South Coast
AQMD

DRAFT FINAL
2022
AIR QUALITY
MANAGEMENT PLAN

Appendix IV-A

South Coast AQMD's Stationary and Mobile Source Control Measures

DRAFT FINAL 2022 AQMP
APPENDIX IV-A

SOUTH COAST AQMD'S STATIONARY AND MOBILE SOURCE CONTROL MEASURES

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Introduction

This Appendix describes the South Coast Air Quality Management District (South Coast AQMD) staff's proposed stationary and mobile source control measures to be included in the Draft 2022 AQMP. -Control measures presented in this appendix are designed to achieve the 2015 8-hour ozone National Ambient Air Quality Standards (NAAQS) by 2037. -The proposed 8-hour ozone control measures are further divided into stationary source ozone measures and mobile source ozone measures. -The measures are based on a variety of control strategies and incentive programs that are at or near commercial availability and/or are deemed technologically feasible in the next few years. –The South Coast AQMD will prioritize distribution of incentive funding in Environmental Justice (EJ) areas and seek opportunities to expand funding to benefit the most disadvantaged communities.

Control Measures

A control measure is a set of specific technologies and methods identified for potential implementation to reduce emissions to attain an air quality standard. South Coast AQMD's proposed stationary source ozone measures are designed to assist to attain the 2015 8-hour ozone standard primarily through NOx emission reductions with limited strategic VOC reductions. Co-benefits from GHG emissions reduction policies and other measures are included as well.

The NOx measures are further divided to three groups based on the scale of combustion equipment, which are Residential Combustion Sources (R-CMB), Commercial Combustion Sources (C-CMB), and Large Combustion Sources (L-CMB). Measures pursuing co-benefits from Energy and Climate Change Programs are grouped as ECC. VOC measures include Petroleum Operations and Fugitive VOC Emissions (FUG), Coatings and Solvents (CTS), Compliance Flexibility Programs (FLX), and Biogenic Sources (BIO). There are other measures such as Multiple Component Sources (MCS) and Public Outreach (FLX).

In the 2022 AQMP, the South Coast AQMD is proposing a total of 49 ~~48~~ control measures. Out of the 49 ~~48~~ proposed control measures, 31 ~~30~~ target reductions from stationary sources. South Coast AQMD's control measures focus on stationary sources as that is the area where South Coast has the strongest regulatory authority. The majority of these measures are anticipated to be developed in the next several years and implemented prior to 2037.

Table IV-A-1 provides a list of South Coast AQMD proposed ozone measures for stationary sources along with anticipated emission reductions in 2032 and 2037.

TABLE IV-A-1

SOUTH COAST AQMD PROPOSED STATIONARY SOURCE 8-HOUR OZONE MEASURES

Number	Title [Pollutant]	Emission Reductions ~~(tpd)~~ (tons per day) (2032/2037)
South Coast AQMD Stationary Source NOx Measures:		
Residential Combustion Source Measures:		
R-CMB-01	Emission Reductions from Replacement with Zero Emission or Low NOx Appliances - Residential Water Heating [NOx]	~~0.48~~0.46 / ~~1.29~~1.25
R-CMB-02	Emission Reductions from Replacement with Zero Emission or Low NOx Appliances - Residential Space Heating [NOx]	~~0.45~~0.44 / ~~1.20~~1.17
R-CMB-03	Emissions Reductions from Residential Cooking Devices [NOx]	~~0.30~~0.29 / 0.~~81~~79
R-CMB-04	Emission Reductions from Replacement with Zero Emission or Low NOx Appliances - Residential Other Combustion Sources [NOx]	~~1.17~~1.15 / ~~3.13~~3.09
	Total Residential Combustion Source Reductions	**~~2.4~~2.34 / ~~6.43~~6.29**
Commercial Combustion Source Measures:		
C-CMB-01	Emission Reductions from Replacement with Zero Emission or Low NOx Appliances - Commercial Water Heating [NOx]	0.04 / 0.25
C-CMB-02	Emission Reductions from Replacement with Zero Emission or Low NOx Appliances - Commercial Space Heating [NOx]	0.04 / 0.21
C-CMB-03	Emission Reductions from Commercial Cooking Devices [NOx]	0.21 / ~~0.62~~0.64
C-CMB-04	Emission Reductions from Small Internal Combustion Engines [NOx]	0 / ~~2.1~~2.25
C-CMB-05	NOx Reductions from Small Miscellaneous Commercial Combustion Equipment (Non-Permitted) [NOx]	0 / ~~4.24~~5.14
	Total Commercial Combustion Source Reductions	**0.29 / ~~7.42~~8.49**
Large Combustion Source Measures:		
L-CMB-01	NOx Reductions from RECLAIM Facilities [NOx]	0 / ~~0.28~~0.31
L-CMB-02	Reductions from Boilers and Process Heaters (Permitted) [NOx]	0 / ~~0.5~~0.45
L-CMB-03	NOx Emission Reductions from Permitted Non-Emergency Internal Combustion Engines [NOx]	0 / ~~0.31~~0.34
L-CMB-04	Emission Reductions from Emergency Standby Engines (Permitted) [NOx, VOCs]	0.0 / ~~2.0~~2.04
L-CMB-05	NOx Emission Reductions from Large Turbines [NOx]	0 / ~~0.06~~0.07
L-CMB-06	NOx Emission Reductions from Electricity Generating Facilities [NOx]	0.09 / ~~0.62~~0.91
L-CMB-07	Emission Reductions from Petroleum Refineries [NOx]	0 / ~~0.77~~0.89
L-CMB-08	NOx Emission Reductions from Combustion Equipment at Landfills and Publicly Owned Treatment Works [NOx]	0 / 0.33
L-CMB-09	NOx Reductions from Incinerators [NOx]	0 / ~~0.89~~0.90
L-CMB-10	NOx Reductions from Miscellaneous Permitted Equipment [NOx]	0 / ~~1.16~~1.01
	Total Large Combustion Source Reductions	**0.09 / ~~6.92~~7.28**

TABLE IV-A-1 (CONTINUED)

SOUTH COAST AQMD PROPOSED STATIONARY SOURCE 8-HOUR OZONE MEASURES

Number	Title [Pollutant]	Emission Reductions (tons per day)~~(tpd)~~ (2032/2037)
South Coast AQMD Co-Benefits from Energy and Climate Change Programs Measures:		
ECC-01	Co-Benefits from Existing and Future Greenhouse Gas Programs, Policies, and Incentives [NOx]	TBD / TBD[b]
ECC-02	Co-Benefits from Existing and Future Residential and Commercial Building Energy Efficiency Measures [NOx, VOCs]	TBD / TBD
ECC-03	Additional Enhancements in Reducing Existing Residential Building Energy Use [NOx, VOCs]	TBD / TBD
South Coast AQMD Stationary Source VOC Measures:		
FUG-01	Improved Leak Detection and Repair [VOCs]	0.6 / 0.6
FUG-02	Emission Reductions from Industrial Cooling Towers [VOCs]	TBD / TBD
CTS-01	Further Emission Reductions from Coatings, Solvents, Adhesives, and Lubricants [VOCs]	0.5 / 0.5
FLX-02	Stationary Source VOC Incentives [VOCs]	TBD / TBD
BIO-01	Assessing Emissions from Urban Vegetation [VOCs]	TBD / TBD
L-CMB-04[c]	Emission Reductions from Emergency Standby Engines (Permitted) [NOx, VOCs]	0.0 / 0.1
	Total Stationary Source VOC Reductions	**1.1 / 1.2**
South Coast AQMD Stationary Source Other Measures:		
MCS-01	Application of All Feasible Measures [All Pollutants]	TBD / TBD
MCS-02	Wildfire Prevention [NOx, PM]	N/A / N/A
FLX-01	Improved Education and Public Outreach [All Pollutants]	N/A / N/A

[a] N/A are reductions that cannot be quantified due to the nature of the measure (e.g., outreach) or if the measure is designed to ensure reductions that have been assumed to occur will in fact occur.

[b] TBD are reductions to be determined once the measure is further evaluated, the technical assessment is complete, and inventories and cost-effective control approaches are identified, and are not relied upon for attainment demonstration purposes.

[c] This is a NOx control measure with co-benefits of VOC reductions.

~~The~~ South Coast AQMD proposes a total of 18 mobile source measures which are categorized in to five groups – emission growth management, facility-based mobile sources, on-road and off-road, incentives, and other (see Table IV-A-2). Three emission growth management measures (EGM-01 to EGM-03) are proposed to identify actions to help mitigate and potentially provide emission reductions due to new development and redevelopment projects, projects subject to general conformity requirements, and clean construction policy. Four facility-based mobile source measures (FBMSMs) (MOB-01 to MOB-04) seek to identify actions that will result in additional emission reductions at commercial marine ports, rail yards and intermodal facilities, warehouse distribution centers, and commercial airports. FBMSMs for marine ports and intermodal rail yards are currently undergoing an Indirect Source Rule development process. Six on-road and off-road mobile measures focus on on-road light/medium/heavy-duty vehicles, international shipping vessels, passenger locomotives and small off-road engines. Additionally, incentive-based measures such as MOB-11 will use established protocols such as Carl Moyer Program guidelines and report to the Governing Board periodically. MOB-12, Pacific Rim Initiative for Maritime Emission Reductions seeks NOx emission reductions from partnership with local, State, federal and international entities. Three other measures (MOB-13 to MOB-15) focus on fugitive VOC emissions from tanker vessels, fleet vehicles mitigation options, and the development of a work plan to support and accelerate the deployment of zero emission infrastructure needed for the widespread adoption of zero emission vehicles and equipment.

TABLE IV-A-2

SOUTH COAST AQMD PROPOSED MOBILE SOURCE 8-HOUR OZONE MEASURES

Number	Title [Pollutant]	Emission Reductions (tpd) (2032/2037)
Emission Growth Management Measures:		
EGM-01	Emission Reductions from New Development and Redevelopment [All Pollutants]	TBD / TBD
EGM-02	Emission Reductions from Projects Subject to General Conformity Requirements [All Pollutants]	TBD / TBD
EGM-03	Emission Reductions from Clean Construction Policy [All Pollutants]	TBD / TBD
Facility-Based Mobile Source Measures:		
MOB-01	Emission Reductions at Commercial Marine Ports [NOx, SOx, PM]	
MOB-02A	Emission Reductions at New Rail Yards and Intermodal Facilities [NOx, PM]	TBD / TBD
MOB-02B	Emission Reductions at Existing Rail Yards and Intermodal Facilities [NOx, PM]	TBD / TBD
MOB-03	Emission Reductions at Warehouse Distribution Centers [NOx]	TBD / TBD
MOB-04	Emission Reductions at Commercial Airports [All Pollutants]	TBD / TBD
On-Road and Off-Road Mobile Source Measures:		
MOB-05	Accelerated Retirement of Older Light-Duty and Medium-Duty Vehicles [VOCs, NOx, CO]	~~0.21~~0.20 / ~~0.14~~0.11 [NOx]
MOB-06	Accelerated Retirement of Older On-Road Heavy-Duty Vehicles [NOx, PM]	TBD / TBD
MOB-07	On-Road Mobile Source Emission Reduction Credit Generating Program [NOx, PM]	TBD / TBD
MOB-08	Small Off-Road Engine Equipment Exchange Program [VOCs, NOx, PM]	TBD / TBD
MOB-09	Further Emission Reductions from Passenger Locomotives [NOx, PM]	TBD / TBD
MOB-10	Off-Road Mobile Source Emission Reduction Credit Generation Program [NOx, PM]	TBD / TBD
Incentive-Based Measures		
MOB-11	Emission Reductions from Incentive Programs [NOx, PM][1]	~~10.72~~7.11 / ~~9.88~~6.69 [NOx]
MOB-12	Pacific Rim Initiative for Maritime Emission Reductions	TBD / TBD
Other Measures		
MOB-13	Fugitive VOC Emissions from Tanker Vessels [VOCs]	TBD / TBD
MOB-14	Rule 2202 – On-Road Motor Vehicle Mitigation Options [VOCs, NOx, CO]	TBD / TBD
MOB-15	Zero Emission Infrastructure for Mobile Sources [All Pollutants]	TBD / TBD

[1] MOB-11 has concurrent PM2.5 reductions of ~~0.21~~0.23 and ~~0.17~~0.21 tons per day in 2032 and 2037, respectively.

