross vehicle weight ratings (GVWR) greater than 26,000 lbs through an accelerated vehicle replacement program with new 2010 and later model year engines. In addition, for heavy-duty vehicles not replaced with new models, existing vehicle engines would be repowered with commercially-available engines meeting 2010 emission standards or modified with retrofit kits to achieve the lowest possible emission levels. Given the exceedences of the federal 24-hour fine particulate (PM2.5) ambient air quality standard in the Mira Loma area, the proposed measure will place priority to replace older heavy-duty vehicles serving warehouse and distribution centers located within a 10 mile radius of the District's Mira Loma air monitoring station.

Regulatory History

The regulation of emissions from heavy-duty diesel mobile emission sources is the responsibility of CARB and U.S. EPA. Specifically, heavy-duty vehicle engines are subject to specific emission standards pursuant to state and/or federal requirements. Emission standards for new diesel engines powering heavy-duty vehicles were first established for the 1973 model-year and have gradually increased in stringency over time. The current most stringent set of heavy-duty engine emission standards has been established by CARB and U.S. EPA for 2010 and subsequent model-years, which includes a 0.2 g/bhp-hr NO_x emission standard.

In December 2008, CARB adopted the Truck and Bus Regulation which applies to a significant number of heavy-duty vehicles with gross vehicle weight ratings of 14,001 lbs and greater. Heavier trucks (26,001 lbs and greater) must meet regulatory requirements beginning January 1, 2012. Lighter heavy-duty trucks (14,001 lbs to 26,000 lbs) must meet regulatory requirements beginning January 1, 2015.

The Carl Moyer Memorial Air Quality Standards Attainment Program is in its 13th year. The Carl Moyer Program was placed into state law and is the enabling mechanism to fund the cleanup of older diesel vehicles and equipment. At its initial inception, the Carl Moyer Program was funded annually through a state budget line item that must be approved by the state legislature. In 2004, the state legislature approved Senate Bill (SB) 1107, which allowed for the funding of the Carl Moyer Program. In addition, the state legislature passed Assembly Bill (AB) 923, which provides funding until 2015 and allowed California local air districts to opt into a local Carl Moyer Program.

The SB1107 funds are generated from new vehicle sales. In lieu of having Smog Check inspections in the first four years, new vehicles are now subject to their first Smog Check inspection after six years. A fee of $48 is assessed at the time of vehicle purchase, which is typically less expensive than the Smog Check inspection and certificate. Half of the $48 is directed to CARB, who distributes the funds among local air districts for implementation of the Carl Moyer Program.

The AB923 program has two components. One is a tire disposal fee which generates about $10 million a year and is distributed by CARB among the local air districts. The other is a $2 Department of Motor Vehicle registration fee that each local air district's Board has the authority to approve independently and generate funds from vehicles registered within their respective district boundaries. Fees generated are used for both the Carl Moyer and the School Bus Programs.

In 2006, California voters approved a bond measure called Proposition 1B. The bond measure would generate $19 billion of which $2 billion would go towards improving California's freight transportation infrastructure; $1 billion towards the cleaning up older diesel vehicles; and $200 million to school bus retrofits. The funding is predicated on bond sales. To-date, close to 2,000 older diesel trucks have been replaced with either newer diesel trucks or alternative fuel trucks.

PROPOSED METHOD OF CONTROL

This measure seeks additional emission reductions from older, pre-2010 heavy-duty vehicles beyond the emission reductions targeted in CARB's Truck and Bus Regulation. In addition, the proposed action is to direct a portion of available public funding to assist in replacing older diesel trucks serving warehouse and distribution centers to a truck with an engine meeting on-road heavy-duty exhaust emission standards and replacing older cargo handling equipment with equipment meeting Tier 4 off-road exhaust emission standards by 2015. The incentive programs will place the highest priority on on-road vehicles that provide at least 75% of their service to warehouse and distribution centers in the Mira Loma region and have gross vehicle weight ratings of 26,001 lbs or greater.

A significant number of heavy-duty trucks have been replaced through Proposition 1B Goods Movement Emission Reduction Program funding, the Carl Moyer Program, and other local incentives programs. This measure would continue these programs through 2023. In addition, this measure would seek a provision from the State for the District to implement a SOON-like (Surplus Off-Road Option for NOx) provision for the largest on-road truck fleets operating in the South Coast Air Basin.

While the Truck and Bus Regulation will ultimately require a majority of the heavy-duty trucks to meet 2010 heavy-duty exhaust emission standards by 2023, funding programs, which partially offset the costs, are typically made available to fleets with 10 or less trucks. However, many of these smaller fleets are not able to provide the remaining capital necessary to purchase a 2010-compliant truck and thus, cannot take advantage of funding opportunities. As such, the District staff believes a SOON-like program for the largest on-road truck fleets can lead to greater emission reductions earlier and complement traditional funding programs.

Examples of SOON-like programs include the San Pedro Bay Ports Clean Truck Program where the Ports adopted programs to incentivize the use of 2007 or cleaner trucks entering the Ports. Revenues from the Clean Truck Program are used to help fund cleaner trucks. A SOON-like program implemented regionwide would require the largest on-road truck fleets to access incentives funding to replace older model trucks earlier than required or to replace older model trucks which would otherwise be exempt from the regulation.

EMISSIONS REDUCTION

Emission reductions are not estimated at this time and will depend on the actual number of vehicles participating in the program.

RULE COMPLIANCE AND TEST METHODS

CARB, subject to existing and future waiver decisions by U.S. EPA, has the authority to establish emission standards and certification requirements, and verify compliance with these requirements, for on-road vehicles and engines sold in California. In addition, CARB has the authority to establish requirements for the verification of retrofit kits that would be used to modify heavy-duty diesel engines. Compliance with requirements of an incentive program(s) used to offset the costs of new heavy-duty vehicles, engines, or retrofit kits could be jointly or separately administered by SCAQMD or CARB.

COST EFFECTIVENESS

The cost effectiveness of the proposed action is not estimated. Recent funding for goods movement related vehicles under the Proposition 1B Air Quality Improvement Funds provided at least $35,000 per truck replaced.

IMPLEMENTING AGENCY

CARB, SCAQMD or U.S. EPA could jointly or separately implement incentive programs that would help offset the costs associated with new truck purchase, engine repower, and/or retrofit kit installation. In particular, there is a need to incentivize emission reductions from interstate trucks registered outside of California, but operating substantially within California.

REFERENCES

CARB (2010). Amendments to the On-Road Truck and Bus Regulation.

CARB (2010). Proposition 1B Goods Movement Emissions Reduction Program: Final Guidelines for Implementation.

ONRD-05: FURTHER EMISSION REDUCTIONS FROM HEAVY-DUTY VEHICLES SERVING NEAR-DOCK RAILYARDS [NOX, PM]

SOURCE CATEGORY:	ON-ROAD HEAVY-DUTY DIESEL VEHICLES (26,001 LBS AND GREATER GVWR) TRANSPORTING CONTAINERS BETWEEN MARINE PORTS AND NEAR-DOCK RAILYARDS	
CONTROL METHODS:	ACCELERATED REPLACEMENT OF UP TO 1,000 EXISTING HEAVY-DUTY VEHICLES WITH ZERO-EMISSION VEHICLES OR ZERO-EMISSION CONTAINER MOVEMENT SYSTEMS	
EMISSIONS (TONS/DAY):		
ANNUAL AVERAGE	**2008**	**2023 (2023 – 2007 SIP)***
NOX INVENTORY	3.17	0.75 (0.88)
NOX REDUCTION		0.75 (0.88)
NOX REMAINING		0.00 (0.00)
PM10 INVENTORY	0.13	0.027 (0.03)
PM10 REDUCTION		0.027 (0.03)
PM10 REMAINING		0.00 (0.00)
PM2.5 INVENTORY	0.12	0.025 (0.03)
PM2.5 REDUCTION		0.025 (0.03)
PM2.5 REMAINING		0.00 (0.00)
SUMMER PLANNING INVENTORY	**2008**	**2023**
NOX INVENTORY	3.01	0.72 (0.89)
NOX REDUCTION		0.72 (0.89)
NOX REMAINING		0.00 (0.00)
CONTROL COST:	TBD	
IMPLEMENTING AGENCY:	CARB, SAN PEDRO BAY PORTS, SCAQMD	

* Emission reductions provided are based on the 2012 AQMP emissions inventory. Values provided in parentheses are based on the 2007 SIP emissions inventory projections for 2023.

DESCRIPTION OF SOURCE CATEGORY

Background

Intermodal container movement is the movement of containers directly between the marine ports and a railyard. There are three types of railyards used for intermodal: on-dock railyards, near-dock railyards, and off-dock railyards. On-dock railyards are located on marine terminals, near-dock railyards are less than five miles from marine terminals, and off-dock railyards are more than five miles from marine terminals. Heavy-duty diesel trucks are currently used to transport containers from marine terminals to near- and off-dock railyards. These trucks are a significant source of NOx and PM emissions.

The Intermodal Container Transfer Facility (ICTF) operated by Union Pacific (UP) is presently the only near-dock railyard. ICTF serves both the Ports of Los Angeles and Long Beach. In January 2009, the Ports of Los Angeles and Long Beach released a California Environmental Quality Act (CEQA) Notice of Preparation to double the throughput at ICTF. In addition, Burlington Northern Santa Fe (BNSF) Railway is proposing to build the Southern California International Gateway (SCIG) facility that will be a near-dock railyard directly south of the ICTF. ICTF and the proposed SCIG facility are located less than five miles from the Ports of Los Angeles and Long Beach.

Regulatory History

In December 2007, the California Air Resources Board (ARB) adopted a regulation to reduce emissions from drayage trucks operating at California's ports and intermodal railyards. This regulation was amended in 2010. The drayage truck regulation applies to diesel-fueled drayage trucks having a gross vehicle weight rating greater than 26,000 pounds operating at specified California ports, intermodal railyards, or both. The regulation sets two compliance deadlines that affect all drayage trucks operating specifically at California's ports and intermodal railyards:

- Phase 1: By December 31, 2009, all pre-1994 model year (MY) engines are to be retired or replaced with 1994 and newer MY engines. Furthermore, all drayage trucks with 1994 – 2003 MY engines are required to achieve an 85 percent PM emission reduction through the use of an approved Level 3 verified diesel emission control strategy (VDECS).

- Phase 2: By December 31, 2013, all trucks would be required to further reduce emissions to meet the 2007 MY California or federal heavy-duty diesel-fueled on-road emission standards.

CARB's On-Road Heavy-Duty Diesel Truck and Bus Rule incorporates the Drayage Truck Regulation and will further require that trucks operating at the Ports meet 2010 federal on-road standards by 2021.

In 2006, the Ports of Los Angeles and Long Beach adopted the San Pedro Bay Ports Clean Air Action Plan (CAAP), a planning and policy document that sets goals and implementation strategies to reduce air emissions and health risks associated with Port operations. One measure contained in the CAAP reduces emissions from on-road heavy-duty trucks used to dray goods to and from the Ports. CAAP Control Measure HDV-1: Performance Standards for On-Road Heavy Duty Vehicles (Clean Truck Program) requires all on-road trucks entering the Ports comply with the following:

- October 1, 2008: All pre-1989 trucks are banned from entering the Port.
- January 1, 2010: 1989-1993 trucks will be banned, in addition to 1994-2003 trucks that have not been retrofitted to achieve 85 percent DPM reduction and 25 percent NOx reduction through use of a CARB-approved Level 3 VDECS.

- January 1, 2012: All trucks that do not meet the 2007 federal on-road standards will be banned from the Ports starting in 2012; CARB's Drayage Truck Regulation aligns with the Clean Truck Program.

When fully implemented, this CAAP measure and the statewide Drayage Truck Regulation will reduce emissions from drayage trucks accessing current and future near-dock railyards, such as the ICTF and SCIG railyards. However, due to the large number of truck trips to the ICTF and potential future near-dock railyards, additional emission reductions are needed from trucks.

PROPOSED METHOD OF CONTROL

This control measures calls for CARB to adopt a regulation or through other enforceable mechanisms, which further reduce emissions from near-dock railyard drayage trucks. The regulation would require by 2020, all containers transported between the marine ports and the near-dock railyards to use zero-emission technologies that do not create tailpipe emissions from the vehicle or systems that transport containers by regulating truck emissions and potentially allowing alternative technologies. Zero-emission technologies are well suited for transporting containers to near-dock railyards because of their short distance to and from marine terminals. In lieu of a regulation or to complement a regulation, other enforceable mechanisms may achieve the objectives of the control measures. The Ports of Los Angeles and Long Beach have successfully implemented the Clean Truck Program as mentioned above. A second phase of such a program could be implemented to bring zero-emission trucks or hybrid trucks with sufficient all-electric range to serve the near-dock railyards. In addition, incentives funding programs will encourage the deployment of such zero-emission trucks.

Any of several types of zero-emission container movement systems could be used to implement this measure. Zero-emission container movement systems include, but are not limited to, on-road technologies such as battery-electric trucks, fuel cell trucks, hybrid-electric trucks with all-electric range (AER) and zero-emission hybrid or battery-electric trucks with "wayside" power (such as electricity from overhead wires). The measure could also be implemented with the deployment of zero-emission fixed guideway systems such as electric, maglev or linear synchronous motor propulsion or any other technologies that result in zero-emission track miles.

Such systems are not currently in use for full-scale port to railyard operations and, depending on the technology, may require different levels of additional development and optimization. However, a variety of these technologies are being demonstrated, and there is substantial evidence that they can be made commercially available prior to 2020, particularly if regulations create a positive signal to technology developers by requiring the use of zero-emission technologies.

In addition, many of these zero-emission technologies are expected to be operationally feasible to serve the ports. For example, electric trucks with adequate zero-emission range, power and reliability – such as are being developed and demonstrated at the Ports could fit into current operating procedures as a replacement for fossil fuel-powered trucks. Drayage service to and from near-dock railyards is particularly conducive to implementation of zero-emission trucking technologies because of the relatively short distance involved (less than five miles) and because

near-dock railyards could be served by a relatively limited number of trucks compared to the total number serving the ports and region.

Zero-emission trucks can be powered by grid electricity stored in a battery, by electricity produced onboard the vehicle through a fuel cell, or by "wayside" electricity from outside sources such as overhead catenary wires, as is currently used for transit buses and heavy mining trucks. All technologies eliminate fuel combustion and utilize electric drive as the means to achieve zero-emission and higher system efficiency compared to conventional fossil fuel combustion technology. Hybrid-electric trucks with all-electric range can provide zero emission in certain corridors and flexibility to travel extended distances (e.g., outside the region) powered by alternative fuels, conventional fuels, or fuel cells.

EMISSIONS REDUCTION

The proposed control measure would require zero-emission technologies to replace up to 1,000 heavy-duty trucks that serve the San Pedro Bay Ports and the near-dock railyards. Implementation of this control measure is expected to result in 0.75 and 0.025 tons/day of NOx and PM emission reductions.

RULE COMPLIANCE AND TEST METHODS

Compliance would be based on monitoring, recordkeeping, and reporting requirements that have been established in existing regulations. In addition, compliance would be verified through inspections and other recordkeeping and reporting requirements.

COST EFFECTIVENESS

Not determined.

IMPLEMENTING AGENCY

CARB would adopt a new regulation or amend the existing Drayage Truck Regulation to require zero-emission on-road technologies or fixed guideway systems, if feasible. This control measure should be adopted by CARB no later than 2015, with full implementation by 2020.

REFERENCES

SCAQMD (2012). Comment letter on Port of Los Angeles Draft Environmental Impact Report for the Southern California International Gateway (SCIG) Project.

GROUP 2

OFF-ROAD MOBILE SOURCE MEASURES

OFFRD-01: EXTENSION OF THE SOON PROVISION FOR CONSTRUCTION/INDUSTRIAL EQUIPMENT [NOx]

CONTROL MEASURE SUMMARY		
SOURCE CATEGORY:	OFF-ROAD DIESEL-FUELED CONSTRUCTION, INDUSTRIAL EQUIPMENT, AIRPORT GROUND SUPPORT EQUIPMENT, AND DRILLING EQUIPMENT	
CONTROL METHODS:	ACCELERATED TURNOVER OR RETROFIT OF OLDER EQUIPMENT AND ENGINES	
EMISSIONS (TONS/DAY):		
ANNUAL AVERAGE	**2008**	**2023***
NOX INVENTORY	37.1	15.91
NOX REDUCTION		7.47
NOX REMAINING		8.44
SUMMER PLANNING INVENTORY	**2008**	**2023**
NOX INVENTORY	37.1	15.91
NOX REDUCTION		7.47
NOX REMAINING		8.44
CONTROL COST:	TBD. FUNDING FROM SOON – UP TO $30 MILLION PER YEAR	
IMPLEMENTING AGENCY:	SCAQMD	

* Emission reductions provided are based on the 2012 AQMP emissions inventory. The emissions inventory in the 2007 SIP was updated as part of the Final Approval of the 2007 SIP for the 1997 8-Hour Ozone Standards (77 FR 12674) and is the same inventory used for the 2012 AQMP.

DESCRIPTION OF SOURCE CATEGORY

The purpose of this measure is to promote faster turnover of older in-use construction and industrial diesel engines.

Background

In 2023, off-road equipment is the second largest source category of NOx emissions and accounts for 14 percent of the total NO_x emissions in the South Coast Air Basin. Heavy-duty construction, industrial, airport ground support (GSE), and drilling equipment are eligible for participation in the District's Surplus Off-road Opt-in for NOx (SOON) program and represent almost 40 percent of the off-road equipment category NOx emissions. In 2007, CARB adopted the In-Use Off-Road Diesel-Fueled Fleets Regulation that reduces primarily PM and secondarily NOx emissions through retrofit controls, engine repowers, equipment replacement and fleet reduction. NOx emission reductions of about 17 percent are expected to be achieved with full implementation of the regulation by 2023.

Regulatory History

The Federal Clean Air Act prohibits states from regulating emissions from new engines used in construction and farming equipment less than 175 horsepower. Diesel engines greater than 175 horsepower are regulated by CARB. In September 1996, CARB, U.S. EPA, and the diesel engine manufacturers signed a statement of principles, which called for a cooperative effort to reduce NO_x, VOC, and PM emissions by more than 60 percent. In August 1998, U.S. EPA adopted new emission standards pertaining to off-road diesel engines. Subsequently, in January 2000 and in December 2004, CARB adopted amendments to existing California emission standards to harmonize with the federal requirement. These amendments included a tiered approach starting from 1996 for Tier 1 and concluding in 2015 with all engines required to meet Tier 4 standards.

In order to accelerate the introduction of new low emission equipment, CARB adopted the In-Use Off-Road Diesel-Fueled Fleets Regulation (Off-Road rule) in 2007. The rule applies to diesel-fueled construction, mining, industrial, airport ground support equipment, and mobile oil drilling equipment and established annual fleet average emission targets. Fleets that do not meet the fleet average in any year are required to "turnover," (i.e., retire, replace, retrofit, or repower) a specified percentage of their horsepower. The Off-Road rule was amended in 2011 which relaxed the target emission reductions and set the initial date for vehicle compliance to 2014.

As part of the statewide regulation, CARB adopted the SOON provision that allows air districts to opt-in to additional NOx emission reductions from the largest off-road fleets subject to the regulation. The District has been implementing the SOON provision since 2008. The District Governing Board set aside up to $30 million per year to implement the SOON provision.

PROPOSED METHOD OF CONTROL

New off-road diesel engines are now required to meet Tier 4 emission standards. Tier 4 includes optional phase-in provisions (Interim Tier 4 standards) with relaxed standards from 2008 to 2014, depending on horsepower category. By 2015, all new off-road diesel engines between 75 hp and 750 hp, which represent most off-road construction equipment, will be required to meet exhaust emissions standards of 0.3 g/bhp-hr NOx and 0.015 g/bhp-hr PM. To comply with these standards, advanced fuel injection, air induction, and after-treatment technologies are required. The emission reductions from Tier 4 engines compared to Tier 0 engines are at least 95 percent for NOx and PM.

The long life of off-road equipment means that older, high-emitting engines will remain in the off-road equipment population beyond 2020. District staff believes that by using incentive programs, such as the Carl Moyer Program and the SOON Provision of the Off-Road rule, significant emission reductions could be realized by accelerating fleet turnover through equipment replacement and engine repowers.

During the last four years, the SOON program has funded close to 500 engine repowers at an average cost effectiveness of approximately $11,000/ton NOx reduction. The District Governing Board has allocated up to $30,000,000 per year for the program. This measure proposes to extend the current SOON Program beyond 2014 to 2023.

EMISSIONS REDUCTION

While the NOx emissions from the off-road category are projected to be around 44 tpd in 2023, emissions from vehicles eligible to participate in the SOON program are 15.91 tpd. Reductions from this proposed measure are estimated to be 7.47 tpd for NOx.

COST EFFECTIVENESS

The SOON program has funded approximately 500 engine repowers during the last four years at an average cost effectiveness of approximately $11,000/ton NOx reduced. While the cost of Tier 4i and Tier 4 engine repowers are expected to be higher, the cost effectiveness is expected to remain the same because of the lower NOx emission standards of the Tier 4 engines. This measure proposes to extend the SOON program with proposed funding of up to $30,000,000 per year and is expected to repower at least 1,200 Tier 0 engines to Tier 4 by 2023 resulting in 7.47 tpd of NOx reductions.

IMPLEMENTING AGENCY AND ISSUES

The District would implement the SOON provision of the In-Use Off-Road Diesel-Fueled Fleets Regulation.

REFERENCES

CARB (2010). Emissions Inventory Model for Baseline and Final Proposal (Access database) – OSM vehicle scenario table; total population adjusted for 2012 Growth Factor of 1.046. Database available at http://www.arb.ca.gov/msprog/ordiesel/offroad_1085.htm

CARB (2010). Initial Statement of Reasons – Proposed Amendments to the Regulation for In-Use Off-road Diesel Fueled Fleets.

CARB (2011). Final Regulation Order Dec 2011- Regulation for In-Use Off-Road Diesel-Fueled Fleets.

OFFRD-02: FURTHER EMISSION REDUCTIONS FROM FREIGHT LOCOMOTIVES* [NOX, PM]

CONTROL MEASURE SUMMARY		
SOURCE CATEGORY:	LOCOMOTIVE ENGINES (ALL CLASSES EXCEPT PASSENGER)	
CONTROL METHODS:	ACCELERATED REPLACEMENT OF EXISTING LOCOMOTIVE ENGINES MEETING TIER 4 OR CLEANER EXHAUST STANDARDS	
EMISSIONS (TONS/DAY)*:		
ANNUAL AVERAGE	**2008**	**2023 (2023 – 2007 SIP)***
NOX INVENTORY	22.12	17.8 (22.6)
NOX REDUCTION		12.7 (16.6)
NOX REMAINING		5.1 (6.0)
PM10 INVENTORY	0.67	0.41 (0.83)
PM10 REDUCTION		0.34 (0.67)
PM10 REMAINING		0.07 (0.16)
PM2.5 INVENTORY	0.62	0.38 (0.76)
PM2.5 REDUCTION		0.32 (0.62)
PM2.5 REMAINING		0.06 (0.14)
SUMMER PLANNING INVENTORY	**2008**	**2023**
NOX INVENTORY	22.12	17.8 (22.6)
NOX REDUCTION		12.7 (16.6)
NOX REMAINING		5.1 (6.0)
CONTROL COST:	TBD	
IMPLEMENTING AGENCY:	CARB, U.S. EPA, AND SAN PEDRO BAY PORTS	

* Emission reductions provided are based on the 2012 AQMP emissions inventory. Values provided in parentheses are based on the 2007 SIP emissions inventory projections for 2023. The reductions will not be resubmitted as part of the 2012 AQMP SIP since the commitment is already contained in the approved 2007 SIP for the 8-hour ozone ambient air quality standard.

DESCRIPTION OF SOURCE CATEGORY

Background

Diesel-electric locomotives have a large diesel engine (main traction engine) for generating electric power which in turn drives electric motors in each axle. Locomotives can be grouped into three major categories: switch or yard locomotives, medium-horsepower (MHP) locomotives, and interstate line haul locomotives. Switch or yard locomotives range in sizes from 1,006 to 2,300 horsepower (hp), and are generally used within railyards to assemble

railcars to form a train. They are also, in limited cases, used in short local haul services. MHP locomotives range from 2,300 to 3,800 hp, and are used in passenger and various local and intrastate freight line haul locomotive operations. The small-size MHP locomotives ranging in sizes from 2,301 to 2,999 hp are used in local service and as large switch locomotives. The mid-size MHP locomotives (3,000 to 3,300 hp) perform local and regional short line-haul services, or provide additional power to assist trains over steep grades. The large-size MHP locomotives (3,301 to 3,800 hp) are generally used for intrastate or regional line haul locomotive operations. Interstate line haul locomotives are high-power locomotives with over 4,000 hp, and are used to move freight over long distances and many states.

CARB estimates that about 139 switchers, 150 MHP, and 200 interstate line haul locomotives operate within the South Coast Air Basin at any given time. Locomotives contributed approximately 22.1 tons per day of NOx and 0.62 ton per day of PM2.5 emissions to the South Coast Air Basin emissions inventory in 2008. The U.S. EPA locomotive regulations, CARB diesel fuel regulation, and the 1998 Memorandum of Understanding (MOU) between CARB, Union Pacific Railroad Company (UP), and Burlington Northern Santa Fe Railway Company (BNSF) have collectively produced reductions in locomotive emissions from 2000 to 2010. CARB projected freight locomotives to contribute 17.8 tons per day in 2023 to the South Coast Air Basin's annual average NOx emissions inventory.

Regulatory History

In December 1997, the U.S. EPA published emission standards for diesel locomotives. These standards included Tier 0 standards for 1973-2001 uncontrolled locomotives upon rebuilding of their diesel engines; more stringent Tier 1 standards for new 2002-2004 locomotives; and modestly stringent Tier 2 standards for 2005 and newer locomotives. In 2008, the U.S. EPA adopted a three-part regulation to further reduce emissions from existing locomotive engines, reduce idling emissions, and introduce new generations of clean locomotives. First, locomotives originally manufactured after 1972 and powered by Tier 0, Tier 1, and Tier 2 engines are required to meet new emission standards when the locomotives are remanufactured. Second, newly-built line-haul and switch locomotives are subject to a different set of stringent near-term (Tier 3) and longer-term (Tier 4) emissions standards. Tier 3 standards are already effective, and Tier 4 standards will be effective beginning in 2015. Lastly, newly-built and remanufactured locomotives are also required to be equipped with an Automatic Engine Stop/Start System capable of shutting-down a locomotive after idling for no more than 30 minutes continuously. This three-part regulatory approach is expected to achieve up to 22 percent NOx and 63 percent PM reductions from remanufactured locomotives, compared to their corresponding current standards. Additionally, locomotives powered by Tier 3 or Tier 4 engines will achieve up to 83 percent NOx and 87 percent PM reductions, compared to engines meeting the current Tier 2 standards.

Besides the federal emission requirements for locomotives, CARB has signed two memorandums of understanding (MOU) with the two Class 1 freight railroads operating in California, Burlington Northern Santa Fe Railway (BNSF) and Union Pacific Railroad (UP). The first agreement, the South Coast MOU, was signed in 1998. Among other features, it commits the two Class 1 railroads to meeting Tier 2 NOx standards, on average, starting in 2010 with their locomotives operating in the South Coast Air Basin. The second CARB agreement,

the Rail Yard Agreement, was signed in 2005. It calls upon the two Class 1 railroads to reduce diesel emissions in and around railyards in California including a statewide locomotive idling limitation program, increase use of low-sulfur diesel for locomotives fueled in California, and a visible emissions detection and repair program.

In 2010, the Ports of Los Angeles and Long Beach updated the San Pedro Bay Ports Clean Air Action Plan that includes a measure calling nearly all locomotives entering the Ports and nearby intermodal yards to meet an emissions goal of Tier 4 by 2020.

PROPOSED METHOD OF CONTROL

The proposed measure carries forward the freight locomotive control measures from the 2007 SIP. The measure calls for replacing existing locomotive engines with Tier 4 engines beginning 2015 such that by 2023, there will be at least 95% Tier 4 locomotives operating in the South Coast Air Basin. CARB would seek further emission reductions from freight locomotives through enforceable mechanisms within its authority. In addition, the Ports as landlords of the property which the near-dock railyards operate have the ability to negotiate (either through lease agreements or environmental mitigation measures) the use of Tier 4 locomotives to achieve the emission reductions provided in this measure. As part of the proposed efforts, the District and CARB will work with U.S. EPA to develop additional enforceable mechanisms to ensure that the proposed control measure is fully implemented by 2023.

EMISSIONS REDUCTION

It is estimated that by 2023, this measure would reduce NOx by 70 percent and direct PM2.5 by about 75 percent. Full implementation of the proposed control measure would result in a 12.7 tons/day reduction in NOx and 0.32 tons/day reduction in PM2.5 emissions by 2023.

COST EFFECTIVENESS

The cost-effectiveness will be determined after further discussion with CARB and railroads.

IMPLEMENTING AGENCY

U.S. EPA has the legal authority to adopt emission standards for locomotives. CARB has developed voluntary agreements with the Class I railroads for further emission reductions. In addition, the Ports of Los Angeles and Long Beach have the ability as landlords to negotiate certain conditions on leases and other contractual arrangements, potentially including port-wide conditions.

REFERENCES

CARB (2009). Technical Options to Achieve Additional Emissions and Risk Reductions from California Locomotives and Railyards.

U.S. Environmental Protection Agency (2008). Control of Emissions of Air Pollution From Locomotive Engines and Marine Compression-Ignition Engines Less Than 30 liters per Cylinder: Republication; Final Rule, 40 CFR Parts 9, 85, et. al.

Port of Los Angeles and Long Beach (2010). San Pedro Bay Ports Clean Air Action Plan, 2010 Update.

OFFRD-03: FURTHER EMISSION REDUCTIONS FROM PASSENGER LOCOMOTIVES [NOX, PM]

CONTROL MEASURE SUMMARY		
SOURCE CATEGORY:	LOCOMOTIVE ENGINES (PASSENGER)	
CONTROL METHODS:	ACCELERATED REPLACEMENT OF EXISTING LOCOMOTIVE ENGINES MEETING TIER 4 OR CLEANER EXHAUST STANDARDS	
EMISSIONS (TONS/DAY):		
ANNUAL AVERAGE	**2008**	**2023**
NOX INVENTORY	3.94	4.46
NOX REDUCTION		2.96
NOX REMAINING		1.50
PM10 INVENTORY	0.083	0.094
PM10 REDUCTION		0.088
PM10 REMAINING		0.006
PM2.5 INVENTORY	0.076	0.086
PM2.5 REDUCTION		0.062
PM2.5 REMAINING		0.024
SUMMER PLANNING INVENTORY	**2008**	**2023**
NOX INVENTORY	3.94	4.46
NOX REDUCTION		2.96
NOX REMAINING		1.50
CONTROL COST:	THE COST-EFFECTIVENESS OF THIS MEASURE WILL VARY DEPENDING ON THE TYPE OF CONTROL EQUIPMENT. THE AVERAGE COST-EFFECTIVENESS IS ESTIMATED TO BE AROUND $5,000/TON.	
IMPLEMENTING AGENCY:	SOUTHERN CALIFORNIA REGIONAL RAIL AUTHORITY (METROLINK)	

DESCRIPTION OF SOURCE CATEGORY

The purpose of this control measure is to promote earlier and cleaner replacement or upgrade of existing passenger locomotives to meet Tier 4 locomotive emission standards.