Rule Effectiveness

U.S. EPA has adjustment factors by industry type but an adjustment is not necessary when emissions can be calculated by means of a direct determination. In most cases, South Coast AQMD calculates emission reductions by means of direct determination. As described below under Rule Compliance and Test Methods, the compliance demonstration for each proposed control measure, where the South Coast AQMD accounted for emission reductions, identifies the compliance mechanisms such as recordkeeping, inspection and maintenance activities, etc., and test methods such as South Coast AQMD, CARB, and U.S. EPA approved test methods. The South Coast AQMD's ongoing source testing and on-site inspection programs also strengthen the status of compliance verification. In addition, the South Coast AQMD conducts workshops, and compliance education programs to inform facility operators of rule requirements and assist them in performing recordkeeping and self-inspections. These compliance tools are designed to ensure that rule compliance would be achieved on a continued basis. As a result, the majority of control measures proposed in this appendix with quantifiable emission reductions are based on a rule effectiveness of 100 percent. With respect to implementation of existing rules, emissions reported through the South Coast AQMD's Annual Emission Reporting (AER) program are based on actual emissions, substantiated by source testing or other processing data. Any upset conditions or emissions under variance are also included in the AER.

Format of Control Measures

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

Control Measure Number

Each control measure is identified by a control measure number such as "CM # CTS-01" located at the upper right--hand corner of every page. -"CM #" signifies "control measure number" and is immediately followed a three-letter designation, such as "CTS," which represents the abbreviation for a source category or specific programs. -For example, "CTS" is an abbreviation for "Coatings and Solvents." -The following provides a description of the abbreviations for each of the measures.

- ECC Energy and Climate Change Sources
- CMB Combustion Sources
- FUG Fugitive VOC Emissions
- CTS Coatings and Solvents
- MCS Multiple Component Sources
- FLX Compliance Flexibility Sources
- MOB Mobile Sources
- EGM Emission Growth Management Sources
- BIO Biogenic Sources

Title

The title contains the control measure name and the major pollutant(s) controlled by the measure.

Summary Table

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

Some measures in the summary table are listed as "TBD" (to be determined) for emission inventory, emission reductions and/or cost control. –The "TBD" measures require further technical and feasibility evaluations to determine the emission reduction potential and thus, the attainment demonstration is not dependent on these measures. -However, they are included in the AQMP as part of a comprehensive plan with all feasible measures. -These measures will require further development after the approval of the AQMP, but could be proposed for rule or program development at a later date. -Emission reductions achieved and quantified by these measures can be applied toward contingency requirements, make up for any shortfalls in reductions from other quantified measures, be credited towards rate-of-progress reporting, and/or be incorporated into future AQMP revisions.

Description of Source Category

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

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

Proposed Method of Control

The purpose of this section is to identify potential control options an emission source can use to achieve emission reductions. –If an expected performance level for a control option is provided, it is intended for informational purposes only and should not be interpreted as the targeted overall control efficiency for the proposed control measure. -To the extent feasible, the overall control efficiency for a control measure should take into account achievable controls in the field by various subcategories within the control measure. -A more detailed type of this analysis is typically conducted during rulemaking, not in the planning stage. -It has been the South Coast AQMD's long standing policy not to exclude any control technology and to intentionally identify as many control options as possible to spur further technology development.

In addition to the proposed control methods discussed in each control measure, affected sources may have the option of partially satisfying the emission reduction requirements of each control measure with incentive programs that will become available in the future from the implementation of control measure. Examples of incentive programs currently available and future enhancements to those incentive programs would be described in this section.

Emission Reductions

The emission reductions are estimated based on the baseline inventories prepared for the 2022 AQMP and are provided in the Control Measure Summary Table. -The emissions section of the control measure summary table includes the 2018 base year inventory and the 2031, 2032, and 2037 future year inventories. -The 2031, 2032, and 2037 inventory projections reflect implementation of existing adopted rules.

The emission reductions listed in the control measure summary table represent the current best estimates, which are subject to change during rule development. –As demonstrated in previous rulemakings, the South Coast AQMD is always seeking maximum emission reductions when proven technically feasible and cost-effective. –For emission accounting purposes, a weighted average control efficiency is calculated based on the targeted controls. -The concept of a weighted average acknowledges the fact that a control measure or rule may consist of several subcategories, and the emission reduction potential for each subcategory is a function of proposed emission limitation and the associated emission inventory. -Therefore, the use of control efficiency to estimate emission reductions does not represent a commitment by the South Coast AQMD to require emission reductions uniformly across source categories. –In addition, due to the current structure of emission inventory reporting system, a control measure may partially affect an inventory source category (e.g., certain size of equipment or certain level of material usage). -In this case, an impact factor is incorporated into the calculation of a control efficiency to account for the fraction of inventory affected. -During the rule development, the most current inventory will be used. –However, for tracking rate-of-progress for the SIP emission reduction commitment, the approved AQMP inventory will be used. –More specifically, emission reductions due to mandatory or voluntary, but enforceable, actions will be credited towards SIP obligations.

Rule Compliance and Test Methods

This section addresses requirements in the 1990 Clean Air Act by which the U.S. 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 South Coast AQMD would continue to verify rule compliance through site inspections, recordkeeping, and submittal of compliance plans (when applicable).

In addition to requiring recordkeeping and monitoring requirements, the 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 identifies appropriate approved South Coast AQMD, CARB, and U.S. EPA source test methods.

Cost- Effectiveness

~~Discounted Cash Flow (DCF) is a Governing Board approved method used to calculate the cost-effectiveness of each control measure. Having been used over the past decades, it provides an effective tool to compare cost-effectiveness with past regulatory actions. As control measures undergo the rule making process, more detailed control costs will be developed.~~Discounted Cash Flow (DCF) and Levelized Cash Flow (LCF) are two different approaches to convert the compliance costs anticipated at various points in time to the same time frame: DCF converts all costs to the present value while LCF annualizes all costs over the equipment life. The conversions are done irrespective of how the compliance costs are actually financed by each affected facility. The difference in cost conversion between DCF and LCF means that the dollar costs of compliance alternatives are expressed at different time periods; therefore, the cost-effectiveness results, albeit both in dollar per ton, are not directly comparable to each other. It should also be noted that given that CARB Mobile Source Measure costs are only available for 2023-2037, DCF figures are unable to be calculated and the LCF figures presented here were calculated with a Modified LCF (MLCF) method. This MLCF approach uses the traditional LCF method, but modifies it to only include costs incurred between 2023-2037. For more detailed information on how DCF and LCF are calculated, please see the Appendix 2B of the 2022 Draft AQMP Socioeconomic Report. For more details on the MLCF method, please refer to Chapter 2 of the 2022 Draft AQMP Socioeconomic Report.

The CARB 2022 State Strategy for the State Implementation Plan (2022 State SIP Strategy) has control measures for residential and commercial building space and water heating appliances that align with the South Coast AQMD 2022 AQMP Control Measures. The 2022 AQMP Socioeconomic Report did not estimate cost-effectiveness for control measures R-CMB-01 (Residential Water Heating), R-CMB-02 (Residential Space Heating), C-CMB-01 (Commercial Water Heating), or C-CMB-02 (Commercial Space Heating) to avoid overlap with CARB's control measures. Staff will instead refer to the cost assumptions found in the 2022 State SIP Strategy, Appendix A: Economic Analysis.

The cost-effectiveness values contained herein represent the best available information at this time. -As additional information regarding technology, affected facilities, and existing processes becomes available, the cost-effectiveness will be revised and analyzed during rulemaking.

Implementing Agency

This section identifies the agency(ies) responsible for implementing the control measure. -Also included in this section is a description of any legal or jurisdictional issues that may affect the control measure's implementation.

References

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

R-CMB-01: EMISSION REDUCTIONS FROM REPLACEMENT WITH ZERO EMISSION OR LOW NOx APPLIANCES – RESIDENTIAL WATER HEATING [NOx]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	RESIDENTIAL WATER HEATING			
CONTROL METHODS:	REGULATORY APPROACH: ZERO EMISSION AND LOW NOx LIMIT, AND INCENTIVE APPROACH: ZERO EMISSION TECHNOLOGY			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
NOx Inventory	~~1.95~~1.89	~~1.86~~1.80	~~1.86~~1.80	~~1.84~~1.78
NOx Reduction		~~0.32~~0.30	~~0.48~~0.46	~~1.29~~1.25
NOx Remaining		~~1.54~~1.50	~~1.38~~1.34	~~0.55~~0.53
SUMMER PLANNING	2018	2031	2032	2037
NOx Inventory	~~1.95~~1.89	~~1.86~~1.80	~~1.86~~1.80	~~1.84~~1.78
NOx Reduction		~~0.32~~0.30	~~0.48~~0.46	~~1.29~~1.25
NOx Remaining		~~1.54~~1.50	~~1.38~~1.34	~~0.55~~0.53
CONTROL COST:	$496,600 per ton of NOx (CARB Zero-Emission Standard for Space and Water Heaters Cost-Effectiveness, Quasi-LCF)~~$0 to $230,000 per ton of NOx reduction~~			
INCENTIVE COST:	TBD			
IMPLEMENTING AGEI	SOUTH COAST AQMD			

Description of Source Category

Background

Control measure R-CMB-01 seeks further NOx emission reductions from residential building water heating sources that are subject to Rule 1121 - Control of Oxides of Nitrogen (NOx) from Residential Type, Natural Gas-Fired Water Heaters.

R-CMB-01 sources were previously included under the 2016 AQMP control measure CMB-02 for NOx emission reductions from residential and commercial appliances, with a control strategy focused on a combination of long-term regulation and short-term incentives to replace existing water heaters with new zero emission or low NOx emission units.

Regulatory History

Rule 1121 - Control of Nitrogen Oxides from Residential Type, Natural-Gas-Fired Water Heaters, applies to manufacturers, distributors, retailers, and installers of natural gas-fired water heaters, with heat input rates less than 75,000 BTU per hour. This type of water heater~~s~~ is typically a tank type for residential water heating. Rule 1121, last amended in 2004, requires the implementation of 10 ng/J NOx emission limit, which currently remains one of most stringent NOx standards for this appliance in the nation.