Background

Diesel-electric locomotives have a large diesel engine (main traction engine) for generating electric power which in turn drives electric motors in each axle. Passenger locomotives have engines with about 3,800 horsepower and four drive axles. U.S. EPA emission standards affect 1973-2001 locomotives upon engine rebuild and new 2002 and later locomotives. Locomotives remain in commercial service from 25 to 40 years.

Two passenger railroads, Metrolink and Amtrak, operate passenger train service in the South Coast Air Basin. Metrolink operates seven service lines, 55 stations, and moves approximately 40,000 passengers daily over a 512 track-mile network located almost exclusively within the South Coast Air Basin. Amtrak operates three interstate routes and one intrastate route that travel through the Basin. Metrolink locomotives contribute approximately 77 percent of the emissions of NOx and PM2.5, with Amtrak locomotives responsible for the remainder. Metrolink's fleet consists of approximately 60 percent older Tier 0 locomotives with the remainder being locomotives that meet the Tier 2 emission standards. Metrolink plans to upgrade their fleet so that all locomotives will meet the cleanest (Tier 4) emission standards from 2014 through 2016 which will result in a fleet with at least 85 percent lower emissions. Amtrak's fleet that travels in the South Coast Air Basin is almost exclusively locomotives meeting the Tier 0 emission standards and plans are being made to upgrade them to Tier 0+ emission standards.

Regulatory History

U.S. EPA promulgated regulations for the control of emissions from locomotives in 1998 and 2008. The regulations require locomotives to meet increasingly more stringent emission levels (Tier 0 thru Tier 4) when they are manufactured and in some cases additional emissions improvements when they are remanufactured at the end of their useful life. For newly manufactured passenger locomotives the cleanest emission standards (Tier 4) are required beginning in 2015 and will result in emissions that are over 90 percent cleaner than those from unregulated locomotive engines. For passenger locomotives manufactured before 2012 (i.e., meeting Tier 0, 1 or 2 emission standards), modest emissions improvements (referred to as "plus" standards) are required at the date of remanufacture which usually occurs seven to 10 years after the new locomotive is put into service.

Locomotives by design remain in operation for a long time (typically over 30 years). As such, emission reductions from natural turnover of the passenger locomotive fleet will take many years to be realized. Additionally, as most of the passenger locomotives operating in the Basin meet the Tier 0 or Tier 2 standards, they are only required to meet the more modest Tier 0 plus and Tier 2 plus standards on remanufacture unless they are replaced with new locomotives.

PROPOSED METHOD OF CONTROL

Metrolink's Board (Southern California Regional Rail Authority) has adopted a locomotive replacement plan which includes the procurement of Tier 4 locomotive engines to replace its 30 Tier 0 locomotives over a three-year period. In addition, the replacement plan calls for repowering the existing Tier 2 locomotives to Tier 4 emissions levels. These actions will result in 100% Tier 4 passenger locomotives by 2023.

In addition, the District will encourage Amtrak to replace or repower their Tier 0 locomotives to meet Tier 4 locomotive emission standards starting in 2015 rather than remanufacturing these engines.

EMISSIONS REDUCTION

Emission reductions are estimated to be 2.96 tons/day for NO_x and 0.06 tons/day PM2.5 in 2023.

COST EFFECTIVENESS

Metrolink staff estimates that upgrading their oldest locomotives will cost approximately $3.4 million per locomotive, and for their newer locomotives, approximately $2.4 million each. Total cost to upgrade the fleet will be approximately $150 million. Assuming a 20-year locomotive life, the cost effectiveness of the upgrades will be in the range of $5,000 per ton of emissions reduced.

IMPLEMENTING AGENCY

The Southern California Regional Rail Authority will be considering the procurement of Tier 4 locomotive engines.

REFERENCES

Southern California Regional Rail Authority (2012). Adoption of Locomotive and Equipment Fleet Plan.

OFFRD-04: FURTHER EMISSION REDUCTIONS FROM OCEAN-GOING MARINE VESSELS WHILE AT BERTH [ALL POLLUTANTS]

CONTROL MEASURE SUMMARY		
SOURCE CATEGORY:	AUXILIARY ENGINES AND BOILERS ON OCEAN-GOING MARINE VESSELS	
CONTROL METHODS:	USE OF SHORE-SIDE ELECTRICAL POWER OR OTHER EQUIVALENT CLEAN TECHNOLOGIES	
EMISSIONS (TONS/DAY):		
ANNUAL AVERAGE	**2008**	**2023**
VOC INVENTORY	0.52	0.47
VOC REDUCTION		TBD*
VOC REMAINING		TBD
NOX INVENTORY	13.7	7.06
NOX REDUCTION		TBD*
NOX REMAINING		TBD
SOX INVENTORY	16.8	2.11
SOX REDUCTION		TBD*
SOX REMAINING		TBD
PM10 INVENTORY	1.42	0.33
PM10 REDUCTION		TBD*
PM10 REMAINING		TBD
PM2.5 INVENTORY	1.38	0.33
PM2.5 REDUCTION		TBD*
PM2.5 REMAINING		TBD
SUMMER PLANNING INVENTORY	**2008**	**2023**
VOC INVENTORY	0.53	0.47
VOC REDUCTION		TBD*
VOC REMAINING		TBD
NOX INVENTORY	13.7	7.06
NOX REDUCTION		TBD*
NOX REMAINING		TBD
CONTROL COST:	TO BE DETERMINED	
IMPLEMENTING AGENCY:	SAN PEDRO BAY PORTS, CARB, SCAQMD	

* Emission reductions will be determined after projects are identified and implemented.

DESCRIPTION OF SOURCE CATEGORY

The purpose of this control measure is to incentivize additional controls on auxiliary engines and boilers on ocean-going marine vessels while at berth.

Background

Ocean-going vessels (OGV) visit the Ports of Los Angeles and Long Beach over 4,500 times per year and can remain at berth for up to 48 hours or more loading and unloading cargo. While at berth (also called hotelling), ships use auxiliary engines to provide electricity and boilers to provide steam while the ship is in operation. Ships require electrical power while at berth for operation of lights, ventilation, and loading and unloading operations and steam is used for heating. Beginning August 2012 until January 1, 2014, auxiliary engines and boilers use diesel oil that can contain sulfur levels as high as 10,000 ppm (as compared to diesel used by other mobile vehicles at 15 ppm). These engines and boilers produce significant amounts of NO_x, SOx, PM, and toxic air contaminant (TAC) emissions. A typical medium-size cargo ship burns seven tons of diesel fuel a day while at the port, and generates as much as one ton of NO_x, 0.5 tons of SOx and 60 pounds of PM10 daily. Overall, auxiliary engines produce upwards of 12.3 tpd of NOx, 6.0 tpd of Sox, and 0.88 tons per day of PM10 in the South Coast Air Basin each year with boilers contributing the remainder of the at-berth NOx, SOx, and PM10 emissions of 1.3, 10.6, 0.52 tpd, respectively.

This early action measure focuses on having ocean-going vessels not subject to the statewide shorepower regulation to cold iron, which is a technology that is used to provide on-board power from the shore, while berthed at the Ports of Los Angeles and Long Beach. Other technologies that are currently being evaluated include a bonnet system to funnel ship exhaust emissions into filter and NOx reduction systems, and are considered under this measure.

Regulatory History

The regulation of emissions from ocean-going vessels is primarily accomplished through CARB and U.S. EPA regulations. Cargo container, cruise lines, and refrigerated cargo (reefers) vessels are subject to CARB's shorepower regulation which requires fleets that have vessels that frequently visit California ports (for cargo container and reefers - 25 visits per year or more, and for cruise liners - five visits or more per year) to reduce emissions from their fleets by 50 percent beginning in 2014 and by 80 percent in 2020. Strategies to control emissions include shorepowering of vessels (utilizing grid based electrical power in lieu of auxiliary engines) and exhaust after-treatment by ducting exhaust gases from auxiliary engines and boilers to treatment systems.

PROPOSED METHOD OF CONTROL

Electrical power for hotelling operations can be provided to a ship via electrical cables using shorepower. Shorepower can be locally generated at the port or obtained from the grid. Shorepower can be locally generated using clean technologies such as fuel cells, gas turbines, microturbines, and combined cycle units. These stationary power generating systems can use alternative fuels such as natural gas, reducing emissions to very low levels. The in-Basin grid power generation NO_x emission factor is significantly lower than that of diesel-fueled engines

especially because most stationary power generating units have installed selective catalytic reduction (SCR) control technologies. The use of shorepower for hotelling operations is termed "cold ironing."

Due to technical and operational (i.e., frequency of calls) reasons, however, cold ironing may not be a viable option for all types of ships. Also, ships require steam for hotelling operations. If all the electrical power for hotelling is supplied by cold ironing, steam must be provided from the ship's boilers or the shore to the ships. Based on energy consumption, steam can account for as much as 30 percent of all energy used during hotelling.

This measure would seek at a minimum, an additional 25 percent of the calls not subject to the statewide shorepower regulation to deploy shorepower technologies or alternative forms of emission reductions as early as possible.

EMISSIONS REDUCTION

Emission reductions are not estimated at this time and will depend on the number of vessels participating and the type of technology utilized.

COST EFFECTIVENESS

CARB staff estimated the cost effectiveness of the regulation to range from $11,000 to $47,000 per ton of NOx controlled as part of the adoption of the statewide Shorepower Regulation. TIAX under contract to the District evaluated the bonnet system that funnels the emissions to a shore-side treatment system. The cost effectiveness of this system range from $15,000 to $45,000 per ton of NOx controlled. The expected cost effectiveness of this control measure should fall within the ranges of these two studies.

IMPLEMENTING AGENCY

San Pedro Bay Ports, CARB, SCAQMD.

REFERENCES

CARB (2007). Initial Statement of Reasons for the Proposed Rulemaking: Regulations to Reduce Emissions From Diesel Auxiliary Engines on Ocean-Going Vessels While At-berth at a California Port.

Ports of Los Angeles and Long Beach (2010). San Pedro Bay Ports Clean Air Action Plan, 2010 Update.

TIAX (2008). Evaluation of the Advanced Maritime Emission Control System (AMECS), Report to South Coast Air Quality Management District.

OFFRD-05: EMISSION REDUCTIONS FROM OCEAN-GOING MARINE VESSELS [NOX, PM]

CONTROL MEASURE SUMMARY		
SOURCE CATEGORY:	MARINE VESSELS (CATEGORY 3 ENGINES)	
CONTROL METHODS:	PORTS INCENTIVES FOR TIERS 2 AND 3 OCEAN-GOING VESSEL CALLS	
EMISSIONS (TONS/DAY):		
ANNUAL AVERAGE	**2008**	**2023**
NOX INVENTORY	25.7	24.1
NOX REDUCTION		TBD*
NOX REMAINING		TBD
PM10 INVENTORY	2.3	0.78
PM10 REDUCTION		TBD*
PM10 REMAINING		TBD
PM2.5 INVENTORY	2.2	0.74
PM2.5 REDUCTION		TBD*
PM2.5 REMAINING		TBD
SUMMER PLANNING INVENTORY	**2008**	**2023**
NOX INVENTORY	25.7	23.2
NOX REDUCTION		TBD*
NOX REMAINING		TBD
CONTROL COST:	THE CONTROL COSTS VARY WITH THE TYPE OF CONTROL TECHNOLOGY IMPLEMENTED	
IMPLEMENTING AGENCY:	SAN PEDRO BAY PORTS, CARB, U.S. EPA	

* Emission reductions will be determined after the vessel participation rates are reported.

DESCRIPTION OF SOURCE CATEGORY

The purpose of this measure is to incentivize the newest Tier 2 and Tier 3 vessels to call at the Ports of Los Angeles and Long Beach.

Background

Ocean-going vessels (OGV), because of their large relatively-uncontrolled diesel engines, contribute a significant portion of NO_x, PM, greenhouse gas and toxic emissions particularly in coastal regions and in and around shipping ports. OGV engines can range in size from 1,000 to over 100,000 horsepower and can burn significant amounts of fuel a day. Beginning in 2016,

vessels built to operate in North American waters will be required to meet emission standards requiring exhaust emission controls that will be significantly cleaner than today's engines. However, because of OGV long lifetimes (on the order of 20 or more years), it will be many years before sufficient numbers of the cleanest vessels will call at marine ports in the region to significantly reduce emissions. Moreover, post-2015 vessels may not be routed to North American ports. It is essential that the cleanest vessels be incentivized to call at marine ports as expeditiously as possible to ensure progress toward meeting ambient air quality standards.

Regulatory History

The regulation of emissions from mobile port-related emission sources is traditionally the responsibility of CARB and U.S. EPA. Specifically, ships are each subject to specific emission standards pursuant to state, federal, and/or international requirements. The standards, primarily affecting new units, vary in stringency and compliance dates.

OGV main and auxiliary engines are subject to the International Maritime Organizations international emission standards as contained in Annex VI to the International Convention on the Prevention of Pollution from Ships (MARPOL Annex VI). U.S. flagged ships must meet similar U.S. EPA requirements, but most vessels must meet the IMO standards as they are not U.S. flagged ships. In October 2008, the IMO adopted new standards for engines and require vessels to meet increasingly more stringent NOx emission standards. The standards are designated by Tiers ranging from Tier 0 being uncontrolled or no emission controls, to the most stringent Tier 3 standard. Tier 2 NOx emission standards are around 20% cleaner than Tier 0 standards and can be achieved through engine design changes. The Tier 3 NOx standard is significantly more stringent (better than 80 percent cleaner) and most likely can only be met using engine aftertreatment systems. Engines on vessels must meet the Tier 3 NOx standard if they are built after 2015 and must travel through designated Emission Control Areas (ECA). ECAs can be created by member states if approved by the IMO. On March 26, 2010, the IMO designated waters within 200 nautical miles of the United States and Canadian coasts as the North American ECA.

In addition to NOx emission requirements, IMO and CARB require vessels to use lower sulfur distillate fuels when the vessels travel within 200 nautical miles (as defined in the ECA) or 24 nautical miles of the California coastline (as defined in the CARB regulation). By 2015, all vessels will be required to use distillate fuels with sulfur contents less than 1,000 ppmw when they travel within the North American ECA.

PROPOSED METHOD OF CONTROL

As part of the San Pedro Bay Ports Clean Air Action Plan 2010 update, the Ports adopted incentive programs to maximize the early introduction and preferential deployment of vessels to the San Pedro Bay Ports with cleaner/newer engines meeting the new Tier 2 and Tier 3 IMO NOx standards. The Port of Long Beach is proposing to offer up to $2,500 for each Tier 2 vessel call and up to $6,000 for each Tier 3 vessel call. The Port of Los Angeles is proposing a scoring standard based on the "Environmental Ship Index" or ESI to establish the level of incentive funding. The Ports indicated that the program will be monitored annually regarding participation and if adjustments will be necessary to maximize Tier 2 and Tier 3 vessel calls.

This measure seeks to enhance the Ports' programs as necessary to maximize the number of Tier 3 vessels calling at the Ports. In addition, other mechanisms that could complement the Port program will be explored. Examples include discussions on the state and federal level on mechanisms to incentivize Tier 2 and Tier 3 vessel calls through the North American ECA and programs to retrofit or repower existing vessels to meet Tier 3 standards.

EMISSIONS REDUCTION

Based on the assumed penetration of new Tier 2 and Tier 3 vessels in the U.S. EPA rulemaking, this measure could achieve, at a minimum, NOx, PM10, and PM2.5 reductions of 2.8 tpd, 0.1 tpd, and 0.09 tpd, respectively, by 2023. Emission reductions could be higher if the participation rate of the Ports programs and other potential programs are greater than anticipated.

COST EFFECTIVENESS

Not Determined.

IMPLEMENTING AGENCY

San Pedro Bay Ports relative to existing incentives programs. San Pedro Bay Ports, CARB, U.S. EPA, and the District relative to seeking additional mechanisms to incentivize Tier 3 vessel calls at the state and federal levels.

REFERENCES

Ports of Los Angeles and Long Beach (2010). San Pedro Bay Ports Clean Air Action Plan, 2010 Update.

GROUP 3

ACTIONS TO DEPLOY ADVANCED CONTROL TECHNOLOGIES

ADV-01: ACTIONS FOR THE DEPLOYMENT OF ZERO AND NEAR-ZERO EMISSION ON-ROAD HEAVY-DUTY VEHICLES [NOX, PM]

CONTROL MEASURE SUMMARY	
SOURCE CATEGORY:	ON-ROAD HEAVY-DUTY VEHICLES (26,001 LBS AND GREATER)
CONTROL METHODS:	ADVANCED NEAR-ZERO AND ZERO-EMISSION TECHNOLOGIES
EMISSIONS (TONS/DAY):	NOT ESTIMATED
CONTROL COST:	THE CONTROL COSTS VARY WITH THE TYPE OF CONTROL TECHNOLOGY IMPLEMENTED
IMPLEMENTING AGENCY:	SCAQMD, SCAG, LOS ANGELES COUNTY TRANSPORTATION AUTHORITY, SAN PEDRO BAY PORTS, CARB, CALTRANS, U.S. EPA

DESCRIPTION OF SOURCE CATEGORY

The technology and infrastructure phases, combined with the agency implementation actions, focus on defining, developing, demonstrating and deploying transportation systems and technologies that will address mid- to long-term regional needs. These actions seek to develop coordinated solutions for mobility, economy, energy and the environment, so that single investments can provide multiple benefits. A key strategy is to deploy zero- and near-zero freight transport equipment powered by clean energy. This strategy has the potential to simultaneously address regional and local air quality problems, foster public support for needed freight infrastructure capacity enhancements, provide greater energy security and cost certainty, address climate change, and foster local jobs in logistics and clean technology.

Background

This measure describes the actions needed to commercialize advanced zero-emission and cleaner combustion emission technologies that could be deployed in the 2015 to 2035 timeframe. Such technologies include advanced engine controls to achieve at least 95 percent reduction in NOx exhaust emissions beyond the current 2010 heavy-duty exhaust emissions standards or a combination of advanced engine controls deployed with electric hybrid systems and zero-emission technologies such as electric, battery-electric, and fuel cells. In addition, greater use of any alternative fuels and renewable fuels with relatively low NOx emissions compared to conventional fuels, in conjunction with zero-emission technologies, are important over the next 10 to 20 years for any vehicle vocations where zero-emission technologies could not be applied in that timeframe.

Regulatory History

The establishment of emission standards for on-road heavy-duty diesel emission sources is the responsibility of CARB and U.S. EPA. Specifically, heavy-duty vehicle engines are subject to

specific emission standards pursuant to state and/or federal requirements. Emission standards for new diesel engines powering heavy-duty vehicles were first established for the 1973 model-year and have gradually increased in stringency over time. The current most stringent set of heavy-duty engine emission standards has been established by CARB and U.S. EPA for 2010 and subsequent model-years, which includes a 0.2 g/bhp-hr NO_x emission standard.

In December 2008, CARB adopted the Truck and Bus Regulation which applies to a significant number of heavy-duty vehicles with gross vehicle weight ratings of 14,001 lbs and greater. Heavier trucks (26,001 lbs and greater) must meet regulatory requirements beginning January 1, 2012. Lighter trucks (14,001 lbs to 26,000 lbs) must meet regulatory requirements beginning January 1, 2015.

In the South Coast Air Basin, the two national ozone standards established by U.S. EPA will require reductions in emissions of nitrogen oxides (NOx) well beyond reductions resulting from current rules, programs and commercially-available technologies. Because most significant emission sources are already controlled by over 90 percent, attainment of the ozone standards will require broad deployment of zero- and near-zero emission technologies in the 2015 to 2035 timeframe.

PROPOSED METHOD OF CONTROL

Two separate sets of actions are proposed under this measure. The first is the establishment of an optional NOx exhaust emissions standard that is at least 95 percent lower than the current 2010 on-road exhaust emissions standard (i.e., at or below 0.01 g/bhp-hr). The second set of actions is to develop zero-emission technologies for heavy-duty vehicles that can be deployed in the 2015 to 2035 timeframe.

Actions to Deploy Technologies to Achieve 95 Percent or Greater Reductions in NOx

This proposed action seeks CARB to establish an optional NOx exhaust emissions standard which represents a 95 percent reduction of the 2010 standard or 0.01 g/bhp-hr. The optional NOx standard serves as a benchmark for heavy-duty engine manufacturers to develop the next generation of cleaner combustion engines. Such engines in combination with the ability to achieve a specific level of zero-emission miles are likely to be developed in the near-term to achieve the proposed optional NOx exhaust emission standard. In addition, having optional NOx emission standards provides certainty in funding incentives, by establishing a standard for engines to meet in order to receive incentives.

Actions to Deploy Zero-Emission Technologies for On-Road Heavy-Duty Vehicles

There has been much progress in developing on-road technologies with zero- and near-zero emissions, particularly for light-duty vehicles and passenger transit. In general, however, additional technology development, demonstration and commercialization will be required prior to broad deployment of zero-emission technologies for freight movement. The actions and schedules specified below describe a path to evaluate, develop, demonstrate, fund and deploy such technologies for on-road heavy-duty vehicles.

Infrastructure Planning Actions. Part of the actions and schedules specified below involve evaluations and determinations regarding infrastructure needed to support deployment of zero- and near-zero emission technologies. The key question is whether on-road trucks will be able to operate fully under their own power with zero-emission technologies, or whether that equipment will require some form of "wayside" electric or magnetic power built into the roadway infrastructure to boost the pulling capacity or range of the equipment.

This may include battery charging or fueling infrastructure, as well as transportation infrastructure such as dedicated truck lanes. Such lanes can provide opportunities to incentivize zero-emission vehicles (e.g., through discounts of any applicable tolls) as well as to provide wayside electric power to trucks, much as power is now provided to electric transit buses in San Francisco and other cities. Alternatively, if battery, fuel cell or other zero- and near-zero emission technologies progress sufficiently, the need for wayside power for rail or trucks may be diminished or eliminated.

There are multiple technologies under consideration, and each must be analyzed to assess utility and practicality, costs, benefits, and reliability. Some technologies are more developed than others; some may have a quicker ramp-up to commercialization than others. A path forward to development and deployment of a long-term freight system is set out below, including a schedule with milestones and key decision points.

Phase 1: Project Scoping and Existing Work

Continue to build on current regional research and technology testing efforts.

Southern California has long been a goods movement hub, and a significant amount of work has already been done to assess current and future goods movement volumes; to explore the range of technologies under consideration; to evaluate user needs and potential markets; to analyze current and projected transportation corridors and select the highest priority corridors; and to begin to develop and test some vehicle prototypes. That work has already been initiated, and constitutes Phase 1 of the effort to develop and implement a long-term freight system.

A high level summary of the work completed or underway in Southern California is provided below, along with the challenges that remain for successful commercialization and widespread deployment of zero- or near-zero emission truck technologies.

Existing Work

Over the last five years, studies have assessed the transportation corridors that currently carry high volumes of freight truck traffic and are likely to be heavily impacted in the future.[3] The I-710 corridor was selected as high priority for introduction of zero-emission technology.[4] The 2012 Regional Transportation Plan also designates a route along the 60 freeway as an east-west freight corridor.

[3] Los Angeles County Metropolitan Transportation Authority, et al, *Multi-County Goods Movement Action Plan.* Prepared by Wilbur Smith Associates, April 30, 2008.

[4] Los Angeles County Metropolitan Transportation Authority , *Alternative Goods Movement Technology Analysis-Initial Feasibility Study Report. Final Report. I-710 Corridor Project EIR/EIS*. Prepared by URS. January 6, 2009.

The truck technologies being assessed for a zero-emission freight transport system can be grouped into two categories: zero-emission trucks alone and zero-emission trucks combined with wayside power systems. Zero-emission trucks using their own motive power would have significantly smaller infrastructure needs but would be limited in their applicability by the technology. Integrating infrastructure, such as wayside power, with the truck technology would provide a system to power trucks while on the road and thereby significantly increase the utility and range of the trucks while operating in zero-emission mode.

Zero-emission truck technology includes full battery-electric trucks, fuel cell trucks, and dual-mode (hybrid) electric trucks with all-electric range. Battery-electric trucks are established in smaller trucks and in a variety of different vocations. Fuel cell trucks – either with a small battery pack or with the fuel cell as a range extender with a larger battery pack – have been demonstrated in other categories and are seeing significant progress in both light- and heavy-duty vehicle applications.

Dual-mode trucks would have sufficient battery power to operate in electric-only mode, but would also have a source of motive power (internal combustion engine running on diesel, natural gas, hydrogen, or other fuel) that provides flexibility for longer routes. The terminology of dual-mode is being used here to signify a truck with a distinct all-electric range as opposed to most current hybrids which use a battery and electric motor to augment an internal combustion engine.

Wayside power technologies include overhead catenary, in-road power such as third rail or linear synchronous motor (LSM), and fast charging. All three technologies must be integrated closely with the zero-emission trucks, and all have the potential to significantly increase the functionality and range of trucks utilizing batteries, including dual mode-hybrids. (It is unlikely that fuel cell trucks would need wayside power, due to their range and relatively quick refueling capability). In overhead catenary systems, power is delivered from the electrical grid through the overhead wire to a pantograph on the vehicle itself. Catenary systems are well-established and efficient in light-rail applications, trolley cars and buses, and even mining trucks.

For in-road power, the roadway itself provides power to the vehicles, which must be equipped with pick-up devices. In one technology, cables/wires embedded in the roadway carry electric power; in another technology, LSMs provide power by interacting with a permanent magnet on the vehicle. In-road power systems have advantages but the technology is currently less developed than catenary. Fast-charging is a high-power charging system used to quickly recharge the batteries in an electric vehicle at destination points, e.g., railyards or distribution centers. While technically not "wayside" power, fast charging is similarly grouped with other approaches that require infrastructure to be designed and built into the freight facilities and corridors.

Zero-emission truck prototype testing is underway with funding from the Port of Los Angeles, the Port of Long Beach, and the District. A demonstration of the Balqon lead-acid battery electric truck was initiated in 2007. The battery was upgraded to a lithium-ion battery, and testing of the upgraded system is underway. Additional testing is ongoing with units made specifically for drayage by Vision Motor Corporation, using a combination of lithium-ion batteries and fuel cells.

Phase 2: Evaluation, development, and prototype testing

Overview. The actions described below are directed at developing and demonstrating truck technologies for regional service, developing and demonstrating truck technologies for interstate transport, and evaluating the logistics impacts of a zero- or near- zero emission freight system.

Near-Term Major Infrastructure Project Approvals. In the near term, while the technology development and demonstration actions described below are being undertaken, it is anticipated that several major regional infrastructure projects will be considered for approval. These include the I-710 freight corridor project, the BNSF Southern California International Gateway railyard project, and the Union Pacific Intermodal Container Transfer Facility modernization and expansion project. These proposed projects will, if approved, comprise key portions of regional freight infrastructure for many decades to come. (Other major projects may also be considered for approval in this timeframe). The action to approve such projects will be a key opportunity to establish appropriate operating and environmental requirements for the infrastructure. In some cases, the project approval action may be the only opportunity to establish requirements. *It is therefore important that such project approvals be fashioned to assure that the projects participate in the technology development and demonstration activities for trucks described below, and that the project approvals ensure implementation of resulting technologies when determined to be feasible.*

Port to Near-Dock Railyard Transport. The case of container transport between the ports and the near-dock railyards is unique. Such transport presents fewer technical and other issues compared to regional transport due to the relatively short distances involved — about five miles. In addition, as described in the Roadmap for Moving Forward with Zero Emission Technologies at the Ports of Long Beach and Los Angeles,[5] the ports have already done considerable work to evaluate and develop truck technologies for this service, and battery and fuel cell hybrid vehicles are now being actively demonstrated. It is also possible that zero-emission trucks for this relatively short corridor can be successfully deployed without wayside power (although, as noted below, this corridor would be a good location to initially demonstrate wayside power technology that ultimately could be deployed for longer range regional transport). Finally, the total number of trucks needed for this service is limited compared to the thousands of vehicles needed for regional service. The number required between the ports and near-dock railyards is likely approximately 500 per railyard.

The truck technologies being developed and demonstrated for container transport between the ports and near-dock railyards can form the basis of technologies used in the region as a whole. For example, development of trucks capable of operating on electric power, even for relatively short distances, can potentially be coupled with wayside power to extend zero-emission range farther through the region. Fuel cell hybrid truck technologies hold the promise of extended range without wayside power. The current effort to develop and demonstrate zero-emission truck technologies for the port to near-dock railyard application thus should be viewed as an important initial part of the effort to develop regional zero-emission transport.

[5] http://www.cleanairactionplan.org/civica/filebank/blobdload.asp?BlobID=2527

For these reasons, it is appropriate that the schedules for technology development and demonstration activities, and technology deployment, reflect the potential for earlier technology implementation between the ports and near-dock railyards than for the region as a whole. The schedules specified below for regional zero-emission truck technology deployment extend from 2015 to beyond 2021, depending on need for wayside power. *By contrast, the technology development, demonstration and deployment schedules for container transport between the ports and near-dock railyards target full deployment of zero-emission technologies as soon as practicable but no later than 2020.*

Phase 3: Initial deployment and operational demonstration

Truck Fleet Evaluation Testing. Develop, deploy and assess, with local fleet users, multiple vehicles with on-going data collection, analysis and sharing for rapid iterative design improvement.

Further Demonstrate Wayside Power. Demonstrate the ability to introduce and power multiple trucks on a test corridor.

Select Truck Corridor Technologies and Needed Infrastructure for Phase 4 Deployment. Assess whether viable truck technologies will require wayside power or other infrastructure. Incorporate needed infrastructure into constrained portion of RTP for corridors determined to be high priority based on potential truck volumes.

Phase 4: Full scale demonstrations, commercial deployment and infrastructure construction (if wayside power is needed)

Phases 1-3 are designed to bring truck technologies and needed infrastructure to the beginning of commercial deployment. This timing corresponds well with needed decisions for what technologies and infrastructure to include in the 2016 RTP, the next major SIP, and the I-710 corridor. The results of the first three phases will be used to determine the concrete commercialization steps needed in Phase 4, especially the regulatory and market mechanisms needed to launch and expand commercialization. In addition, it is necessary to continue expanding plans for any needed wayside power infrastructure to additional high priority corridors (e.g., priority East-West corridor route identified by SCAG). The timing for this step is highly dependent on the need for wayside power if needed, and the construction of such infrastructure.

Actions

- By 2013 – Demonstration: Develop and build trucks and wayside power infrastructure sufficient for demonstration within the transport corridor consisting of the Terminal Island Freeway and connecting routes to the Ports (or alternative routes serving the same locations); commence demonstration upon completion of trucks and infrastructure.

- By 2015 – Initial Operational Deployment: Build wayside power infrastructure sufficient for operation on the Terminal Island Freeway and connecting routes to the Ports (or alternative routes serving the same locations), and build maximum number of trucks for initial operational deployment allowed by available funding (with all feasible leveraging of

private resources), unless a zero-emission technology not utilizing wayside power is determined to be superior and can be implemented in a similar or earlier time frame. In the latter case, remaining funds allocated to this project will be applied to demonstration and deployment of zero-emission trucks not utilizing wayside power.