Rule 1121 was originally adopted in 1978, establishing a 40 ng/J NOx emission limit for residential water heaters. This rule was amended in 1999 to lower the emission limit by two steps, from 40 ng/J to 20 ng/J on July 1, 2002 (interim limit) and then 10 ng/J on January 1, 2005 (final limit). The rule was amended in 2004 to extend the compliance date for the final rule limit. With that amendment, the final emission limit of 10 ng/J became applicable on January 1, 2006, for conventional water heater of 50-gallon capacity or less, on January 1, 2007 for conventional water heater greater than 50 gallon capacity, and on January 1, 2008 for direct-vent, power-vent, and power direct-vent water heaters. Manufacturers paid a mitigation fee during the interim period prior to the final compliance date.

Proposed Method of Control

Control measure R-CMB-01 seeks NOx emission reductions from residential building water heating sources by: (1) requiring zero emission water heating units through a regulatory approach for both new and existing residences; and (2) allowing low NOx technologies as a transitional alternative in lieu of installing and operating zero emission water heaters, when installing a zero emission unit is determined to be infeasible (e.g., colder climate zones, or architecture design obstacles). A mitigation fee will be considered where appropriate. The mitigation fee collected would be utilized as incentives to accelerate the adoption of zero emission units.

A primary zero emission residential water heating technology is the all-electric heat pump water heater. Most homeowners who have heat pumps use them to heat and cool their homes. But a heat pump also can be used to heat water, either as stand-alone water heating system, or as a combination water heating and space conditioning system. Because they remove heat from the air, any type of air-source heat pump system works more efficiently in a warm climate. Manufacturers' heat pump water heater development involves expanding the number of available models, further improving unit energy efficiency, enhancing heat pump performance for colder weather, and developing a heat pump water heater that can operate from a (residential standard) 120-volt plug-in. The low power 120-volt design can plug into existing wall outlets without requiring expensive panel upgrades and/or home rewiring that can be required for traditional heat pumps that require 240-volts, providing a more cost-effective solution for retrofit applications.

The primary lower NOx water heating technologies include fuel cell water heaters and gas heat pump water heaters. The South Coast AQMD has funded a fuel cell demonstration project in collaboration with Southern California Gas Company (SoCalGas). Residential fuel cells used for the generation of electricity and hot water have been available commercially in Europe since 2009. This technology is yet to be utilized in the United States market. A residential fuel cell with a hot water storage tank is a suitable technology to provide hot water usage for a small number of residents. The South Coast AQMD also has funded a natural gas heat pump water heater demonstration by Stone Mountain Technologies. A natural gas heat pump water heater is another lower NOx emission technology that uses a natural gas fired engine instead of electricity, to drive the heat pump compressor. Control measure R-CMB-01 also proposes to incentivize zero emission technologies adoption with a focus on electric panel upgrades needed for older homes especially for homes in disadvantaged communities. The collected mitigation fees would fund the incentives. The incentive approach would not only promote more participation in building electrification but also provide an opportunity to improve some of the inequities. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Incentives Implementation

Integrity Elements

Emission reductions that are projected to be achieved from the voluntary incentive measures must be demonstrated to be quantifiable, surplus, enforceable, and permanent. This demonstration must include project type(s); project life; applicable incentive program guideline(s), by title, year, chapter(s); and analysis of applicable incentive program guideline(s) for consistency with integrity elements. The following describes the definitions and provides examples of the key elements of such a demonstration:

- Quantifiable: Emission reductions are quantitatively measurable supported by existing and acceptable technical data. The quantification should use well-established, publicly available, and approved emission factors and accepted calculation methodology. There must be procedures to evaluate and verify over time the level of emission reductions actually achieved.

  Potential emission reductions associated with various equipment types are discussed in the Proposed Method of Control section. The following table provides an overview of the sources, emission reductions, and proposed incentives for targeted sources.

- Surplus: Emission reductions must be above and beyond any South Coast AQMD, state, or federal regulation. Emission reductions used to meet air quality attainment requirements are surplus as long as they are not otherwise relied on in the State Implementation Plan (SIP), SIP-related requirement, other State air quality programs adopted but not in the SIP, a consent decree, or federal rules that focus on reducing criteria pollutants or their precursors. In the event that SIP emission reductions are relied on to meet air quality-related program requirements, they are no longer surplus. In addition, the emission reductions are available only for the remaining useful life of the equipment being replaced (e.g., if the equipment being replaced had a remaining useful life of five years, the additional emission reductions from the new equipment are available for SIP or conformity purposes under this guidance for only five years).

- Enforceable: The South Coast AQMD will be responsible for assuring that the emission reductions credited in the SIP will occur. Emission reductions and other required actions are enforceable if:

  - They are independently verifiable;
  - Program violations are defined;
  - Those liable for emission reductions can be identified;

- The South Coast AQMD and the U.S. EPA maintain the ability to apply penalties and secure appropriate corrective action where applicable;
- The general public have access to all the emissions-related information obtained from the source;
- The general public can file suits against sources for violations (with the exception of those owned and operated by Tribes); and
- They are practically enforceable in accordance with other U.S. EPA guidance on practicable enforceability.

Actual emission reductions, for example, can be assured through the replacement equipment registration, recordkeeping and reporting, and inspections (initial inspection after installation and subsequent on a regular basis thereafter, if needed) throughout the term. Specific enforcement mechanisms will be addressed in the guidelines for the individual incentive measures.

- <u>Permanent</u>: The emission reductions need to be permanent throughout the term for which the credit is generated. The emission reductions are permanent if these reductions are ensured to occur over the duration of the SIP program, and for as long as they are relied on in the SIP.

  For example, those awarded incentives would need to ensure the projects are properly implemented and the reductions are occurring and will continue to occur. Thus, recipients of the incentive awards would agree to contract provisions, such as recordkeeping and reporting to track reductions and agreements that newly installed equipment would not be removed without concurrence with the South Coast AQMD (i.e., permanent placement) and the proof that the replaced equipment would be destructed or at least not be operated any more in the Basin (e.g., pictures, certification). Detailed procedures to ensure permanent reductions will be described in the guidelines for the individual incentive measures.

Guidelines

Each SIP needs to have detailed and comprehensive guidelines that are approved by the South Coast AQMD Governing Board. The guidelines will be the protocol to implement the program, to ensure SIP applicability, and to maintain SIP approvability:

☑ Voluntary incentive program should demonstrate compliance with the four key elements of the SIP: quantifiable emissions plus incentive costs, surplus reductions, enforceable compliance, and permanent reductions.

☑ Working group should be established to solicit public input and feedback during SIP guideline development.

☑ Process and procedures to apply for incentives should be clearly explained in the guideline.

☑ It needs to clearly describe how incentives would be awarded (e.g., priority to high emitters and/or age of equipment, tiered process, first come first serve, or EJ area priority).

☑ It should have conditions of some form for agreement (e.g., contracts) including tracking and ensuring permanent reductions. The following forms should be prepared:

- ☑ Application Forms (samples are required).
- ☑ Contracts with Conditions (samples are required).
- ☑ Product Example.

☑ Tracking mechanism is required to ensure overall effectiveness of program and procedures to correct emission projections, such as reductions by the committed target date (e.g., 2031, 2037) and submittal to the U.S. EPA annually. Tracking checklist should include:

- ☑ Project Title.
- ☑ Product.
- ☑ Annual Emission Reductions (e.g., from 2030 to 2050, incremented by one year).
- ☑ Life of project (e.g., 10 years).
- ☑ Installation dates (e.g., fixed year 2030 or multiple installation years 2017 and 2018).

☑ Possible recordkeeping, reporting, and monitoring requirements need to be addressed.

☑ Individual outreach efforts (e.g., social media, email blasts) to promote the program, make aware of deadlines to apply, and provide timing locations of workshops.

☑ Program guidelines should be approved by the South Coast AQMD Governing Board and published online.

Emission Reductions

Staff estimates NOx emission reductions could be approximately ~~0.32~~0.30 tons per day by 2031 and ~~1.29~~1.25 tons per day by 2037, which would be achieved by a regulatory approach (See Table R-CMB-01-A). Incentive programs for accelerating zero emission technology adoption would promote further emission reductions earlier than required.

The target of this regulatory approach is to implement zero emission technologies for 50 percent of the applicable sources and implement low NOx water heating technologies in conjunction with a mitigation fee for the remaining~~st~~ 50 percent by 2037. The low NOx water heating technologies could be the alternative for applications when zero emission technologies are deemed not feasible (e.g., colder climate zones, or architecture design obstacles). The alternative approach should define an emission limit (e.g., 5 ng/J) and the associated mitigation fee. In-depth analysis during future rule development would determine when regulatory off-ramps should be provided under certain situations.

To implement zero emission technologies for 50 percent of the applicable sources by 2037, 10 percent would come from new buildings and 40 percent from existing buildings starting in year 2029. This proposed implementation year considers~~has considered~~ the state and local policy development timelines and the time required for our rule development and implementation. Staff recognizes that a unit replacement for existing buildings may occur at the end of the unit lifetime, which creates a natural unit turnover. As a water heater’s useful lifetime is around 10 years, there would be more than 40 percent natural turnover over an eight-year period of time by 2037 for existing buildings. Additional NOx emission reductions could be achieved with state and local incentive programs that have been launched or proposed. The South Coast AQMD will propose incentives to promote water heater replacement with heat pumps and will also seek partnerships for implementing the incentives.

For low NOx water heating technologies, the emission reductions are estimated based on ~~its~~ implementation for the remaining 50 percent of the sources by 2037, with a consideration of natural turnover and 50 percent of reduction from 10 to 5 ng/J NOx emissions for each replacement.

With the Title 24 code update for the readiness of new building electrification, the implementation for new buildings could occur earlier (e.g., 2024) than that for existing buildings. However, for a conservative emission reduction estimation, the implementation start year for new buildings would also occur in 2029 as for older buildings.

TABLE R-CMB-01-A

Emission Reduction Potential for R-CMB-01 Sources

R-CMB-01 Residential Water Heating	Proposal for Reduction			NOx Emission Reductions (tpd)	
	Current NOx Limit	Potential NOx Limit	Start of Implementation	2031	2037
Regulatory Approach – Zero Emission	10 ng/J	0 ng/J	2029	~~0.23~~0.22	~~0.92~~0.89
Regulatory Approach – Other Technologies	10 ng/J	5 ng/J	2029	~~0.09~~0.08	~~0.37~~0.36
Regulatory Approach – Overall	---	---	2029	~~0.32~~0.30	~~1.29~~1.25

Rule Compliance and Test Methods

South Coast AQMD Method 100.1

Cost Effectiveness

The CARB 2022 State SIP Strategy has proposed control measures for residential and commercial building space and water heating appliances, which align with the South Coast AQMD 2022 AQMP Control Measures R-CMB-01 (Residential Water Heating), R-CMB-02 (Residential Space Heating), C-CMB-01 (Commercial Water Heating), and C-CMB-02 (Commercial Space Heating). CARB would design any such standard in collaboration with energy and building code regulators and with air districts to ensure consistency with all state and local efforts and would work carefully with communities to consider any housing cost or affordability impacts, recognizing that reducing emissions and energy demand from these appliances can generate cost-savings and health benefits with properly designed standards. For the cost-effectiveness estimates of these control measures, staff will refer to the CARB analysis. All cost assumptions for CARB measures can be found in the 2022 State SIP Strategy, Appendix A: Economic Analysis.[2]

According to California Energy Commission's analysis for the 2022 Title 24 development, even though equipment and replacement costs for electric heat pump water heaters are greater than traditional natural gas fired water heaters, there are cost savings from installation, exhaust flue, and maintenance over the lifetime of the equipment. Therefore, staff estimates that proposing zero emission water heating for new residential buildings would not pose an additional adverse cost.