Major Agency Implementation Actions

YEAR(S)	AGENCY	AGENCY ACTION
2012	SCAG	• Incorporate "footprint" and planning for incorporation of wayside power into regional truck lanes in 2012 constrained RTP • Incorporate funding to support truck and wayside power evaluation and demonstration efforts described in this chapter into constrained portion of RTP • Implement plan of advocacy to secure action by federal or other governments where required to implement any related elements of the SIP or RTP; include evaluation of impacts of zero-emission technologies on national priorities, e.g., energy security, energy cost certainty, interstate transportation, climate protection.
2012-2014	District, CARB, and SCAG	• Evaluate and demonstrate potential truck technology implementation and funding mechanisms, including: ▪ Regulatory requirements; incentives (local, state, federal, interstate cooperative); differential tolls; public-private partnerships • Evaluate potential funding mechanisms for truck infrastructure (e.g., wayside power), including: ▪ federal, state, local government funding; tolling; public-private partnerships; electric utility funding of corridor construction

Major Agency Implementation Actions

YEAR(S)	AGENCY	AGENCY ACTION
2015	District, CARB, and SCAG	• Resolve need for wayside power infrastructure for trucks on I-710 and other corridors beyond near-dock railyards, including East-West corridor (based on expected range and functionality of technologies in zero-emission mode without wayside power in 2020-2030 timeframe) • If wayside power is needed, incorporate such technology description into RTP constrained plan and next major SIP • Develop recommendations regarding type of funding and implementation mechanisms for trucks and any needed infrastructure • Incorporate recommendations regarding type of funding and implementation mechanisms into RTP constrained plan and next major SIP, including: ▪ Strategy description and timeframe for any rules ▪ Strategy description, potential funding sources and timeframe for any incentives
2015-2016	District, CARB, SCAG	Determine need for wayside power infrastructure for trucks on major freight movement corridors. Incorporate decisions regarding type of funding and implementation mechanisms into RTP constrained plan and SIP, including: • Strategy description and timeframe for potential regulatory actions • Strategy description, potential funding sources and timeframe for needed incentives • Begin deployment of zero- and near-zero emission trucks for regional service.
2017+	District, CARB, SCAG	• Begin full deployment of appropriate zero- and near-zero emission trucks for substantially all regional transport. • 2020 – Target for full deployment of zero-emission trucks transporting containers between the ports and near-dock railyard facilities.

EMISSIONS REDUCTION

Not Determined

COST EFFECTIVENESS

Not Determined

IMPLEMENTING AGENCY

SCAQMD, SCAG, Los Angeles County Transportation Authority, San Pedro Bay Ports, SCAG, CARB, Caltrans, and U.S. EPA. In July 2011, the Los Angeles County Metropolitan Transportation Authority formed the Countywide Zero-Emission Trucks Collaborative, which includes the Ports of Los Angeles and Long Beach, Caltrans, SCAG, and the District, to address issues including, but not limited to, developing a common definition of "zero-emission trucks", establishing performance standards, coordinating infrastructure policies/standards, and seeking funding for demonstration projects.

Potential Partners For Development, Testing, Funding, and Deployment of Landside Freight Transport Technology

Achieving zero- or near-zero emissions freight transport is an ambitious goal, but given the current volume of freight movement in Southern California, and the projected increases over the next two decades, accomplishing this goal is critical to economic and public health in the region. Success will require private companies and public agencies working together with a shared vision and a commitment to address the practical issues to ensure efficient operations.

Following is a partial list of entities that will be contacted to seek a contribution of expertise, in-kind services, equipment, space, and/or funding to support the effort.

Government:
California Department of Transportation
Southern California Association of Governments and its member agencies
Los Angeles County Metropolitan Transportation Authority
Alameda Corridor Transportation Authority

U.S. Environmental Protection Agency
California Air Resources Board and air quality agencies in other states
South Coast Air Quality Management District

U.S. Department of Energy
California Energy Commission

Port of Long Beach
Port of Los Angeles

Private:
Commercial Technology Developers and Manufacturers
Trucking
Rail
Shipping
Warehousing and Distribution Centers
Logistics Supply Chain Specialists
Beneficial Cargo Owners

Non-Profit and Academic:
CALSTART
Center for Environmental Research and Technology (CE-CERT)
Philanthropic Foundations in Coordination with Environmental Organizations
Academic Institutions with Specialized Knowledge in Logistics Field

REFERENCES

SCAG (2012) Regional Transportation Plan, Adopted

ADV-02: ACTIONS FOR THE DEPLOYMENT OF ZERO-EMISSION AND NEAR-ZERO LOCOMOTIVES [NOX, PM]

CONTROL MEASURE SUMMARY	
SOURCE CATEGORY:	LOCOMOTIVES (ALL CLASSES)
CONTROL METHODS:	ADVANCED NEAR-ZERO AND ZERO-EMISSION TECHNOLOGIES BEYOND LOCOMOTIVE TIER 4 EMISSION STANDARDS
EMISSIONS (TONS/DAY):	TBD
CONTROL COST:	THE CONTROL COSTS VARY WITH THE TYPE OF CONTROL TECHNOLOGY IMPLEMENTED
IMPLEMENTING AGENCY:	SCAQMD, SAN PEDRO BAY PORTS, CARB, U.S. EPA

DESCRIPTION OF SOURCE CATEGORY

Background

This measure describes the actions needed to commercialize advanced zero-emission and near-zero emission technologies that could be deployed in the 2020 to 2030 timeframe. Such technologies include advanced engine controls or a combination of advanced engine controls with hybrid systems or external power source to power the electric motor to achieve greater reduction in NOx exhaust emissions beyond the Tier 4 locomotive engine emissions standards and zero-emission technologies such as electric, battery-electric, and fuel cells. In addition, greater use of any alternative fuels and renewable fuels with relatively low NOx emissions compared to conventional fuels, in conjunction with zero-emission technologies, are important over the next 10 to 20 years for any locomotive applications where zero-emission technologies could not be applied in that timeframe.

Regulatory History

U.S. EPA promulgated regulations for the control of emissions from locomotives in 1998 and 2008. The regulations require locomotive engines to meet increasingly stringent emission levels (Tier 0 through Tier 4) when they are manufactured and in some cases, additional emissions improvements when they are remanufactured at the end of their useful life. For newly manufactured locomotives the cleanest emission standard (Tier 4) is required in 2015 and will result in emissions that are over 90 percent cleaner than those from unregulated locomotive engines.

Beside the federal emission requirements for locomotives, CARB has signed two agreements with the two Class 1 railroads operating in California, Burlington Northern Santa Fe Railway (BNSF) and Union Pacific Railroad (UP). The first agreement, the South Coast Memorandum of Understanding (MOU), was signed in 1998. Among other features, it commits these railroads to meeting Tier 2 NOx standards, on average, starting in 2010 with their locomotives operating

in the South Coast Air Basin. The second agreement, the Rail Yard Agreement signed in 2005, calls upon the Class I railroads to reduce diesel emissions in and around railyards in California including a statewide locomotive idling limitation program, increase use of low-sulfur diesel for locomotives fueled in California, and a visible-emissions detection and repair program.

In 2010, the Ports of Los Angeles and Long Beach updated the San Pedro Bay Ports Clean Air Action Plan that includes a measure calling for locomotives entering the Ports and nearby intermodal yards to meet a goal of using Tier 4 locomotives by 2020.

PROPOSED METHOD OF CONTROL

Actions for the deployment of near-zero or zero-emission locomotives would include four phases as outlined below:

Phase 1: Project Scoping and Existing Work

Southern California has long been a goods movement hub with locomotives playing a central role. Significant effort has gone into analyzing the options for a zero-emission rail system in the Basin. These include recent efforts by the Ports of Long Beach and Los Angeles in their *Roadmap* study[6] and by SCAG in the freight rail electrification report[7]. Each of these efforts highlights the technical opportunities and the need to pursue a zero-emission freight transport system for the future. However, they also highlight the difficult challenges associated with this sector, especially with regard to operational needs, integration of the technologies into the national rail system, federal safety requirements, and cost.

At this time, several broad technology categories have gained the most focus and could be applied toward freight and passenger locomotives to achieve zero-emissions track miles: overhead catenary (with electric or dual-mode locomotives), linear synchronous motor (LSM) technology, and battery-hybrid systems (either integrated into a new locomotive or as a tender car). Another technology with potential for zero emissions is fuel cells.

In addition, the use of alternative fuels such as liquefied natural gas (LNG) have a potential role in reducing emissions further prior to commercialization of battery-hybrid systems and as a primary fuel in conjunction with battery-hybrid technologies.

Of these technologies, catenary systems are the most extensively used today, although more commonly in passenger train and light-rail applications. LSM systems are less developed, but have potential in terms of being able to use existing rail beds and conventional rail cars, with modifications. Dual mode (i.e., combined diesel-electric and electric capable) locomotives with wayside power have the potential for zero-emission range capability within catenary system areas, and have the ability to minimize operational changes, but have not been developed or demonstrated in a freight application due to insufficient market case or regulatory impetus.

[6] Port of Long Beach and Port of Los Angeles, Roadmap for Moving forward with Zero Emission Technologies at the Ports of Long Beach and Los Angeles, Technical Report, August 2011.

[7] Southern California Association of Governments. *Task 8.2 Analysis of Freight Rail Electrification in the SCAG Region*, Technical Memorandum. Draft Version, Prepared by Cambridge Systematics, August 26, 2011.

General Electric (GE) indicated that Tier 4 diesel-electric locomotives could be augmented with advanced battery technology to allow periodic zero-emission operation. GE indicated that the goal would be for the batteries to be able to provide full power for a line-haul locomotive for up to 30 miles with no emissions from the locomotive engine, operate in the Tier 4 diesel-electric mode for up to 70 miles while also recharging the battery bank, and then return back to the battery mode for the next 30 miles. The fuel savings would allow a one-third downsizing of the fuel storage tank to be able to provide additional space for battery storage within a conventional-length locomotive. This approach would allow the battery mode to be engaged up to twice while operating within the South Coast Air Basin. Under this scenario, the hybrid locomotive could provide up to a 60 percent reduction beyond Tier 4 emissions levels within the Basin.

Another option is the potential use of battery tender cars connected to locomotives to provide power within urban areas with air quality issues. Such a system could provide zero-emission operation with either new or existing locomotives, and would reduce or eliminate the need for wayside power. Tender cars could also potentially be designed to connect existing locomotives to wayside power. The operational impacts of tender car augmentations, the duty cycle and power demands of line haul locomotives, and the power, weight, and costs of battery tender cars – while operating within the South Coast Air Basin – would need to be studied further. However, the potential benefits can be significant since the battery tender car could potentially be used in any urban area and recharged as the train transits from the South Coast Air Basin to its destination. In addition, the use of tender cars addresses the concerns regarding sufficient space for the batteries if they are installed inside the locomotive and capacity and number of batteries needed will not be limited to the dimensions of the locomotive, but to the capacity and dimension of the rail car.

All of these systems and approaches (with the exception of traditional catenary-electric locomotives) will need additional study, research, design, proof of concept testing, and both small and full scale demonstration programs to advance the technology for freight and passenger applications within Southern California. All will need additional examination of means to address operational impacts and costs.

Phase 2: Evaluation, development, and prototype testing (2012 – 2014)

Actions needed to implement phase 2 include:

1. *Secure Funding.* Collaborate with public and private partners to secure funding commitments for the development of new technology locomotive prototypes and infrastructure demonstrations.

2. *Evaluate Practicability of Applying Existing Electrified Rail Technologies to Region*. Conduct an evaluation of the practicability of applying existing electrified rail technologies to the region. Electrified rail technologies are currently used in many countries to move passenger and freight. This evaluation would comprehensively assess the practicability of utilizing such existing technologies for rail service in the South Coast Air Basin.

3. *Develop Locomotive Prototypes and Wayside Power Infrastructure*. This phase involves the development and design validation, and initial proof of concept and prototype testing of several types of zero-emission locomotive technologies and supporting infrastructure. This includes improvements to currently available technologies as well as new technologies that may have cost or operational advantages. Basic performance requirements at this stage include, but not limited to, sufficient tractive power to haul double-stacked railcars, adequate braking capability and other parameters to support safe operation, and the ability to operate in zero-emission mode. This task should seek to further evaluate, develop, and test prototypes for the following technologies, at a minimum:

    - Overhead catenary electric system: Initiate development of an overhead catenary demonstration, with either an all-electric or dual-mode locomotive. The prototype locomotive must be built to provide comparable performance capabilities (e.g., tractive effort) as a U.S. diesel-electric freight locomotive. The prototype electric or dual-mode electric locomotive would need to be tested with an existing electrical rail system (e.g., Amtrak passenger electric rail system for the Acela on the east coast) – assuming the electric rail system has the proper voltage and electrical connections/hardware for the prototype locomotive.

    - LSM technology: Set up a test track and demonstrate proof of concept for an LSM system in a freight locomotive application.

    - Dual-mode with battery-hybrid system: Initiate development of battery-hybrid locomotives with zero-emission range that would achieve up to 60 percent lower than Tier 4 emissions when operating within the South Coast Air Basin

    - Battery tender car: Develop a prototype designed for compatibility with existing U.S. diesel-electric or new Tier 4 locomotives. If the battery tender car is designed for use with catenary systems, similar to the electric or dual-mode locomotives, it would need to be tested within an existing electrical rail system.

    - Other technology options: CARB and the District are currently funding a study by UC Irvine to develop a design for a Solid Oxide Fuel Cell to power a locomotive. The fuel cell will need to be able to generate comparable horsepower as a current U.S. diesel-electric freight line haul locomotive, or about 4,500 gross horsepower. Union Pacific Railroad has agreed to participate in the construction of a prototype fuel cell locomotive upon successful completion.

4. *Select Locomotive Technologies for Phase 3 Demonstration*. Assess the development of the locomotive technologies and infrastructure from Phase 2 programs and select appropriate technologies to proceed with prototype development and testing programs.

Phase 3: Initial deployment and operational demonstration (2014-2016)

Actions needed to implement Phase 3 include:

1. *Conduct Advanced Technology Locomotive Demonstrations*. Evaluate zero-emission line-haul rail technologies with any needed wayside power source on test or operations track

with sufficient length, switches and grades to validate operational feasibility within the Basin. Move most promising technologies to initial demonstration in operational service, preferably within the Basin.

2. *Select Advanced Technology Locomotive Technologies for Phase 4 Deployment*. Assess the development of the locomotive technologies and infrastructure from Phase 3 testing and demonstration programs, and select technologies and infrastructure to proceed to initial deployment.

Phase 4: Full scale demonstrations, commercial deployment and infrastructure construction (if wayside power is needed) (2017-2023)

Actions to implement Phase 4 include:

At this stage, it is still expected that advanced rail technologies will require additional field demonstrations prior to full commercialization. Technology choices need to advance from small scale demonstration phase to full scale demonstration in operational service. New technology deployments must be coordinated with any needed infrastructure. The timing for this step is highly dependent on the need for wayside power (or not) and the construction of such infrastructure.

The actions needed to develop implementation mechanisms (e.g., funding and regulatory mechanisms) to deploy zero and near-zero emission rail technologies as part of a long-term freight system that meets the performance objectives described earlier are provided in the schedule below.

Major Agency Implementation Actions

YEAR(S)	AGENCY	AGENCY ACTION
2012-2013	SCAG	• Identify funding to support rail evaluation and demonstration efforts. • Implement plan of advocacy to secure action by federal or other governments where required to implement any related elements of the SIP or RTP; include evaluation of impacts of zero-emission technologies on national priorities, e.g., energy security, energy cost certainty, interstate transportation, and climate protection. Evaluate and determine practicability of applying existing electrified rail technologies to region. • Evaluate potential funding and implementation mechanisms for zero- and near-zero emission locomotives, and wayside power, including: ▪ Private (railroads); federal, state, local government; public-private partnerships; electric utility.

YEAR(S)	AGENCY	AGENCY ACTION
2012-2014	District, CARB	• Begin discussions on development and deployment of Tier 4 locomotives with footprint to hookup external power source. • Evaluate and determine practicability of external sources of power such as battery tender cars. • Initiate demonstration projects for identified technologies. • If demonstrations of battery tender cars or other zero- and near-zero emission technologies are determined feasible, begin discussions to deploy such technologies on a phase-in basis.
2015-2016	District, CARB, SCAG	• Identify technologies, infrastructure, and implementation mechanisms in RTP amendment and next major SIP. • If existing electrified rail technologies were determined to be practicable for the region, begin infrastructure planning, development and deployment of such technologies.
2017-2018	District, CARB, SCAG	• If new rail technologies are needed to achieve zero- or near-zero emission in the region, determine need for wayside power for new rail technologies (based on expected range of technologies in zero-emission mode without wayside power in 2020-2030 timeframe). • If wayside power is needed, incorporate "footprint" and planning for wayside power into rail lines into 2018 constrained RTP. • Incorporate recommendations regarding type of funding and implementation mechanisms into constrained RTP and next major SIP, including: ▪ Strategy description and timeframe for any rules. ▪ Strategy description, potential funding sources and timeframe for any incentives.
2018+		• If battery tender car or other external sources of electrical power are demonstrated, begin deployment of such technologies. • Construct needed infrastructure for zero-emission technologies, as needed.

EMISSIONS REDUCTION

Not Determined

COST EFFECTIVENESS

Not Determined

IMPLEMENTING AGENCY

SCAQMD, San Pedro Bay Ports, CARB, U.S. EPA.

Potential Partners For Development, Testing, Funding, and Deployment of Landside Freight Transport Technology

Achieving zero- or near-zero emissions freight transport is an ambitious goal. But given the current volume of freight movement in Southern California, and the projected increases over the next two decades, accomplishing this goal is critical to economic and public health in the region. Success will require private companies and public agencies working together with a shared vision and a commitment to address the practical issues to ensure efficient operations.

Following is a partial list of entities that will be contacted to seek a contribution of expertise, in-kind services, equipment, space, and/or funding to support the effort.

Government:
California Department of Transportation
Southern California Association of Governments and its member agencies
Alameda Corridor Transportation Authority

U.S. Environmental Protection Agency
California Air Resources Board and air quality agencies in other states
South Coast Air Quality Management District

U.S. Department of Energy
California Energy Commission

Port of Long Beach
Port of Los Angeles

Private:
Commercial Technology Developers and Manufacturers
Trucking
Rail
Shipping
Warehousing and Distribution Centers
Logistics Supply Chain Specialists
Beneficial Cargo Owners

Non-Profit and Academic:
CALSTART
Center for Environmental Research and Technology (CE-CERT)
Philanthropic Foundations in Coordination with Environmental Organizations
Academic Institutions with Specialized Knowledge in Logistics Field

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ADV-03: ACTIONS FOR THE DEPLOYMENT OF ZERO-EMISSION AND NEAR-ZERO CARGO HANDLING EQUIPMENT [NOX, PM]

CONTROL MEASURE SUMMARY	
SOURCE CATEGORY:	OFF-ROAD EQUIPMENT USED TO MOVE FREIGHT CONTAINERS
CONTROL METHODS:	ADVANCED NEAR-ZERO AND ZERO-EMISSION TECHNOLOGIES
EMISSIONS (TONS/DAY):	TBD
CONTROL COST:	THE CONTROL COSTS VARY WITH THE TYPE OF CONTROL TECHNOLOGY IMPLEMENTED
IMPLEMENTING AGENCY:	SCAQMD, SAN PEDRO BAY PORTS, CARB, U.S. EPA

DESCRIPTION OF SOURCE CATEGORY

Background

Emissions from goods movement related mobile sources (e.g., ships, trains, trucks, and off-road equipment) continue to represent a significant and increasing portion of the emissions inventory in the South Coast Air Basin, adversely affecting not only the local port area, but also the regional air quality of the Basin. The purpose of this early action measure is to demonstrate and commercialize advanced zero-emission and near-zero emission technologies for cargo handling equipment operated at marine ports, intermodal freight facilities, and warehouse distribution centers that could be deployed in the 2020 to 2030 timeframe. Such technologies include advanced engine controls to achieve further reductions in NOx exhaust emissions beyond the Tier 4 off-road exhaust emissions standards and zero-emission technologies such as electric, battery-electric, and fuel cells.

Regulatory History

The U.S. EPA and CARB's Tier 1, Tier 2, Tier 3, and Tier 4 emission standards for non-road diesel engines require compliance with progressively more stringent standards for hydrocarbon, CO, NOx, and PM. Tier 4 standards for non-road diesel-powered equipment complement the latest 2007 and later on-road heavy-duty engine standards requiring 90 percent reduction in NOx and PM when compared against the current level. To meet these standards, engine manufacturers will produce new engines with advanced emissions control technologies similar to those already expected for on-road heavy-duty diesel vehicles. These standards for new engines will be phased in starting with smaller engines in 2008 until all but the very largest diesel engines meet NOx and PM standards in 2015.

In December 2005, CARB adopted a regulation to reduce emissions from cargo handling equipment (CHE) such as yard tractors and forklifts starting in 2007. The regulation calls for the replacement or retrofit of existing engines with engines that use Best Available Control

Technology (BACT). Beginning January 1, 2007, the regulation will require that newly purchased, leased, or rented CHE be equipped with either a 2007 or later on-road engine, a Tier 4 off-road engine or the cleanest verified diesel PM emissions control system which reduces PM by 90% and NOx by at least 70 percent for yard tractors. For non-yard tractors cargo handling equipment currently verified technologies reduce PM by 85 percent.

In November 2006, the Ports of Los Angeles and Long Beach adopted the San Pedro Bay Ports Clean Air Action Plan (CAAP). One of the control measures (CHE-1) provided in the CAAP calls for terminal operators to use cargo handling equipment with the cleanest engines by 2012 (2007 on-road heavy-duty engine emission standards or Tier 4 off-road engine standards). The CAAP accelerates the implementation of CARB's rule requirements through lease requirements or other mechanisms. The CAAP measure provides an additional 15 percent NOx and 19 percent PM reductions by 2011 beyond CARB's regulation based on the replacement of existing cargo handling equipment with equipment meeting Tier IV off-road or 2007 on-road engine standards (for port tenants with lease openings by 2011).

By 2020 under current regulations, all cargo handling equipment will meet Tier 3 off-road standards with a PM retrofit device, 2007 or 2010 on-road standards, or Tier 4 off-road standards.

PROPOSED METHOD OF CONTROL

Cargo handling equipment is generally categorized as construction equipment (excavators, front-end loaders, tractors, etc) used for bulk material handling, forklifts, container handling equipment (top picks, side picks), rubber-tired gantry cranes, and yard trucks. This equipment is predominately diesel powered. Due to the CARB regulation, the 2023 population is estimated from the CHE Emissions Inventory Model to be 85 percent Tier 4 or 2010 on-road, 9 percent Tier 4i or 2007 on-road, and 6 percent Tier 3 with PM retrofit devices. As a result, there are opportunities to further reduce emissions through accelerated turnover to zero-emission and near-zero emission technologies.

The proposed measure is to further develop zero-emission technologies for cargo handling equipment. Zero-emission technologies include battery electric (BEV) and plug-in electric hybrid (PHEV) technologies. These technologies are based on automotive systems and are now being demonstrated in cargo handling equipment. Other potential technologies include fuel cell (FC) and fuel cell-battery hybrids (FCH) for mobile equipment, as well as container movement systems using wide-span grid-power based overhead cranes and container conveyer systems to replace cranes, forklifts, and yard trucks. In addition, hybrid systems have been developed and deployed on cranes used at marine ports and intermodal railyards. The following table summarizes potential zero-emission and hybrid systems to be evaluated over the next several years.

TECHNOLOGY	APPLICATION	STATUS/ POTENTIAL EMISSION REDUCTION
Electric	Wide Span Gantry Cranes	Available but not used in local ports, demonstrations under discussion/100%
Battery-Electric	Yard Tractor; Top-Pick/Side-Pick; Forklifts	Yard tractor demonstrations underway, other CHE demonstrations planned/100%
Fuel Cell	Yard Tractor; Top-Pick/Side-Pick; Forklifts	Demonstrations under discussion /100%
Plug-In Hybrid Electric	Yard Tractor; Top-Pick/Side-Pick; Forklifts	Drayage truck demonstration underway, CHE Demonstrations under discussion /75%
Alternative Fuels	Compressed/Liquefied Natural Gas	Available for trucks and forklifts, demonstrations under discussion for CHE/ 50%
Hybrid Systems	Gantry Cranes	Available but in limited use; Demonstration under discussion/50%
Battery-Electric	Gantry Cranes	Demonstration under discussion/100%

Battery-electric and fuel-cell equipment. Zero-emission yard truck prototype testing is underway with funding from the Port of Los Angeles, the Port of Long Beach, and the District. A demonstration of the Balqon lead-acid battery electric truck was initiated in 2007. The battery was upgraded to a lithium-ion battery, and testing of the upgraded system is underway. Additional testing is ongoing with units made specifically for drayage by Vision Motor Corporation, using a combination of lithium-ion batteries and fuel cells. Transfer of these technologies from on-road truck applications to off-road yard trucks are considered to be straightforward and is currently in the planning stage at the Ports of Los Angeles. Transfer of the technology to cargo handling equipment such as top-picks is in the discussion stage but has not been demonstrated.

Hybrid diesel-electric equipment. Class 6 hybrid and/or plug-in hybrid trucks offering reduced emissions are now becoming commercially available from a number of established manufacturers, e.g. Kenworth T370. These trucks could operate in drayage service and development is continuing on Class 7 and Class 8 trucks. Application of these technologies to yard trucks are also considered to be straightforward. The Ports are currently considering a demonstration of a hybrid yard truck. Applications of hybrid technologies to other cargo handling equipment including forklifts, top-picks/side-picks, and gantry cranes are in the research and development stage with demonstrations possible within two years. Ports are also evaluating alternative-fueled drayage trucks and are planning to demonstrate CNG and LNG cargo handling equipment.

Grid electric. Wide span gantry cranes and automated guideways for moving and positioning cargo containers in the ports and railyards are commercially feasible but have not been used in local port applications. The Ports have reviewed some proposals for demonstrations and are in continuing discussions with applicants.

Alternative Fuels. Natural gas fueled trucks and buses are commonly available. Gasoline and propane fueled off-road equipment is available and could be adapted to compressed or liquid natural gas.

Schedule for Action

The actions described below are directed at developing and demonstrating technologies for zero-or near-zero emission cargo handling systems. Development of equipment capable of operating on electric power, even for relatively short times, should be viewed as an important initial part of the effort to develop a zero-emission cargo handling system. For these reasons, it is appropriate that the schedules for technology development and demonstration activities, and technology deployment, reflect the potential for earlier technology implementation in focused applications rather than for all equipment categories and vocations. The schedules specified below for zero-emission cargo handling equipment technology deployment extend from 2015 to beyond 2023.

Actions

San Pedro Bay Ports Technology Advancement Program (TAP) Working Group (2012-2014). The District, CARB, and U.S. EPA serve on the TAP Working Group to evaluate potential emission reduction projects. The TAP could serve as a forum to focus efforts specifically on zero-emission penetration into specific types of cargo handling equipment. The power storage, drive systems, and fast charging technologies are currently emerging technologies. Other technologies and/or combinations of technologies may emerge that could also play a role in the longer-term zero emission cargo handling system. The Working Group would coordinate with core end users to define their needs and key vehicle design parameters in the 2012 – 2014 timeframe.

Secure Funding (2012-2014). Collaborate with public and private partners to secure funding commitments for the development of vehicle prototypes and infrastructure demonstrations.

Develop and Demonstrate Equipment Prototypes (2012-2015). This phase involves the development, design validation, and initial demonstration of several types of advanced prototype vehicles. The demonstration would include technology optimization for prescribed equipment types and functions. This task should seek to further evaluate, develop, and test prototypes.

Select Technologies for Field Evaluation (2012-2017). Identify potential equipment types and drive technologies to test in small-scale demonstrations. Designate equipment test deployment, and develop a test and development plan for a limited number of equipment.

Equipment Evaluation Testing (2013-2020). Develop, deploy and assess, with operators, multiple equipment types with on-going data collection, analysis, and sharing for rapid iterative design improvement.

Deployment (2015+). Identify/develop mechanisms to deploy demonstrated technologies as early as possible. Such mechanisms may include lease agreements, environmental mitigation measures, and funding incentives.

EMISSIONS REDUCTION

Not Determined

COST EFFECTIVENESS

Not Determined

IMPLEMENTING AGENCY

SCAQMD, San Pedro Bay Ports.

REFERENCES

CARB (2005). California Code of Regulations, Title 13, Chapter 9, Article 4.8, Section 2423 - California Exhaust Emission Standards and Test Procedures for New 2008 and Later Tier 4 Off-Road Compression-Ignition Engines.

CARB (2005). California Code of Regulations, Title 13, Chapter 9, Article 4.8, Section 2479 - Regulation for Mobile Cargo Handling equipment at Ports and Intermodal Rail Yards.

CARB (2011). Cargo Handing Emissions Inventory Model, available at http://www.arb.ca.gov/ports/cargo/cheamd2011.htm

Los Angeles County Metropolitan Transportation Authority (2008). Multi-County Goods Movement Action Plan, prepared by Wilbur Smith Associates.

Los Angeles County Metropolitan Transportation Authority (2009). Alternative Goods Movement Technology Analysis-Initial Feasibility Study, I-710 Corridor Project EIR/EIS Final Report, prepared by URS.

Ports of Los Angeles and Long Beach (2010). San Diego Ports Clean Air Action Plan, 2010 Update.

ADV-04: ACTIONS FOR THE DEPLOYMENT OF CLEANER COMMERCIAL HARBOR CRAFT [NOX, PM]

CONTROL MEASURE SUMMARY	
SOURCE CATEGORY:	CATEGORY 1 AND 2 MARINE ENGINES USED IN COMMERCIAL HARBOR CRAFT
CONTROL METHODS:	ADVANCED HYBRID SYSTEMS AND ALTERNATIVE FUEL ENGINES
EMISSIONS (TONS/DAY):	TBD
CONTROL COST:	THE CONTROL COSTS VARY WITH THE TYPE OF CONTROL TECHNOLOGY IMPLEMENTED
IMPLEMENTING AGENCY:	SCAQMD, SAN PEDRO BAY PORTS, CARB, U.S. EPA

DESCRIPTION OF SOURCE CATEGORY

Background

This measure describes the actions needed to commercialize advanced engine control technologies and hybrid systems that could be deployed in the 2020 to 2030 timeframe. Such technologies include advanced engine controls to achieve at least a 60 percent reduction in NOx exhaust emissions beyond the most stringent Category 1 and 2 marine engine exhaust emissions standards. There are approximately 750 commercial harbor craft operating within the District that are estimated to emit 17.7 tpd of NOx. Commercial harbor craft includes tug, ferry, crew and supply, excursion, commercial fishing, work, barge, dredge, and pilot vessels. Commercial harbor craft generally have multiple propulsion and auxiliary engines per vehicle with total power of between several hundred and several thousand horsepower. Essentially all are currently diesel powered. Work activity varies significantly with some vessels spending most time within the port harbor and adjacent waters while others leave the local port for adjacent ports, Catalina Island, or oil platforms. Several harbor craft operators have deployed hybrid systems on their harbor craft to improve fuel efficiency and reduce criteria and greenhouse gas emissions. NOx and PM-reducing after treatment systems are also beginning to be demonstrated.

Regulatory History

The U.S. EPA established new engine standards for new "Category 1 and 2" diesel engines – engines rated over 50 hp used for propulsion in most commercial harbor craft. These standards are to be phased in between 2004 and 2017 and limit NOx, VOC, CO and PM emissions, but the emissions reductions achieved are modest in the next five years. The current most stringent standard for marine engines is Tier 4 (0.03 g/bhp-hr PM and 1.3 g/bhp-hr NOx) which takes effect in all engine categories by 2017. These standards do not require either diesel particulate filters or selective catalytic reduction after-treatment systems.

In 2007, CARB adopted a Regulation for Commercial Harbor Craft to accelerate deployment of low emission engines. A compliance schedule was included requiring that commercial harbor craft with Tier 0 and Tier 1 engines would have to be retired or repowered by 2023. In addition, any new vessel had to have engines built to the then-current emission standard (Tier 2, Tier 3 or Tier 4).