For existing residential buildings, a primarily additional cost proposing zero emission water heating for older buildings would be electrical panel upgrades, which is approximately $2,000 to $4,000 in the South Coast AQMD jurisdiction. Investment on an electrical upgrade would benefit the building electrification for implementing other zero emission appliances. Therefore, the cost-effectiveness should also consider potential emission reductions from electrifying other appliances.

~~The cost-effectiveness for implementing zero emission residential water heating is estimated to be in the range of $0 to $230,000 per ton of NOx reduction.~~ The cost-effectiveness of the CARB Zero-Emission Standard for Space and Water Heaters measure is $496,600 per ton of NOx (Quasi-LCF). The additional cost may be partially offset by local utility companies and state agencies who have proposed incentives for heat pumps (e.g., California TECH Initiative) or panel upgrade. ~~The~~ South Coast AQMD would also propose an incentive program to further lower the upfront cost. The cost for heat pumps will be lowered when the market achieves greater penetration. On the other hand, improvements in available technology may also lower the cost of equipment as well as related upgrades. For example, heat pump water heaters that are compatible with 120-volt electric systems are currently entering the market, removing the need for upgrading electric service in older homes.

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from these stationary sources.

References

South Coast Air Quality Management District. (2004). Rule 1121 – Control of Nitrogen Oxides from Residential Type, Natural Gas-Fired Water Heaters (Amended September 3, 2004).

[2] California Air Resources Board, Proposed 2022 State SIP Strategy Appendix A: Economic Analysis, September 2022. https://ww2.arb.ca.gov/sites/default/files/2022-09/2022_State_SIP_Strategy_App_A.pdf

South Coast Air Quality Management District. (2004). Final Staff Report: Proposed Amended Rule 1121 – Control of Nitrogen Oxides from Residential Type, Natural Gas-Fired Water Heaters. South Coast Air Quality Management District. August 2004.

South Coast Air Quality Management District. (2017). Final 2016 Air Quality Management Plan. South Coast Air Quality Management District. March 2017.

Department of Energy. Heat Pump Water Heater.
https://www.energy.gov/energysaver/water-heating/heat-pump-water-heaters

Energy-Solution. California TECH Initiative
https://energy-solution.com/tech/

Advanced Water Heating Initiative. 120-Volt Heat Pump Water Heater Technology Validation and Commercialization.
https://www.advancedwaterheatinginitiative.org/120v-field-study

Southern California Gas Company. Residential Natural Gas-fueled Heat Pump Water Heaters – Technology Advancements & Demonstration
https://www.socalgas.com/sustainability/research-and-development

Southern California Gas Company. (2018). Proposal in response to South Coast AQMD Air Pollution Control Projects that Reduce/Mitigate Emissions/Toxic Exposure P2018-06: Residential Fuel Cell Demonstration with Integrated PV and Storage. April 10, 2018.

California Air Resources Board, Proposed 2022 State SIP Strategy Appendix A: Economic Analysis, September 2022.
https://ww2.arb.ca.gov/sites/default/files/2022-09/2022_State_SIP_Strategy_App_A.pdf

California Energy Commission. (2021). Building Energy Efficiency Measure Proposal to the California Energy Code, Title 24, Part 6 Building Energy Efficiency Standards Residential Electric Baseline – Residential HVAC and Residential Water Heating. May 2021.

Application of Southern California Edison Company for Approval of its Building Electrification Programs. December 2021.
https://docs.cpuc.ca.gov/SearchRes.aspx?docformat=ALL&docid=432773552

R-CMB-02: EMISSION REDUCTIONS FROM REPLACEMENT WITH ZERO EMISSION OR LOW NOx APPLIANCES – RESIDENTIAL SPACE HEATING [NOx]

CONTROL MEASURE SUMMARY

SOURCE CATEGORY: RESIDENTIAL SPACE HEATING

CONTROL METHODS: REGULATORY APPROACH: ZERO EMISSION AND LOW NOX LIMIT, AND INCENTIVE APPROACH: ZERO EMISSION TECHNOLOGY

EMISSIONS (TONS/DAY):

ANNUAL AVERAGE	2018	2031	2032	2037
NOx Inventory	~~12.08~~11.66	~~7.54~~7.31	~~7.19~~6.97	~~6.02~~5.84
NOx Reduction		~~0.87~~0.85	~~1.31~~1.27	~~3.49~~3.46
NOx Remaining		~~6.67~~6.46	~~5.88~~5.70	~~2.53~~2.38
SUMMER PLANNING	**2018**	**2031**	**2032**	**2037**
NOx Inventory	~~4.16~~4.01	~~2.60~~2.51	~~2.47~~2.40	~~2.07~~2.01
NOx Reduction		~~0.30~~0.28	~~0.45~~0.44	~~1.20~~1.17
NOx Remaining		~~2.29~~2.23	~~2.02~~1.96	~~0.87~~0.84

CONTROL COST: $496,600 per ton of NOx (CARB Zero-Emission Standard for Space and Water Heaters Cost-Effectiveness, Quasi-LCF)~~$0 to $200,000 per ton of NOx reduction~~

INCENTIVE COST: TBD

IMPLEMENTING AGENCY: SOUTH COAST AQMD

Description of Source Category

Background

Control measure R-CMB-02 seeks nitrogen oxides (NOx) emission reductions from residential space heating sources regulated by Rule 1111 - Reduction of NOx Emissions from Natural-Gas-Fired, Fan-Type Central Furnaces.

R-CMB-02 sources were previously included under the 2016 AQMP control measure CMB-02 for NOx emission reductions from residential and commercial appliances, with a control strategy focused on implementing 14 ng/J Rule 1111 NOx limit and the associated Clean Air Furnace Rebate Program.

Regulatory History

Rule 1111 reduces emissions of NOx from gas-fired fan-type space heating furnaces with a rated heat input capacity of less than 175,000 BTU per hour or, for combination heating and cooling units, a cooling rate of less than 65,000 BTU per hour. The rule applies to manufacturers, distributors, and installers of such furnaces. The applicable furnaces are mainly utilized in residential buildings.

Rule 1111 was adopted by the South Coast AQMD Governing Board in December 1978 establishing a 40 ng/J NOx emission limit. The rule was amended in 2009 lowering the NOx emission limit from 40 to 14 ng/J with a future compliance date. Rule 1111 categorizes furnaces into condensing, non-condensing, weatherized furnaces, and mobile home furnaces. Depending on the furnace type, the compliance date has been postponed by the mitigation fee alternate compliance option or temporary exemption.

Implementation of 14 ng/J NOx limit for condensing and non-condensing furnaces (about 85 percent of market coverage) for installations in new buildings or replacements in existing buildings started on October 1, 2019, except for high-altitude furnaces.[3] Implementation of 14 ng/J NOx limit for weatherized furnaces (about 10 percent of market coverage) commenced on October 1, 2021. The most recent Rule 1111 amendment in September 2021 delayed the implementation for mobile home furnaces (about 4 percent of market coverage) to October 1, 2023 and provided special consideration for high-altitude furnaces. That is, condensing or non-condensing furnaces with 40 ng/J NOx are allowed to be installed in high-altitude areas until March 31, 2022, when 14 ng/J NOx limit becomes effective. Rule 1111 also provides an exemption for downflow and large-sized (≥100,000 BTU/hour) condensing or non-condensing furnaces, replacing existing furnaces in the high-altitude areas. This niche exemption would result in a negligible amount of emission reductions forgone.

In conjunction with the Rule 1111 implementation, the Clean Air Furnace Rebate Program was launched in June 2018 with a fund of $3,000,000 to incentivize early deployment of compliant furnaces, which was subsequently exhausted. So, in September 2020 this program was approved to be updated with an additional fund of $3,500,000 and expanded to incentivize all-electric heat pumps to replace central ducted Rule 1111 non-compliant furnaces. Relevant to the 2016 AQMP CMB-02 implementation, a request for proposal was issued in January 2018 and twenty-six proposals for emission reduction and technology demonstration projects were approved to be funded by the Governing Board in January 2019. Among those proposals, there are two burner technology development projects for residential and commercial furnaces targeting NOx emissions to be certified ranging from 7 to 8 ng/J. Although the Covid-19 pandemic caused a delay, those projects are forecast to be completed in 2022.

Proposed Method of Control

Control measure R-CMB-02 seeks NOx emission reductions from residential building space heating sources by: (1) requiring zero emission space heating units through a regulatory approach for both new and existing residences; and (2) allowing low NOx technologies as a transitional alternative in lieu of installing and operating zero emission space heating units, when installing a zero emission unit is determined to be infeasible (e.g., colder climate zones, or architecture design obstacles). A mitigation fee

[3] Condensing or non-condensing furnaces installed at elevations greater than or equal to 4,200 feet above sea level

will be considered where appropriated. The mitigation fee collected would be utilized as incentives to accelerate the adoption of zero emission units.

With regards to zero emission technologies, all-electric heat pumps offer an energy-efficient and zero emission alternative to natural gas furnaces. There are three types of heat pumps: (1) air-to-air, (2) water source, and (3) geothermal. The heat pump choice depends on whether the unit transfers heat between the building and outside air, water, or ground. The most common type is the air source heat pump. According to the United States Department of Energy, today's heat pump systems can reduce household electricity use for heating by approximately 50 percent compared to electric resistance heating such as furnaces and baseboard heaters. High-efficiency heat pumps also dehumidify better than standard central air conditioners, resulting in less energy usage and more cooling comfort during the summer months. For homes without ducts, air source heat pumps are also available in a ductless version, referred as a split system. Heat pumps have been used for many years in nearly all areas of the United States. However, when utilized in warmer climate zones such as in the South Coast AQMD, heat pumps are even more energy-efficient and cost-effective.

A new type of heat pump for residential systems is the absorption heat pump, also called a natural gas heat pump, which is considered a low NOx emission technology. Instead of using electricity to fuel the operation, a natural gas heat pump has a natural gas fired engine to drive the heat pump compressor.

Current Rule 1111 compliant furnaces are certified at achieving 14 ng/J NOx level, however, many of these furnace models were tested below 10 ng/J for NOx emissions. Staff reviewed the source test results for 24 base models that were certified in 2021 at 14 ng/J NOx emissions. Fifteen models tested below 10 ng/J NOx level, and six of them were at or below 7 ng/J NOx level. Furthermore, lower NOx emission rates are expected by new burner development projects as demonstrated by burner development projects currently funded by the South Coast AQMD. For example, Lantec Products has completed the burner design, operational testing, and certification of residential condensing and non-condensing furnaces emitting no more than 7 ng/J NOx, and will seek to commercialize in the near future. Low NOx space heating technologies would provide an alternative or off-ramp for situations when zero emission requirement is deemed not as feasible/efficient. The examples could include buildings in a cooler climate zone, or structures with special design or function.