The San Pedro Bay Ports Clean Air Action Plan (CAAP) contains a source specific control measure (HC-1) to repower all home port vessels to Tier 3 within five years of engine availability. The CAAP HC-1 measure is implemented through lease requirements or other mechanisms.

PROPOSED METHOD OF CONTROL

Available control technologies that achieve maximum control of emissions include aftertreatment systems using catalysts to control NOx and PM emissions, as well as hybrid engine technologies. The following table summarizes potential near zero-emission technologies to evaluated over the next several years.

TECHNOLOGY	APPLICATION	STATUS/ POTENTIAL EMISSION REDUCTION
Battery-Electric	Vessels with high percentage of standby time or low load time while docked	Small excursion or pleasure craft are available but not commercial harbor craft/100%
Fuel Cell	Vessels with high percentage of medium to high power that have access to fueling infrastructure	Demonstration units in development/100%
Diesel-Electric Hybrid Systems	Vessels with variable engine loads, limited standby time while docked and need for extended range some times.	Technology demonstrated on two tugboats/50% NOx and 70% PM compared to similar standard diesel engine
SCR/DPF Aftertreatment	Vessels with high usage and space available for installation of the systems.	Commercialized in Europe, local demonstration projects underway/80% from Tier 2

Battery-electric. Battery powered recreational boats have been available for many years. Advanced lithium battery technology can be applied to harbor craft.

Fuel cells. Fuel cell power systems are being demonstrated for on-road vehicles and have been used commercially for stationary power generation. Testing is ongoing with units made specifically for drayage by Vision Motor Corporation, using a combination of lithium-ion batteries and fuel cells. Application of these technologies to harbor craft operating appears technically feasible and would provide extended range needed for many harbor craft.

Diesel-electric hybrid. Diesel-battery hybrid technology has been demonstrated on two tugboats at the Ports of Los Angeles and Long Beach. The vessels are equipped with batteries and an electric propulsion motor. This system allows the auxiliary engines to provide electrical propulsion power, as well as supply electrical power to the vessel. With advanced software the power to propel the vessel can come from on-board batteries, one or both auxiliary engines and one or both of the main engines, or any combination of on-board power sources. In addition, when the vessel is docked, grid-based power can be used to charge the batteries thereby displacing a portion of the use of the diesel engines for propulsion and electrical generation. Engine use is thus minimized and optimized and can result in significant emission reductions. The two hybrid tugs are in operation in the Ports of Los Angeles and Long Beach have shown emission reductions of 50 percent for NOx and 70 percent for diesel PM, as well as fuel savings of over 25 percent.

SCR/DPF Aftertreatment. Diesel aftertreatment systems have been demonstrated on ferries in New York and California and will soon be demonstrated on tugs in the District. These systems include selective catalytic reduction (SCR) catalysts for control of NOx and diesel oxidation catalysts (DOC) or DOC plus diesel particulate filters (DPF) for control of PM, VOC, and CO. SCR catalyst systems have been in operation in Europe for more than 10 years on over 200 vessels without any technical issues. These systems have achieved up to 80 percent control of emissions from commercial harbor craft engines. After-treatment systems are particularly appropriate for in-use vessels because of the long useful life of boats and marine engines but space constraints, urea tanks, and high heat from DPF systems are safety concerns. Currently, CARB in coordination with the District and Hug Filtersystems has begun a demonstration of an SCR/DPF aftertreatment device on a tug boat at the Ports of Los Angeles and Long Beach.

Schedule for Action

The following actions are directed at developing and demonstrating reduced emission technologies for commercial harbor craft.

San Pedro Bay Ports Technology Advancement Program (TAP) Working Group (2012-2013). The District, CARB and U.S. EPA serve on the San Pedro Bay Ports Technology Advancement Program (TAP) advisory committee. The TAP could serve as a forum to focus efforts specifically for reduced emission technologies for commercial harbor craft.

Secure Funding (2012-2014). Collaborate with public and private partners to secure funding commitments in 2013 for the development of technology prototypes and in-vessel demonstrations.

Develop and Demonstrate Prototypes (2012-2015). This phase involves the development, design validation, and initial demonstration of reduced emission technologies on vessels. The demonstration would include technology optimization primarily for vessels identified by the Working Group as good candidates for early implementation.

Select Technologies for Field Evaluation (2012-2017). Identify potential vessels and low emission technologies to test in the small scale demonstrations in Phase 3. Designate vessel deployment and lay out a test and development plan for a limited number of vessels.

Technology Evaluation Testing (2013-2020). Develop, deploy, and assess, with vessel operators, multiple technology and vessel types with on-going data collection, analysis, and sharing for rapid iterative design improvement.

Deployment (2015+). Identify/develop mechanisms to deploy demonstrated technologies as early as possible. Such mechanisms may include lease agreements, environmental mitigation, measures, and funding incentives.

EMISSIONS REDUCTION

Not Determined

COST EFFECTIVENESS

Not Determined

IMPLEMENTING AGENCY

SCAQMD, San Pedro Bay Ports, CARB, U.S. EPA.

REFERENCES

CARB (2010). Initial Statement of Reasons for Amendments to the Regulations to Reduce Emissions from Diesel Engines on Commercial Harbor Craft Operated Within California Waters and 24 Nautical Miles of the California Baseline.

CARB (2011). Regulations to Reduce Emissions from Diesel Engines on Commercial Harbor Craft Operated with California Waters and 24 Nautical Miles of the California Baseline, California Code of Regulations, Title 17, Section 93118.5, as amended 2011.

University of California Riverside – CE-CERT (2010). Evaluating Emission Benefits of a Hybrid Tug Boat, Final Report, ARB Contracts 07-413 and 07-419.

ADV-05: ACTIONS FOR THE DEPLOYMENT OF CLEANER OCEAN-GOING MARINE VESSELS [NOX, PM]

CONTROL MEASURE SUMMARY	
SOURCE CATEGORY:	CATEGORY 3 MARINE ENGINES USED IN OCEAN-GOING MARINE VESSELS
CONTROL METHODS:	DEPLOY TIER 3 MARINE ENGINES IN NEW SHIP BUILDS AND TIER 3 LEVEL RETROFIT TECHNOLOGIES IN EXISTING CATEGORY 3 MARINE ENGINE VESSELS
EMISSIONS (TONS/DAY):	TBD
CONTROL COST:	THE CONTROL COSTS VARY WITH THE TYPE OF CONTROL TECHNOLOGY IMPLEMENTED
IMPLEMENTING AGENCY:	SCAQMD, SAN PEDRO BAY PORTS, CARB, U.S. EPA

DESCRIPTION OF SOURCE CATEGORY

Background

Ocean-going marine vessels, which primarily run on diesel oil, contribute a significant portion of NO_x, PM, greenhouse gas, and toxic emissions particularly in coastal regions and in and around shipping ports. These emissions contribute to on-shore air quality problems. In order for progress to continue to meet clean air goals, emission reductions from marine vessels are necessary.

Currently, the San Pedro Bay Ports Technology Advancement Program (TAP) Advisory Group, which is comprised of CARB, U.S. EPA, and SCAQMD is exploring promising retrofit technologies to be used on marine vessels. The TAP is also working on demonstration projects. The primary objectives of the marine vessel technology demonstration projects are to identify technologies that are capable of reducing NO_x, PM, and greenhouse gases, identify and demonstrate emission measurement systems capable of accurately measuring pollutant emissions in ship exhaust streams; and install the most promising technology on an in-use Category 3 ocean-going vessel for demonstration under real world conditions and establish the emission reduction potential in different modes of operation.

This measure describes the actions needed to deploy retrofit technologies on existing Category 3 marine engines to achieve Tier 3 marine engine emission standards. The actions proposed are consistent with Measure OGV-6 provided in the San Pedro Bay Ports Clean Air Action Plan (CAAP). Marine engine manufacturers have indicated that such retrofits are feasible. The Ports of Los Angeles and Long Beach have documented various control technologies that are potentially feasible to deploy. To-date, a limited number of demonstrations have been conducted.

Regulatory History

The regulation of emissions from mobile port-related emission sources is traditionally the responsibility of CARB and U.S. EPA. Specifically, ships are each subject to specific emission standards pursuant to state, federal, and/or international requirements. The standards, primarily affecting new units, vary in stringency and compliance dates.

OGV main and auxiliary engines are subject to the International Maritime Organizations international emission standards as contained in Annex VI to the International Convention on the Prevention of Pollution from Ships (MARPOL Annex VI). U.S. flagged ships must meet similar U.S. EPA requirements. In October 2008, the IMO adopted the current standards for engines and these require vessels to meet increasingly more stringent NOx emission standards. The standards are designated by tiers ranging from Tier 0 being uncontrolled or no emission controls to the most stringent Tier 3 standard. NOx emission standards are modestly more stringent when going from Tier 0 to Tier 2 (approximately 20 percent cleaner) and can be achieved through engine design changes. The Tier 3 NOx standard is significantly more stringent (better than 80 percent cleaner) and most likely can only be met using engine after-treatment systems. Engines on vessels must meet the Tier 3 NOx standard if they are built after 2015 and travel through designated Emission Control Areas (ECA). ECAs can be created by member states if approved by the IMO. On March 26, 2010, the IMO officially designated waters within 200 nautical miles of the United States and Canadian Coasts as the North American ECA.

In addition to NOx emission requirements, IMO and CARB require vessels to use lower sulfur distillate fuels when the vessels travel close enough to our shores. By 2015, all vessels will be required to use distillate fuels with sulfur contents less than 1,000 ppmw when they travel within the North American ECA. With the low sulfur fuel requirements, reduction of SOx and PM emissions will be realized.

PROPOSED METHOD OF CONTROL

As part of the San Pedro Bay Ports Clean Air Action Plan 2010 update, the Ports have adopted a program to reduce diesel particulate matter (DPM) and NOx emissions from the existing fleet of vessels through the identification of new effective technologies. Numerous emission reduction technologies are being evaluated for integration into vessel new builds and use of these technologies as a retrofit for existing vessels will be explored. These would fall into several broad categories shown in the table below. Many of these retrofit technologies are currently available and demonstrated in Europe on smaller ocean-going vessels. The two major marine engine manufacturers, MAN Diesel and Wartsila, have been developing these technologies to meet current and future International Maritime Organization (IMO) standards.

CONTROL	CONTROL DETAILS	ESTIMATE EMISSION REDUCTIONS*	
		NOx	PM
Engine Technologies	Common Rail Fuel Injection, Slide Valves, Electronic Fuel Control, Electronically Controlled Lubrication Systems, and Automated Engine Monitoring/Control Systems	Up to 20%	Up to 40%
Engine Support Technologies	Water Injection, Exhaust Gas Recirculation, High Efficiency Turbo Charging, Scavenging Air Moistening/Humid Air Motor, Two-Stage Turbo Charging	Up to 60%	Up to 20%
After-Treatment Technologies	Selective Catalytic Reduction (SCR), and Exhaust Gas Scrubbers (Wet –freshwater, saltwater, hybrid, and Dry)	Up to 90%	Up to 90%
Alternative Fuels	Liquefied Natural Gas	Up to 90%	Up to 99%
Alternative Supplemental Power Systems	Wind and Solar Power, Marine Fuel Cell, Marine Hybrid Systems, Waste Heat Recovery	Data Not Available	Data Not Available

***** San Pedro Bay Ports Clean Air Action Plan – Guide to OGV Emission Control Strategies

New Slide Valve Designs - Replacement of existing valves on main and auxiliary engines with new "slide" valves could provide up to 30 percent reduction in NOx (depending on the design). In addition, installing slide valves reduces particulate emissions and leads to greater fuel efficiency. MAN Diesel (one of the two leading manufacturers of marine engines) currently has such slide values commercially available. Slide valves are in use on several marine vessels operating in Europe. Slide valves are being tested on container vessels operating in California.

Internal Engine Modifications - There are several modifications that could be made to the engine's operation that would lead to reduced NOx emissions. Modifications include: delayed fuel injection and ignition, which reduces the in-cylinder duration of the combustion gases at high temperatures; lowering fuel injection pressure; raising the degree of premixing; advancing the closing time of the inlet valve to lower the final combustion temperature ("Miller valve timing"); reducing the temperature and pressure of the combustion air fed into the cylinders; optimizing the geometry of the combustion space and the compression ratio; and optimizing the fuel injection method. Such modifications could result in up to 30 percent reduction in NOx emissions.

Direct Water Injection (DWI) - Direct water injection is a form of diesel emulsification, where freshwater is injected into the combustion chamber. Injecting water lowers the combustion temperature leading to lower NOx emissions (on the order of 40 to 50 percent reduction).

Typical water-to-fuel ratio ranges between 40 to 70 percent. As of 2005, there are about 23 vessels operating in the Baltic Region, equipped with water injection, primarily on auxiliary engines. Such use could be transferred to vessels operating in and out of California ports.

Humid Air Motor (HAM) or Saturated Air Motor (SAM) - HAM is similar to the direct water injection application except that seawater is vaporized directly into the combustion chamber to lower the combustion temperature. The waste heat is recovered and used to vaporize the seawater. The salt content of the Baltic Sea water is not as high as in other parts of the ocean, which makes the HAM application more appealing since there is no need to store freshwater on board the vessel.

Selective Catalytic Reduction (SCR) - Similar application to stationary source boilers and engines. SCR technologies have been applied to ferries and roll-on/roll-off vessels in Europe. In addition, four steel carrier vessels operating between California and Korea have used SCR since the early 1990s. The two major Category 3 marine engine manufacturers have indicated that SCR technologies will most likely be Tier 3 solutions. Such technologies can achieve over 90 percent emission reduction in NOx from uncontrolled levels.

Exhaust Gas Recirculation (EGR) - EGR technologies are similar to that used on on-road engines. However, the units are much larger in size and have not been fully developed at this point. As with on-road engine applications, the expected NOx emission reduction is about 50 percent.

Sea Water Scrubbers - Sea water scrubber systems are developed primarily for the cleanup of sulfur oxides and particulates. Relative to NOx emissions reduction, the sea water scrubber has been estimated to have about a 5 percent benefit.

LNG-Fueled Marine Engines - Currently there is limited use of liquid natural gas (LNG) to power propulsion engines on marine vessels. One of the major category 3 marine engine manufacturers recently announced plans to manufacture additional LNG-fueled ocean-going vessels. LNG could meet Tier 3 emissions levels and reduce greenhouse gas emissions.

All of these systems and approaches need additional study, research, design, proof of concept testing, and both small- and full-scale demonstration programs to advance the technology for application on ocean-going vessels traveling in the South Coast Air Basin, as well as a greater examination of operational impacts and costs.

Schedule for Actions

With the goal of ensuring only the cleanest vessels visit the San Pedro Bay Ports, the following actions are identified.

Actions

San Pedro Bay Ports OGV 5 and OGV 6 Task Force (2012-2014). The Ports along with the District, CARB, and U.S. EPA have formed the OGV 5 and OGV 6 task force to work with stakeholders (including vessel operators, engine manufacturers, regulatory agencies) to identify

and prioritize technology options, as well as the most appropriate vessel types for early introduction of the technology using cost, feasibility, operational integration, and other parameters identified by the task force. Technology gaps will also be identified.

Identify and Secure Funding (2012-2014). The TAP program is the ports' vehicle to identify sources and develop partnerships that would accelerate the deployment of developing or developed technology. Through the TAP, partnerships with other public and private groups are developed to secure funding commitments for the development of prototype demonstrations. Efforts to expand these partnerships for other candidate funding sources such as other U.S. Ports, Federal Agencies (e.g., U.S. Maritime Administration), international organizations (e.g., IMO) and air districts should be considered. Interested technology developers and engine manufacturers are also candidates for in-kind contributions, as well as vessel operators.

Develop and Demonstrate Prototypes (2012-2015). Through the TAP collaborative demonstration projects with stakeholders for the development, design validation, and initial demonstration of reduced emission retrofit technologies on vessels are performed. These demonstrations would include retrofit technology optimization primarily for vessel types and engines identified as good candidates for early implementation.

Select Technologies for Fleet Evaluation (2012-2017). Identify potential vessels and retrofit technologies to test in the small-scale demonstrations. Through the TAP designate vessel test deployment, and lay out a test and development plan for a limited number of vessels.

Technology Evaluation Testing (2015-2020). Develop, deploy and assess with multiple vessels with on-going data collection, analysis and sharing for rapid iterative design improvement. The TAP can provide the structure to monitor and evaluate equipment performance and emission benefits during demonstration projects.

Deployment (2017+). Identify and develop mechanism to deploy demonstrated technologies as early as possible. Such mechanism may include lease agreements, environmental mitigation measures, and funding. The San Pedro Bay Ports have adopted programs to incentivize Tier 2 and Tier 3 vessel calls.

As part of this action, between 2012 to 2015, the South Coast Air Quality Management District, CARB, the San Pedro Bay Ports, and U.S. EPA will collaborate and develop potential additional mechanisms to incentivize or require Tier 3 vessel calls at the state and federal levels.

EMISSIONS REDUCTION

Not Determined

COST EFFECTIVENESS

Not Determined

IMPLEMENTING AGENCY

SCAQMD, San Pedro Bay Ports, CARB, U.S. EPA.

REFERENCES

San Pedro Bay Ports Clean Air Action Plan 2010 Update, October 2010

ADV-06: ACTIONS FOR THE DEPLOYMENT OF CLEANER OFF-ROAD EQUIPMENT [NOX, PM]

CONTROL MEASURE SUMMARY	
SOURCE CATEGORY:	OFF-ROAD CONSTRUCTION, INDUSTRIAL ENGINES
CONTROL METHODS:	ADVANCED HYBRID SYSTEMS AND CONTROL TECHNOLOGIES TO ACHIEVE AT LEAST AN ADDITIONAL 60 PERCENT REDUCTION BEYOND TIER 4 EMISSION STANDARDS
EMISSIONS (TONS/DAY):	TBD
CONTROL COST:	THE CONTROL COSTS VARY WITH THE TYPE OF CONTROL TECHNOLOGY IMPLEMENTED
IMPLEMENTING AGENCY:	SCAQMD, CARB, U.S. EPA

DESCRIPTION OF SOURCE CATEGORY

Background

This measure describes the actions needed to commercialize advanced zero-emission and near-zero emission technologies that could be deployed in the 2020 to 2030 timeframe. Such technologies include advanced engine controls to achieve at least an additional 60 percent reduction in NOx exhaust emissions beyond the Tier 4 off-road emission standards.

Regulatory History

The federal Tier 4 final standards are currently the most stringent emission standards for off-road diesel engines used in heavy construction and industrial equipment. These standards take effect in 2014 or 2015 for engines in the 75-750 hp range which includes the majority of this equipment and requires NOx emissions not to exceed 0.3g/bhp-hr. In addition to these standards for new engines, CARB adopted the In-Use Off-Road Diesel-Fueled Fleets Regulation (Off-Road rule) in 2007 in order to accelerate the introduction of equipment using Tier 4 engines. The off-road rule applies to diesel-fueled construction, mining, industrial, airport ground support equipment, and mobile oil drilling equipment and established increasingly stringent annual fleet average emission targets. Fleets that do not meet the fleet average in any year are required to "turnover," (i.e., retire, replace, retrofit, or repower) a specified percentage of their horsepower. The rule currently requires large- and medium-sized fleets to meet 1.5 g/bhp-hr NOx by 2023 and small fleets to meet 1.5 g/bhp-hr NOx by 2028. This represents 70 percent Tier 4, 7 percent Tier 4i equipment with decreasing fractions of Tier 3, Tier 2, Tier 1 and Tier 0 equipment.

PROPOSED METHOD OF CONTROL

Equipment subject to the Off-Road rule represents 59 percent of the 2023 NOx emissions from this source category. Diesel engines produce 70 percent of the 2023 construction and industrial NOx emissions while large spark ignition (LSI) engines, primarily gasoline, represent about 30 percent of the NOx emissions. Different methods of control may be best suited to different types of equipment due to size, work location, and duty cycle. The following four-phase program is proposed to identify and apply the most appropriate control method for each equipment type.

Construction and industrial equipment have substantially different work locations and duty cycles and include engines from all horsepower categories and fuel types. Equipment types range from small boom lifts to heavy off-road trucks and dual-engine scrapers. Construction equipment is usually operated at field locations with limited grid power and limited access. As a result, zero-emission drive systems are more difficult to deploy in construction equipment than other off-road mobile categories. Industrial equipment is usually operated at fixed sites with readily available grid power and with access to alternative fuel required for fuel cells. Industrial equipment therefore is a more likely candidate for early introduction of zero-emission drive systems than off-road construction equipment. The following table summarizes potential zero- and near zero-emissions systems to be evaluated over the next several years.

TECHNOLOGY	APPLICATION	STATUS/POTENTIAL EMISSION REDUCTION
Battery-Electric	Equipment with high percentage of standby time or low load time and located at site with grid power	Industrial equipment commercialized, smaller construction equipment demonstrations needed/100%
Fuel Cell	Equipment with access to fuel infrastructure – most likely equipment at fixed sites or returning to equipment yards at night.	Development of forklifts and other industrial equipment in process/100%
Plug-In Hybrid Electric	Equipment with energy recovery duty cycles or high percentage of idle/low power operation. Equipment can operate at remote sites with conventional fuel or grid power if available at job site. Hybrid technology may vary by equipment type.	On-road truck systems commercialized; industrial equipment in development, construction equipment depends on market interest/40% from Tier 4
CNG/LNG	Equipment at fixed sites or returning to equipment yards at night	Available for some forklifts; demonstrations underway for heavy construction equipment/60% from Tier 4
Hybrid Systems	Equipment with energy recovery duty cycles or high percentage of idle/low power operation. Equipment can operate at remote sites with diesel fuel. Hybrid technology may vary by equipment type.	Entering commercialization in selected applications/25% from Tier 4
Cleaner Combustion Engines	Heavy construction equipment >300 hp	Engines with NOx emissions at least 60% cleaner from Tier 4 standards

Battery-Electric Equipment. Battery-electric equipment is already commercialized for many industrial equipment categories. However, this equipment has been developed with conventional automotive lead acid battery technology. Further demonstrations are needed in conjunction with the latest battery technologies.

Fuel Cell Equipment. This zero-emission technology is being demonstrated in light-duty passenger cars, buses and trucks. Fuel cell technologies need additional development for off-road applications.

Hybrids. Hybrid-electric drives are now being introduced into construction equipment (Caterpillar D7E bulldozer and Komatsu excavator). Other manufacturers including Volvo and John Deere are developing diesel hybrid equipment. For smaller equipment, plug-in hybrid systems are being adapted from light-and medium-duty on-road vehicles.

In order to establish the emission benefit and to facilitate the deployment of hybrid equipment through incentive programs, a methodology to determine the emissions of hybrid drive systems compared to conventional diesel engines will be developed in cooperation with CARB, EPA, and equipment manufacturers with input through the Working Group.

Reduced Emission Diesel Engines. More significant emission reductions (60% below Tier 4 – 0.12 g/bhp-hr) will require further advancements in engine and exhaust treatment technologies for diesel engines or use of alternative fuels such as natural gas. Many of these technologies currently exist and are used for passenger car and truck engines. However, these technologies are not likely to be used in off-road engines without new technology forcing exhaust emissions standards.

Schedule for Action

The following actions are directed at developing and demonstrating technologies for zero- or near-zero emission construction and industrial equipment. Since all of these technologies are currently in some stage of development for on-road trucks and industrial equipment, it is appropriate that the schedules for technology development, demonstration activities and technology deployment, reflect the potential for earlier technology implementation in selected applications than for all equipment categories and applications. The schedules specified below for zero-emission construction equipment technology deployment where feasible extend from 2015 to beyond 2021.

Actions

Off-road Equipment Working Group (2012-2014). A technical working would be formed to focus efforts specifically on near-zero and zero-emission opportunities for penetration into each type of off-road construction and industrial equipment. Performance requirements, work location, and duty cycle will be matched to technology factors including power storage, drive system type, system size and weight, and charging technologies. The Working Group would coordinate with core end users to define their needs and key equipment design parameters in the 2012 – 2013 timeframe. The Working Group will include air quality regulatory agencies,

equipment and drive system manufacturers, equipment operators, and independent research and academic organizations.

Secure Funding (2012-2014). Collaborate with public and private partners to secure funding commitments for the development of vehicle prototypes and infrastructure demonstrations similar to the Off-Road Showcase.

Develop and Demonstrate Equipment Prototypes (2012-2015). This phase involves the development, design validation, and initial demonstration of several types of advanced prototype vehicles. The demonstration would include technology optimization for equipment types and applications recommended by the Working Group.

Select Technologies for Field Evaluation (2012-2017). Identify potential equipment types and drive technologies to test in the small-scale demonstrations. Designate equipment deployment and lay out a test and development plan for a limited number of equipment.

Equipment Evaluation Testing (2013-2020). Develop, deploy and assess, with equipment operators, multiple equipment types with on-going data collection, analysis and sharing for rapid iterative design improvement.

Deployment (2015+). Identify/develop mechanisms to deploy demonstrated technologies as early as possible. Such mechanisms may include lease agreements, environmental mitigation measure, and funding incentives.

EMISSIONS REDUCTION

Not Determined

COST EFFECTIVENESS

Not Determined

IMPLEMENTING AGENCY

SCAQMD, CARB, U.S. EPA

REFERENCES

CARB (2005). California Exhaust Emission Standards and Test Procedures for New 2008 and Later Tier 4 Off-Road Compression-Ignition Engines, California Code of Regulations, Title 13, Chapter 9, Article 4.8, Section 2423.

CARB (2011). In-Use Off-Road Diesel Fueled Fleet Regulation, California Code of Regulations, Title 13, Chapter 9, Article 4.8, Sections 2449 through 2449.2.

CARB (2010). Off-Road Simulation Model, available at http://www.arb.ca.gov/msprog/ordiesel/offroad_1085.htm

ADV-07: ACTIONS FOR THE DEPLOYMENT OF CLEANER AIRCRAFT ENGINES [NOX, PM]

CONTROL MEASURE SUMMARY	
SOURCE CATEGORY:	COMMERCIAL JET AIRCRAFT ENGINES
CONTROL METHODS:	ADVANCED ENGINE TECHNOLOGIES AND CLEANER AVIATION FUELS
EMISSIONS (TONS/DAY):	TBD
CONTROL COST:	THE CONTROL COSTS VARY WITH THE TYPE OF CONTROL TECHNOLOGY IMPLEMENTED
IMPLEMENTING AGENCY:	SCAQMD, CARB, FAA, U.S. EPA

DESCRIPTION OF SOURCE CATEGORY

Background

This measure describes the actions needed to develop, demonstrate, and commercialize advanced technologies, procedures, and sustainable alternative jet fuels that could be deployed in the 2020 to 2030 timeframe. Such technologies include advanced engine controls to reduce landing and takeoff cycle NOx emissions by at least 60 percent, without increasing other gaseous or particulate emissions beyond the International Civil Aviation Organization (ICAO) standards adopted in 2004. In addition, greater use of sustainable alternative jet fuels in conjunction with advanced technologies is critical over the next 10 to 20 years to realize substantial emissions reductions from commercial jet aircraft applications.

Regulatory History

In 1973, the U.S. EPA published emission standards and test procedures to regulate gaseous emissions, smoke, and fuel venting from aircraft engines. In 1997, the standards were revised to be more consistent with those of the ICAO Committee of Aviation Environmental Protection (CAEP) for turbo engines used in commercial aircraft. These standards (CAEP/2) included new CO, HC, and NOx emission standards of 118 grams per kilonewtons (g/kN), 19.6 g/kN, and 40 g/kN, respectively. In 2005, the standards were harmonized with ICAO CAEP/4 requirements which tightened the CAEP/2 NOx standards by 32% for newly-certified commercial aircraft engines.

On June 1, 2012, the U.S. EPA Administrator signed a final rule to further revise the standards to be consistent with the current ICAO CAEP/6 and CAEP/8 requirements to further reduce NOx emissions. The first set of standards take effect 30 days after from the date the rule is published in the Federal Register and will require all new engines meet the ICAO CAEP/6 standards. The CAEP/6 standards represent approximately 12 percent emission reductions from

the ICAO Tier 4 levels. The second set of standards, Tier 8, take effect in 2014 and represents approximately a 15 percent from Tier 6 levels.

PROPOSED METHOD OF CONTROL

The proposed actions seek the development and deployment of new and cleaner commercial aircraft engines beginning 2015 such that by 2023, there will be a substantial number of low-emissions commercial jet aircraft that could be routed to the South Coast Air Basin.

Schedule for Action

State and local aircraft emission regulation is preempted by the Clean Air Act which gives that responsibility to U.S. EPA in consultation with the Federal Aviation Administration (FAA). New engine aircraft standards were adopted in 2005 and revised standards are being proposed by U.S. EPA and CAEP. No regulations are planned for the in-use aircraft fleet so emission reductions can only be achieved through fleet turn-over. Fortunately, new aircraft offer lower fuel consumption, as well as reduced emissions providing an economic incentive for airlines to accelerate replacement of their older aircraft.

In 2010, the FAA initiated the Continuous Lower Energy, Emissions and Noise (CLEEN) Program to reduce NOx emissions by 75% relative to the 2005 emission standards by 2025. Potential low-emission aircraft technologies include alternative fuels, lean combustion burners, high rate turbo bypass, advanced turbo-compressor design, and engine weight reduction. This program provides a framework and goal to develop and demonstrate technologies for improved efficiency and reduced emissions on a continuous incremental basis. The major elements of the framework are described below.

Actions

Formation of the CLEEN program working group (completed). The working group consists of aircraft manufacturers, jet engine manufacturers, component suppliers, the U.S. EPA, and NASA. The working group meets biannually.

Secure Funding (2012-2018). The FAA is providing limited funding for test and evaluation. Participating companies are also providing internal research, prototype preparation and laboratory tests.

Develop and Demonstrate Equipment Prototypes (2012-2018). Prototype technologies are being prepared for laboratory testing.

Select Technologies for Fleet Evaluation (2015-2018). Select successful technology improvements from bench test data to test in flight operations. Identify target flight test partners and lay out a test and development plan for a limited number of vehicles.

Technology Evaluation Testing (2018-2020). Develop, deploy and assess the selected engine technologies on aircraft operated by participating airlines. Provide on-going data collection,

analysis and sharing for rapid iterative design improvement and support for FAA and international flight certification.

Prepare and Submit FAA Certification and Application (2018-2020). Each engine manufacturer is responsible for obtaining certification of successfully demonstrated technology improvements.

Deployment (2020+). Identify/develop mechanisms to deploy demonstrated technologies as early as possible.

EMISSIONS REDUCTION

Not Determined

COST EFFECTIVENESS

Not Determined

IMPLEMENTING AGENCY

SCAQMD, U.S. FAA, U.S. EPA, CARB

REFERENCES

Federal Aviation Administration (2011). Continuous Lower Energy, Emissions, and Noise (CLEEN) Program Presentation by Jim Skalecky. Presented at the AIAA Aerospace Sciences Meeting.

Federal Aviation Administration (2011). Continuous Lower Energy, Emissions, and Noise (CLEEN) Program Presentation by Rhett Jeffries. Presented at the UC Davis Symposium.

Federal Aviation Administration (2012). FAA CLEEN Program Website: http://www.faa.gov/about/office_org/headquarters_offices/apl/research/aircraft_technology/cleen/

U.S. EPA (2012). Control of Air Pollution From Aircraft and Aircraft Engines; Final Emission Standards and Test Procedures, signed June 1, 2012.