In addition to a regulatory approach, incentives for the purchase and installation of zero emission technology (e.g., electric heat pump) or electric panel upgrade would be considered under this control measure not only for additional emission reductions, but also to encourage further development of future zero emission space heating technology for existing residential buildings. With the additional Rule 1111 mitigation fees that have been collected and utilization of the existing Clean Air Furnace Rebate Program, future Rule 1111 incentives could be readily implemented. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost--effectiveness and incremental cost -effectiveness, and may consider alternative compliance mechanisms.

Incentives Implementation

Integrity Elements

Emission reductions that are projected to be achieved from the voluntary incentive measures must be demonstrated to be quantifiable, surplus, enforceable, and permanent. This demonstration must include project type(s); project life; applicable incentive program guideline(s), by title, year, chapter(s); and analysis of applicable incentive program guideline(s) for consistency with integrity elements. The following describes the definitions and provides examples of the key elements of such a demonstration:

- Quantifiable: Emission reductions are quantitatively measurable supported by existing and acceptable technical data. The quantification should use well-established, publicly available, and approved emission factors and accepted calculation methodology. There must be procedures to evaluate and verify over time the level of emission reductions actually achieved.

  Potential emission reductions associated with various equipment types are discussed in the Proposed Method of Control section. The following table provides an overview of the sources, emission reductions, and proposed incentives for targeted sources.

- Surplus: Emission reductions must be above and beyond any South Coast AQMD, state, or federal regulation. Emission reductions used to meet air quality attainment requirements are surplus as long as they are not otherwise relied on in the State Implementation Plan (SIP), SIP-related requirement, other State air quality programs adopted but not in the SIP, a consent decree, or federal rules that focus on reducing criteria pollutants or their precursors. In the event that SIP emission reductions are relied on to meet air quality-related program requirements, they are no longer surplus. In addition, the emission reductions are available only for the remaining useful life of the equipment being replaced (e.g., if the equipment being replaced had a remaining useful life of five years, the additional emission reductions from the new equipment are available for SIP or conformity purposes under this guidance for only five years).

- Enforceable: The South Coast AQMD will be responsible for assuring that the emission reductions credited in the SIP will occur. Emission reductions and other required actions are enforceable if:

  - They are independently verifiable;
  - Program violations are defined;
  - Those liable for emission reductions can be identified;
  - The South Coast AQMD and the U.S. EPA maintain the ability to apply penalties and secure appropriate corrective action where applicable;
  - The general public have access to all the emissions-related information obtained from the source;
  - The general public can file suits against sources for violations (with the exception of those owned and operated by Tribes); and
  - They are practically enforceable in accordance with other U.S. EPA guidance on practicable enforceability.

  Actual emission reductions, for example, can be assured through the replacement equipment registration, recordkeeping and reporting, and inspections (initial inspection after installation and subsequent on a regular basis thereafter, if needed) throughout the term. Specific enforcement mechanisms will be addressed in the guidelines for the individual incentive measures.

- Permanent: The emission reductions need to be permanent throughout the term for which the credit is generated. The emission reductions are permanent if these reductions are ensured to occur over the duration of the SIP program, and for as long as they are relied on in the SIP.

  For example, those awarded incentives would need to ensure the projects are properly implemented and the reductions are occurring and will continue to occur. Thus, recipients of the incentive awards would agree to contract provisions, such as recordkeeping and reporting to track reductions and agreements that newly installed equipment would not be removed without concurrence with the South Coast AQMD (i.e., permanent placement) and the proof that the replaced equipment would be destructed or at least not be operated any more in the Basin (e.g., pictures, certification). Detailed procedures to ensure permanent reductions will be described in the guidelines for the individual incentive measures.

Guidelines

Each SIP needs to have detailed and comprehensive guidelines that are approved by the South Coast AQMD Governing Board. The guidelines will be the protocol to implement the program, to ensure SIP applicability, and to maintain SIP approvability:

- ☑ SIP should demonstrate compliance with the four key elements of the SIP: quantifiable emissions plus incentive costs, surplus reductions, enforceable compliance, and permanent reductions.
- ☑ Working group should be established to solicit public input and feedback during SIP guideline development.
- ☑ Process and procedures to apply for incentives should be clearly explained in the guideline.
- ☑ It needs to clearly describe how incentives would be awarded (e.g., priority to high emitters and/or age of equipment, tiered process, first come first serve, or EJ area priority).
- ☑ It should have conditions of some form for agreement (e.g., contracts) including tracking and ensuring permanent reductions. The following forms should be prepared:
  - ☑ Application Forms (samples are required).
  - ☑ Contracts with Conditions (samples are required).
  - ☑ Product Example.
- ☑ Tracking mechanism is required to ensure overall effectiveness of program and procedures to correct emission projections, such as reductions by the committed target date (e.g., 2031, 2037) and submittal to the U.S. EPA annually. Tracking checklist should include:
  - ☑ Project Title.
  - ☑ Product.
  - ☑ Annual Emission Reductions (e.g., from 2030 to 2050, incremented by one year).
  - ☑ Life of project (e.g., 10 years).
  - ☑ Installation dates (e.g., fixed year 2030 or multiple installation years 2017 and 2018).

- ☑ Possible recordkeeping, reporting, and monitoring requirements need to be addressed.
- ☑ Individual outreach efforts (e.g., social media, email blasts) to promote the program, make aware of deadlines to apply, and provide timing locations of workshops.
- ☑ Program guidelines should be approved by the South Coast AQMD Governing Board and published online.

Emission Reductions

Staff estimates NOx emission reductions could be approximately ~~0.87~~0.85 tons per day by 2031 and ~~3.49~~3.46 tons per day by 2037, which would be achieved by a regulatory approach (See Table R-CMB-02-A). Incentive programs for accelerating zero emission technology adoption would promote further emission reductions earlier than required.

The target of this regulatory approach is to implement zero emission technologies for 50 percent of the applicable sources and implement low NOx space heating technologies in conjunction with a mitigation fee for the remaining~~st~~ 50 percent by 2037. The low NOx space heating technologies could be the alternative for applications when zero emission technologies are deemed not as feasible/efficient (e.g., colder climate zones, or architecture design obstacles). The alternative approach should define an emission limit (e.g., 7 ng/J) and the associated mitigation fee, if appropriate. In-depth analysis during future rule development would determine when regulatory off-ramps should be provided under certain situations.

There are about 4 million housing units potentially utilizing Rule 1111 furnaces with an estimated 25-year lifetime. Based on the furnace sales data in 2015-2016, there are about 150,000 units per year sold in the South Coast AQMD. Manufacturers estimated 10 percent of sales (i.e., 15,000 units) were installed in new buildings. On this basis, to implement zero emission technologies for 50 percent of the applicable sources by 2037, 10 percent would come from new buildings and 40 percent from existing buildings starting in year 2029. Staff recognizes that a unit replacement for existing buildings may occur at the end of the unit lifetime, which creates a natural unit turnover. There would be about 32 percent natural unit turnover over an eight-year period of time by 2037 without stimulation in the market for zero emission technologies. It is anticipated that the remaining 8 percent turnover is achievable with state and local incentive programs that have been launched or proposed. For example, Technology and Equipment for Clean Heating (TECH) Clean California incentives are available statewide as of December 7, 2021. Enrolled contractors installing Heat Pump HVAC systems and Heat Pump Water Heaters can receive at least $3,000 per installation, with opportunities to earn up to $6,600 in select regions where utilities have partnered with TECH Clean California. In December 2021, Southern California Edison applied to California Public Utilities Commission seeking approval for its existing building electrification programs. These programs will support the installation of approximately 250,000 heat pumps and provide electrical upgrades for 65,000 households in 2024-2027. The South Coast AQMD's Clean Air Furnace Rebate Program will continue to promote replacement with heat pumps. The South Coast AQMD will also seek partnerships for implementing incentives.

For low NOx space heating technologies in conjunction with a mitigation fee, the emission reductions are estimated based on its implementation for the remaining 50 percent of the sources by 2037, with a 50 percent ~~of~~ reduction from 14 to 7 ng/J NOx emissions for each replacement.

With the Title 24 code update for the readiness of new building electrification, the implementation for new buildings could occur earlier (e.g., 2024) than that for existing buildings. However, for a conservative emission reduction estimation, the implementation start year for new buildings would also occur in 2029 as for older buildings.

TABLE R-CMB-02-A

Emission Reduction Potential for R-CMB-02 Sources

R-CMB-02 Residential Space Heating	Proposal for Reduction			NOx Emission Reductions (tpd)	
	Current NOx Limit	Potential NOx Limit	Start of Implementation	2031	2037
Regulatory Approach – Zero Emission	14 ng/J	0 ng/J	2029	~~0.75~~0.73	~~3.01~~2.99
Regulatory Approach – Other Technologies	14 ng/J	7 ng/J	2029	~~0.12~~0.12	~~0.48~~0.47
Regulatory Approach – Overall	---	---	2029	~~0.87~~0.85	~~3.49~~3.46

Rule Compliance and Test Methods

South Coast AQMD Method 100.1

Cost Effectiveness

The CARB 2022 State SIP Strategy has proposed control measures for residential and commercial building space and water heating appliances, which align with the South Coast AQMD 2022 AQMP Control Measures R-CMB-01 (Residential Water Heating), R-CMB-02 (Residential Space Heating), C-CMB-01 (Commercial Water Heating), and C-CMB-02 (Commercial Space Heating). CARB would design any such standard in collaboration with energy and building code regulators and with air districts to ensure consistency with all state and local efforts and would work carefully with communities to consider any housing cost or affordability impacts, recognizing that reducing emissions and energy demand from these appliances can generate cost-savings and health benefits with properly designed standards. For the cost-effectiveness estimates of these control measures, staff will refer to the CARB analysis. All cost assumptions for CARB measures can be found in the 2022 State SIP Strategy, Appendix A: Economic Analysis.[4]

According to the California Energy Commission's analysis for 2022 Title 24 development (*January 26, 2021 staff presentation*), an electric heat pump for residential space heating and cooling would require an additional purchase cost of $100 to $450, but that cost would be offset by lower operational cost of approximately $350 per year, as compared to a natural gas furnace and air conditioner system. The company E3 conducted a study in 2019 (E3, 2019) that indicated compared to combined natural gas furnace and air conditioner system, heat pump HVAC systems do not show a capital cost disadvantage. Because of their high energy efficiency, the installation of HVAC heat pumps can result in lifecycle of savings.

However, for a 240-volt heat pump installation in some older buildings, an electric panel upgrade may be required at an estimated cost of $2,000 to $4,000 in the South Coast AQMD jurisdiction.

~~With this additional cost, the cost-effectiveness for implementing zero emission residential space heating is estimated to be in the range of $0 to $200,000 per ton of NOx reduction. If a $1000 per unit incentive would be provided, the cost-effectiveness would be lowered to $100,000 per ton of NOx reducedIt is also anticipated that the cost for heat pumps will be lowered when the market achieves greater penetration.~~

With regards to the cost of other technologies, compared to a 14 ng/J NOx furnace, the median cost increase to manufacture a 7 ng/J NOx furnace is estimated to be approximately $150 per unit. The price markup as the manufactured product is passed through the supply chain is estimated to two or three times the manufacturing cost. Thus, the consumer is likely subject to a unit increase of $500 to purchase a 7 ng/J NOx furnace compared to a 14 ng/J NOx furnace.

The NOx emission reductions~~s~~ from a 14 ng/J furnace are~~is~~ estimated to generate 0.73 lbs of NOx per year. On this basis, the emission reductions for each furnace would be 0.0045 tons over the 25 years lifetime of the unit if the emission limit is lowered from 14 ng/J to 7 ng/J. ~~As a result, the estimated cost-effectiveness for this proposal would be approximately $32,000 per ton of NOx reduced if no mitigation fee would be proposed. If a $400 per unit mitigation fee would be proposed, the cost-effectiveness would be $97,000 per ton of NOx reduced.~~

The cost-effectiveness of the CARB Zero-Emission Standard for Space and Water Heaters measure is $496,600 per ton of NOx (Quasi-LCF). The additional cost may be partially offset by local utility companies and state agencies who have proposed incentives for heat pumps (e.g., California TECH Initiative) or panel upgrade. ~~The~~ South Coast AQMD would also propose incentive program to further lower the upfront cost. It is also anticipated that the cost for heat pumps will be lowered when the market achieves greater penetration.

[4] California Air Resources Board, Proposed 2022 State SIP Strategy Appendix A: Economic Analysis, September 2022. https://ww2.arb.ca.gov/sites/default/files/2022-09/2022_State_SIP_Strategy_App_A.pdf

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from these stationary sources.

References

South Coast Air Quality Management District. (2021). Rule 1111 – Reduction of NOx Emissions from Natural-Gas-Fired, Fan-Type Central Furnaces (Amended October 3, 2021).

South Coast Air Quality Management District. (2017). Final 2016 Air Quality Management Plan. South Coast Air Quality Management District. March 2017.

South Coast Air Quality Management District. (2021). Staff Report: Proposed Amended Rule 1111 – NOx Emissions from Natural-Gas-Fired, Fan-Type Central Furnaces. South Coast Air Quality Management District. September 2021.

South Coast Air Quality Management District. (2018). Board meeting agenda No.3: Issue RFP for Emission Reduction Projects Using Incentive Funding from SOUTH COAST AQMD Special Revenue Funds, Allocate Funds, and Execute Contract. January 5, 2018.

South Coast Air Quality Management District. Clean Air Furnace Rebate Program: https://www.cleanairfurnacerebate.com/

U.S. Department of Energy. Heat Pump Systems. https://www.energy.gov/energysaver/heat-pump-systems

California Energy Commission. Workshops, Notices, and Documents for 2022 Building Energy efficiency Standards. https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency-0

California Energy Commission. (2021). Staff presentation at the Lead Commissioner Hearing, 2022 energy code update rulemaking. May 24, 2021.

E3 study on Residential Building Electrification in California. April 2019. Available at: https://www.ethree.com/wp-content/uploads/2019/04/E3_Residential_Building_Electrification_in_California_April_2019.pdf

LANTEC Products. (2018). Proposal in response to South Coast AQMD Air Pollution Control Projects that Reduce/Mitigate Emissions/Toxic Exposure P2018-06: Next Generation Ultra Low NOx Forced Air Furnace. April 11, 2018.

Energy-Solution. California TECH Initiative https://energy-solution.com/tech/

Application of Southern California Edison Company for Approval of its Building Electrification Programs. December 2021.Available at: https://docs.cpuc.ca.gov/SearchRes.aspx?docformat=ALL&docid=432773552

R-CMB-03: EMISSION REDUCTIONS FROM RESIDENTIAL COOKING DEVICES [NOx]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	RESIDENTIAL COOKING DEVICES			
CONTROL METHODS:	Low NOx Burners, Induction Cooktops and Electric Cooking Devices			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
NOx Inventory	~~1.32~~1.28	~~1.27~~1.23	1.23~~1.27~~	1.21~~5~~
NOx Reduction		~~0.20~~0.19	~~0.30~~0.29	0.~~81~~79
NOx Remaining		~~1.07~~1.04	~~0.97~~0.94	0.42~~4~~
SUMMER PLANNING	2018	2031	2032	2037
NOx Inventory	~~1.32~~1.28	~~1.27~~1.23	~~1.27~~1.23	1.21~~5~~
NOx Reduction		~~0.20~~0.19	~~0.30~~0.29	0.~~81~~79
NOx Remaining		~~1.2707~~1.04	~~0.97~~0.94	0.42~~4~~
CONTROL COST:	~~VARIES FROM COST SAVINGS TO UP TO $937,000/TON OF NOX REDUCED DEPENDING ON EQUIPMENT TYPE AND INFRASTRUCTURE NEEDS~~ DCF METHOD: $144,400/TON OF NOX REDUCED MODIFIED LCF METHOD: $217,500/TON OF NOX REDUCED			
INCENTIVE COST:	TBD			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

Description of Source Category

Control Measure R-CMB-03 seeks to achieve NOx reductions from residential cooking devices including stoves, ovens, griddles, broilers, and others in new and existing residential buildings. Natural gas and electricity are the two main types of energy sources used in this source category. Conventional gas cooking appliances typically use atmospheric burners that mix primary air with fuel gas to create a combustible mixture.[5] Gas cooking devices emit criteria pollutants such as NOx, particulate matter, and CO through incomplete combustion and oxidation processes. Electric cooking devices and induction cooktops that utilize electricity rather than gas do not generate NOx emissions on site. Induction cooktops are also highly energy efficient as they heat cookware directly, resulting in minimal heat loss. Replacing existing gas burners with zero emission and low NOx emission appliances such as electric cooking devices, induction cooktops, and low NOx gas burners can reduce emissions from residential cooking devices.

Some emission sources in R-CMB-03 were previously included in the 2016 AQMP as control measure CMB-04, which addresses NOx emission reductions from restaurant burners and residential cooking. The proposed method of control for CMB-04 in the 2016 AQMP was a combination of regulatory approaches, incentives and/or efficiency standards.

Background

There are over 5.3 million occupied housing units in the South Coast Air Basin. Almost 75 percent of these households use gas appliances for cooking, while the remaining households use electric cooking devices, induction cooktop, and other fuels.[6] The transition from conventional gas burners to~~,~~ electric cooking devices, induction cooktops, or low NOx gas burners would improve both indoor and outdoor ambient air quality.

As part of the 2022 State Strategy for the State Implementation Plan (2022 State SIP Strategy), CARB has proposed statewide emissions standards for combustion-based appliances in residential and commercial buildings to accelerate the transition from fossil fuels. CARB proposed to adopt a statewide zero Greenhouse Gas (GHG) emission standard for space and water heaters, which would have co-benefits of reducing criteria pollutants. Beginning in 2030, 100 percent of sales of new space and water heaters would need to meet zero emission standards. This requirement applies to both new construction and replacement of burned-out equipment in existing buildings. As part of the public measure suggestions, the 2022 State SIP Strategy includes the possibility of additional emissions standards for combustion-based appliances used in buildings such as stoves, work with air districts to set further such standards, work with building and energy code agencies to ready more buildings for zero emission appliances, or take other actions (including potentially incentive programs) to accelerate the removal of fossil fuels from the building stock in both new and existing buildings. Such measures can accelerate the transition away from pollution associated with combustion in these sources while creating economic opportunities for building retrofits.[7]

Regulatory History

NOx emissions from residential cooking devices are not currently regulated by the South Coast AQMD. In the last few years, the State of California has established aggressive goals to reduce GHG emissions across various sectors. State climate actions can help reduce combustion-related emissions from residential cooking appliances. Senate Bill (SB) 100 signed in 2018 increased California's Renewables Portfolio Standard (RPS) to 60 percent renewable energy sources by 2030. California Governor's Executive Order (EO) B-55-18 established the goal of carbon neutrality and 100 percent carbon-free energy sources by

[5] Primary air- air supplied and mixed with fuel prior to ignition that controls the amount of fuel to be burned.

[6] 2019 California Residential Appliance Saturation Study.

[7] CARB 2022 State Strategy for the State Implementation Plan.

2045. The increase in renewable generation in the state will reduce NOx emissions from electricity generating facilities.[8] Furthermore, Assembly Bill (AB) 3232 requires the California Energy Commission (CEC) in consultation with the California Public Utilities Commission (CPUC) and California Air Resources Board (CARB), to develop plans and projections to reduce greenhouse gas emissions from California's residential and commercial buildings to 40 percent below 1990 levels by 2030. Once materialized, AB 3232 is an opportunity to bring further NOx emission reductions from residential and commercial buildings.

Proposed Method of Control

This proposed control measure seeks NOx reductions from residential cooking devices by replacing conventional gas-fired cooking appliances with zero emission and low NOx emission devices such as electric cooking devices, induction cooktops, and low NOx burner technologies.

In the South Coast Air Basin, residential cooking accounts for about 11 percent of total residential combustion emissions in 2018. Electric and induction cooking devices offer the most reductions opportunities with no emissions on site and have been commercially available for years. Electric cooking devices include a coil or infrared heating element that generates heat by electric current and are often inexpensive due to their simple design. High efficiency induction cooktops do not have an open flame and transfer heat directly through magnetic cookware which minimizes heat loss to ambient air. Consequently, this reduces cooking times and NOx emissions and adds extra safety in food preparation. Low NOx gas burners can also provide NOx reductions compared to conventional burners. Organizations such as the Lawrence Berkeley National Laboratory (LBL) have developed a low NOx Ring Burner that can be used for residential and commercial gas cooking devices, as well as other appliances such as water heaters and furnaces. The low NOx Ring Burner can achieve NOx levels of less than 20 ppm, which is about 80 percent lower than the emissions from conventional gas burners.[9] Reductions are achieved by a ring burner design that burns a leaner premixed fuel/air mixture capable of more complete combustion and lower NOx emissions. Additional research and development with an Original Equipment Manufacturer (OEM) are needed for the LBL Ring Burner to meet the American National Standards Institute (ANSI) cooktop standards for commercialization.

NOx reductions could be achieved through a combination of regulatory and incentive approaches. Proposed method of control consists of two steps: step one is a technology assessment including testing of various cooking devices to establish emissions rates. Once emissions rates are defined, step two supports future rule development and incentive programs. The first applies to manufacturers, distributors, and installers establishing emission limits and the latter intends to encourage use of zero emission and low NOx emission technologies. Rule working group will include a diverse group of stakeholders representing manufacturer, distributor, and installer. As for the incentive approach, the South Coast AQMD will consider funding various projects/programs to facilitate the deployment of zero emission and low NOx emission appliances, including, but not limited to technology development, public outreach to promote consumers' choice for clean technology, incentive funding for the purchase and installation of clean technology appliances. Partnerships with utilities will be pursued to implement incentive programs that maximize reductions in a cost-effective manner. Implementation of this control

[8] 2021 SB 100 Joint Agency Report.

[9] Research and Development of Natural Draft Ultra-Low Emissions Burners for Gas Appliances.

measure will be a combination of regulatory and incentive approaches. NOx reductions from commercial cooking devices fall under C-CMB-03. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost--effectiveness and incremental cost--effectiveness, and may consider alternative compliance mechanisms.

Emission Reductions

In 2018, the natural gas consumption for residential cooking was estimated to be over 105 million therms in the South Coast Air Basin, which resulted in 1.28 ~~1.32~~ tons per day of NOx emissions. By 2037, emissions from residential cooking devices account for approximately 1.~~25~~ 21 tons per day. Implementation of this control measure is expected to reduce NOx emissions by 65 percent by 2037, equivalent to about 0.~~81~~ 79 tons per day.

The target of this approach is to implement zero emission technologies for 50 percent of the applicable sources and implement low NOx burner technologies for the remaining 50 percent by 2037. To implement zero emission technologies for 50 percent of the applicable sources by 2037, 10 percent would come from new buildings and 40 percent from existing buildings starting in year 2029. Replacing equipment for existing buildings may occur at the end of the device's lifetime as a natural turnover. The useful lifetime of a cooking appliance is around 12 years, there would be more than 40 percent natural turnover over an eight-year period by 2037 for existing buildings. Additional NOx emission reductions could be achieved with state and local incentive programs that have been launched or proposed. The South Coast AQMD will propose incentives to accelerate existing gas burner replacement with zero emission and low NOx emission devices such as electric cooking devices, induction cooktops, or low NOx gas burner technologies. Partnership with public utility organizations and other regulatory agencies will be pursued actively to attract funding for incentive programs.

Rule Compliance and Test Methods

South Coast AQMD Method 100.1

Cost Effectiveness

The cost of this control measure varies depending on the type of cooking device to be installed or replaced, and whether the cooking device is in a new or existing building. Replacing gas cooking devices in existing buildings with zero emission units can incur additional costs if electrical upgrades are necessary. Title 24 Building Energy Efficiency Standards were established in 1978 to reduce energy consumption from residential and commercial buildings through energy efficiency measures and are updated every three years. Currently, new construction and alterations of existing buildings are subject to the 2019 Title 24 energy code, which includes requirements for buildings to be electric-ready and to install solar panels. Some municipalities also enforce local energy efficiency requirements for new buildings that go beyond the state codes, known as reach codes. For example, the city of Santa Monica approved reach codes requiring additional energy-efficiency measures for new residential and commercial buildings that use gas.[10] Reach codes and Title 24 requirements for new buildings result in lower emissions compared to existing buildings that do not have the same energy efficiency requirements. More details of potential incremental cost for converting conventional gas appliances to zero emission or low NOx units are discussed below.

Equipment Costs: Equipment costs describe the cost of the appliance and installation. The equipment costs for induction cooktops are typically higher than for conventional gas or electric cooking devices. Installation of an induction cooktop over a gas cooking device can add an average one-time incremental equipment cost of about $840.[11,12,13] The ~~equipment~~ cost~~s~~ of an electric cooking ~~devices~~ appliance ~~are~~ is often lower than ~~their~~ its gas counterpart~~s~~, with an average ~~of~~ savings of about $270.[6,7,8,14] Low NOx burners have been proven in technology demonstration projects but are not yet commercially available. Low NOx burners improve the current conventional gas burner design to burn fuel more efficiently~~, and therefore minimal incremental equipment costs are expected~~. Therefore, ~~A~~any small incremental equipment costs are likely offset by utility savings resulting from the more energy-efficient design. In the case where low NOx burners become too expensive, zero emission appliances may serve as a more cost-effective option.

Infrastructure Costs: Infrastructure costs include any building upgrades that are necessary in order to install an induction cooktop or electric cooking device. For existing buildings, infrastructure costs vary largely depending on the age of the residence and the existing electrical infrastructure. Existing buildings may need some electrical upgrades for the installation of electric or induction cooking devices. For example, residences built before 1978 often require infrastructure upgrades to accommodate electric and induction cooktops if other appliances such as space and water heaters are also converted from gas to electric. These upgrades can include updating the household electric panel from 100 to 200 Amps, service connection fees such as increased conduit and conductor sizes, and installing a 240V outlet, incurring costs of $150-$1,500 depending on which upgrades are necessary.[7,8,10] On the other hand, some residential homes already have a dedicated 240V outlet in the kitchen and would not acquire those upgrade costs. Likewise, newer residential homes typically are equipped with a 200-Amp panel and therefore would not require any electrical upgrades. If all other appliances within the residence are also electric, new buildings can have savings of up to $6,000 from avoided costs of gas piping infrastructure.[7,10]

Utility Costs: Switching from conventional gas ~~cooking appliances~~ to electric or induction cooking devices can increase annual utility costs due to the different energy consumption and the difference between natural gas and electricity rates. SoCal Gas (SCG) is the primary natural gas utility company in the South Coast Air Basin, with an average natural gas rate of S1.09 per therm in 2019.[15] Southern California Edison (SCE) and the Los Angeles Department of Water and Power (LADWP) supply over 90 percent of electricity

[10] https://localenergycodes.com/

[11] Residential Building Electrification in California.

[12] Final 2021 Integrated Energy Policy Report Volume I: Building Decarbonization.

[13] Residential Cooktop Performance and Energy Comparison Study

[14] Impacts of Residential Electrification.

[15] Utility Costs and Affordability of the Grid of the Future.

to residents, with average 2020 residential customer rates of 18.22 and 20.63 cents per kWh, respectively.[16] For existing buildings without solar panels, switching from gas cooking devices could increase annual utility cost by an average of $43 per year for electric cooking devices and $35 per year for induction cooktops. The increase in utility cost is mainly driven by the higher cost of electricity in this area, which is typically two to three times more expensive than natural gas. Based on forecasts from the CPUC, both annual residential electricity and gas costs are expected to grow at similar rates of 3.5 to 3.7 percent over the next ten years.[8] Installation of solar photovoltaic (PV) panels can help offset the incremental utility costs and can result in annual savings on energy bills. Currently, over 9.5 million homes in California are powered by solar energy.[17] Depending on the size of the PV system and the electricity usage of a household, the incremental utility cost of electrifying the cooking appliance could be either partially or fully offset with solar panels. ~~Title 24 requires that new buildings have solar panels installed at construction. To capture the different scenarios in incremental utility cost, two scenarios are included the cost-effectiveness calculation: (1) full burden of incremental utility cost assuming residences do not have any solar panels or the solar panels installed do not offset any incremental utility cost; and (2) incremental utility costs are completely offset in residences with solar panels.~~

Cost-effectiveness is determined by the cost of the control over the lifetime emission reductions. ~~Four scenarios are analyzed: switching from gas to electric cooking devices in new and existing homes and switching from gas to induction cooktops in new and existing homes.~~ To calculate the incremental cost, data from several studies were obtained and an average number is determined. The Present Value Factor (PVF) was calculated to account for increasing costs over the 12-year equipment life with a 4 percent interest rate. Incremental utility costs were calculated by subtracting annual gas cooking appliance bills from annual electricity bills for induction and electric cooking devices, based on SCG and SCE rates averaged across the ~~several~~ studies referenced in the 'Equipment Costs' section. The cost per cooking appliance is applied across the affected population in the South Coast Air Basin to calculate the total cost of the control measure. Lifetime emission reductions are calculated by totaling the annual emission reductions over the 12-year lifetime of the cooking appliance. The cost per ton for this control measure is then determined by calculating the total cost of the control measure over the lifetime emission reductions.

Table R-CMB-03-A shows the cost-effectiveness determinations for the conversion from gas to zero emission cooking devices for ~~existing~~ residential buildings. Average ~~Overall, cost-effectiveness varies depending on different assumptions in the building scenarios. Cost-effectiveness for existing buildings is sensitive to the incremental utility cost, and to a lesser extent the infrastructure cost. I~~infrastructure costs of $150 were assumed given that some newer homes already have a 240V outlet in the kitchen, wh~~ereas~~ile others will require ~~for the~~ installation and wiring of a new 240V outlet. ~~in existing buildings and did not include costs for major electrical panel upgrades.~~ Older homes that require electrical panel upgrades will incur additional costs not shown in Table R-CMB-03-A ~~and would not be cost-effective~~. ~~Table R-CMB-03-A shows cost-effectiveness for existing residences for two scenarios which serve as bounding cases: (1) residences without solar panels or with solar panels that do not offset any incremental utility cost, and~~

[16] 2020 Utility Bundled Sales to Ultimate Customers- Residential.

[17] Solar Energy Industries Association.

~~(2) for residences with solar panels that fully offset incremental utility cost.~~ For new buildings, no electrical upgrade costs are assumed. In homes without gas appliances, gas infrastructure is not necessary. In several studies, cost savings from avoided gas infrastructure costs were estimated to range from about $1,200 to $6,000.[8,9,11] As part of this cost-effectiveness calculation, cost savings from avoided gas infrastructure was divided equally between the four major residential combustion categories in residential households (space heating, water heating, cooking, and other). Based on this methodology, an average cost savings of $1,100 is assumed as infrastructure savings in new buildings. Note that these savings are only realized when all other appliances are electric and gas infrastructure is not required. The incremental utility cost for induction cooktops is slightly lower than electric cooking devices due to their higher energy efficiency.

TABLE R-CMB-03-A

Cost-Effectiveness Analysis for ~~Existing~~ Residential Buildings

<table>
<tr><th>Cost*</th><th colspan="2">Conventional Gas to Electric Devices</th><th colspan="2">Conventional Gas to Induction Cooktops</th></tr>
<tr><td>Incremental Equipment Cost*</td><td colspan="2">-$270</td><td colspan="2">$840</td></tr>
<tr><td>Incremental Infrastructure Cost (Existing Buildings)</td><td colspan="2">$150</td><td colspan="2">$150</td></tr>
<tr><td>Incremental Infrastructure Cost** (New Buildings)</td><td colspan="2">-$1,100</td><td colspan="2">-$1,100</td></tr>
<tr><td>Incremental Utility Cost</td><td colspan="2">$0- 43/year</td><td colspan="2">$0- 35/year</td></tr>
<tr><td>~~Lifetime Emission Reductions (Tons)~~</td><td colspan="2">~~2,891~~</td><td colspan="2">~~2,891~~</td></tr>
<tr><td></td><td>~~No Solar Panel or Solar Panels Do Not Offset Any Incremental Utility Cost~~</td><td>~~Solar Panels Fully Offset Incremental Utility Cost~~</td><td>~~No Solar Panel or Solar Panels Do Not Offset Any Incremental Utility Cost~~</td><td>~~Solar Panels Fully Offset Incremental Utility Cost~~</td></tr>
<tr><td>~~Incremental Utility Cost*~~</td><td>~~$43/year~~</td><td>~~$0/year~~</td><td>~~$35/year~~</td><td>~~$0/year~~</td></tr>
<tr><td>~~Total Cost over Equipment Life of 12 Years**~~</td><td>~~$270~~</td><td>~~-$120~~</td><td>~~$1,300~~</td><td>~~$1,000~~</td></tr>
<tr><td>~~Cost Effectiveness* (Dollar per Ton of NOx Reduced)~~</td><td>~~$192,000/ton~~</td><td>~~-$84,000/ton~~</td><td>~~$937,000/ton~~</td><td>~~$709,000/ton~~</td></tr>
</table>

* Negative numbers denote savings

**Infrastructure cost savings in new buildings are from avoided gas infrastructure if all other appliances are also electric

~~** Determined using the Discounted Cash Flow (DCF) Method assuming a 4 percent interest rates~~

~~Similar cost-effectiveness analyses were conducted for new buildings, and the results are shown in Table R-CMB-03-B. For new buildings, all major household appliances are assumed to be electric, and no electrical upgrades are required. In homes without gas appliances, gas infrastructure is not necessary. In several studies, cost savings from avoided gas infrastructure costs were estimated to range from about $1,200 to $6,000.[8,9,11] As part of this cost-effectiveness calculation, cost savings from avoided gas infrastructure were divided equally between the four major residential combustion categories in residential households (space heating, water heating, cooking, and other). Based on this methodology, an average cost savings of $1,100 is assumed as infrastructure savings for electric and induction cooking appliances in new buildings. Note that these savings are only realized when all other appliances are electric and gas infrastructure is not required. The overall cost-effectiveness for implementing electric cooking devices in new buildings is estimated to result in cost savings over the life of the equipment, driven by the lower equipment cost and savings from avoided gas infrastructure. Implementing induction cooking devices in new buildings is cost-effective when the savings from avoided gas infrastructure offset the higher incremental equipment costs.~~

~~TABLE R-CMB-03-B~~

~~Cost_Effectiveness Analysis for New Buildings~~

	~~Conventional Gas to Electric Devices~~		~~Conventional Gas to Induction Cooktops~~	
~~Equipment Cost*~~	~~-$270~~		~~$840~~	
~~Infrastructure Cost**~~	~~$-1,100~~		~~$-1,100~~	
~~Lifetime Emission Reductions (Tons)~~	~~2,891~~		~~2,891~~	
	~~Solar Panels Do Not Offset Any Incremental Utility Cost~~	~~Solar Panels Fully Offset Any Incremental Utility Cost~~	~~Solar Panels Do Not Offset Any Incremental Utility Cost~~	~~Solar Panels Do Not Offset Any Incremental Utility Cost~~
~~Incremental Utility Cost~~	~~$43/year~~	~~$0/year~~	~~$35/year~~	~~$0/year~~
~~Total Cost over Equipment Life of 12 Years***~~	~~$-1,000~~	~~$-1,400~~	~~$37~~	~~$-280~~
~~Cost_Effectiveness* (Dollar per Ton of NOx Reduced)~~	~~$-957,000/ton~~	~~$-1,326,000/ton~~	~~$35,000/ton~~	~~$-286,000/ton~~

~~* Negative numbers denote savings~~

~~**Infrastructure cost savings from avoided gas infrastructure if all other appliances are also electric~~

~~*** Determined using the Discounted Cash Flow (DCF) Method assuming a 4 percent interest rate~~

The cost of implementation for this control measure ~~Based on the above analyses, it is concluded that cost-effectiveness~~ varies based on the equipment type and infrastructure needs. The overall cost-effectiveness is approximately $144,400 per ton of NOx reduced using the DCF method, and approximately $217,500 per ton of NOx reduced using the Modified LCF method. ~~For existing buildings, the conversion from gas to electric or induction cooktop is not cost-effective unlessd the incremental utility cost is either partially or fully offset by the installed solar PV. For new buildings, the conversion to zero emission equipment is found to be cost-effective, mainly driven by the cost savings from avoided gas infrastructure for all electric buildings.~~

Note that potential incentives or rebates are not included as part of the cost-effectiveness analysis. An incentive approach may be needed to reduce cooking emissions for existing residences that face incremental capital and utility costs, especially in disadvantaged communities. The incremental utility, equipment, and/or infrastructure costs may be partially offset by incentives provided by local or state agencies, or local utility companies. For example, income-qualified homeowners in disadvantaged communities may qualify for a free solar panel system that can help offset incremental utility costs. South Coast AQMD could also propose an incentive program to lower the upfront capital costs. ~~Overall, the cost of implementation for this control measure varies substantially depending on the equipment type and infrastructure needs. An incentive approach may be needed to reduce cooking emissions for existing residences that face incremental capital and utility cost, especially in disadvantaged communities.~~

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from these stationary and area sources.

References

California Energy Commission, 2019 California Residential Appliance Saturation Study, August 2021. https://www.energy.ca.gov/data-reports/surveys/2019-residential-appliance-saturation-study

California Air Resources Board, 2022 State Strategy for the State Implementation Plan, January 2022. https://ww2.arb.ca.gov/sites/default/files/2022-01/Draft_2022_State_SIP_Strategy.pdf

California Energy Commission, 2021 SB 100 Joint Agency Report, September 2021. https://www.energy.ca.gov/publications/2021/2021-sb-100-joint-agency-report-achieving-100-percent-clean-electricity

Lawrence Berkeley National Laboratory, Research and Development of Natural Draft Ultra-Low Emissions Burners for Gas Appliances, September 2016. https://www.osti.gov/biblio/1377849

California Statewide Reach Codes Program. https://localenergycodes.com/

Energy and Environmental Economics, Inc., Residential Building Electrification in California, April 2019. https://www.ethree.com/wp-content/uploads/2019/04/E3_Residential_Building_Electrification_in_California_April_2019.pdf

California Energy Commission, Final 2021 Integrated Energy Policy Report Volume I: Building Decarbonization, February 2022. https://efiling.energy.ca.gov/GetDocument.aspx?tn=241361

Frontier Energy, Residential Cooktop Performance and Energy Comparison Study, July 2019. https://frontierenergy.com/wp-content/uploads/Residential-Cooktop-Performance-and-Energy-Comparison-Study_Induction-Range-Report-July-2019-Frontier-Energy.pdf

Navigant Consulting, Inc., Impacts of Residential Electrification, August 2018. https://efiling.energy.ca.gov/GetDocument.aspx?tn=224761

California Public Utilities Commission, Utility Costs and Affordability of the Grid of the Future, May 2021. https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/office-of-governmental-affairs-division/reports/2021/senate-bill-695-report-2021-and-en-banc-whitepaper_final_04302021.pdf

U.S. Energy Information Administration, 2020 Utility Bundled Sales to Ultimate Customers- Residential. https://www.eia.gov/electricity/sales_revenue_price/pdf/table6.pdf

Solar Energy Industries Association. https://www.seia.org/states-map

UCLA Fielding School of Public Heath, Effects of Residential Gas Appliances on Indoor and Outdoor Air Quality and Public Health in California, April 2020. https://coeh.ph.ucla.edu/effects-of-residential-gas-appliances-on-indoor-and-outdoor-air-quality-and-public-health-in-california/

California Energy Commission, Building Energy Efficiency Standards - Title 24. https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards

South Coast Air Quality Management District, 2016 Air Quality Management Plan, September 2011. http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2016-air-quality-management-plan/final-2016-aqmp/final2016aqmp.pdf?sfvrsn=15

R-CMB-04: EMISSION REDUCTIONS FROM REPLACEMENT WITH ZERO EMISSION OR LOW NOx APPLIANCES – RESIDENTIAL OTHER COMBUSTION SOURCES [NOx]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	RESIDENTIAL - OTHERS			
CONTROL METHODS:	REGULATORY APPROACH: ZERO EMISSION AND LOW NOx LIMIT, AND INCENTIVE APPROACH: ZERO EMISSION TECHNOLOGY			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
NOx INVENTORY	~~3.61~~3.53	~~3.83~~3.75	~~3.84~~3.77	~~3.91~~3.84
NOx REDUCTION		~~0.70~~0.68	~~1.05~~1.03	~~2.80~~2.76
NOx REMAINING		~~3.13~~3.07	~~2.79~~2.74	~~1.11~~1.08
SUMMER PLANNING	2018	2031	2032	2037
NOx INVENTORY	~~4.06~~3.97	~~4.28~~4.19	~~4.30~~4.21	~~4.37~~4.29
NOx REDUCTION		~~0.78~~0.76	~~1.17~~1.15	~~3.13~~3.09
NOx REMAINING		~~3.50~~3.43	~~3.12~~3.06	~~1.24~~1.20
CONTROL COST:	~~TBD~~ DCF METHOD: $235,400/TON OF NOx REDUCED MODIFIED LCF METHOD: $357,100/TON OF NOx REDUCED			
INCENTIVE COST:	TBD			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

Description of Source Category

Background

Control measure R-CMB-04, as residential-others, seeks NOx emission reductions from residential combustion sources using natural gas and Liquefied petroleum gas (LPG) that are not water heating (See R-CMB-01), space heating (See R-CMB-02) and cooking equipment (See R-CMB-03). R-CMB-04 sources are miscellaneous, but primarily comprised of swimming pool heaters, laundry dryers, and barbecue grills. Further study is needed to identify other equipment that would be subject to this control measure. Such a study should be included in future rulemaking efforts.

Pool heaters are regulated under Rule 1146.2. Natural gas pool heaters normally have a capacity ranging from 75,000 to 450,000 BTU per hour. The 2012 AQMP estimated that there were about 200,000 residential pool heaters in the South Coast AQMD.

According to the U.S. Department of Energy, laundry dryers with drum sizes less than 4.4 cubic feet are deemed as “compact sized” and dryers with drum sizes equal to or large than 4.4 cubic feet are classified as “standard sized.” Residential laundry dryer drum volumes may be compact sized but for gas models typical drum volumes are between 5.6 and 7.4 cubic feet with heat input ratings between 20,000 and 25,000 BTU/hour.

The laundry market is composed of both gas and electric devices. Gas laundry dryers can be fueled by either natural gas or LPG gas. Most electric dryers operate on 240-volt to heat the equipment’s coils. This is about twice the voltage used to operate the standard household devices. Some compact or portable electric dryers may operate on 110-volts. Gas and electric dryers typically have about the same equipment life. According to H&R Block (usnews.com), a gas dryer’s expected lifespan is about 13 years, compared to an electric dryer’s expected lifespan of 14 years.

According to a 2009 report by the Environmental Council of the States (ECOS), in 2008 U.S. consumers purchased nearly 7 million clothes dryers, of which 5.62 million were electric and 1.35 million were natural gas. That would mean 32,400 annual consumer purchase of natural gas residential laundry dryers in the South Coast AQMD. This estimation is based on a 12 percent nationwide purchase being in California (California Energy Commission, 2013), and 20 percent California purchase being within the South Coast AQMD.

For barbecue grills, according to www.statista.com, a 2013 study by Hearth, Patio & Barbecue Association found that 61 percent of users opted for gas grills and 10 percent of users owned electric rigs. In 2018, gas barbecue grill sales in the United States amounted to about 1.32 billion U.S. dollars. According to www.theatlantic.com, Hearth, Patio & Barbecue Association believes that the electric-grill market is expected to continue to grow at an average rate of 7 percent a year.

R-CMB-04 sources were previously included as a part of control measure CMB-02 in 2016 AQMP for NOx emission reductions from residential and commercial appliances, with a control strategy focused on regulating those currently unregulated commercial furnaces used for space heating and incentivizing zero emission and -low NOx emission technology appliances.

Regulatory History

Pool heaters are regulated under Rule 1146.2 - Emissions of Oxides of Nitrogen from Large Water Heaters and Small Boilers and Process Heaters. More details of Rule 1146.2 are discussed in the Regulatory History for control measure C-CMB-01.

Residential laundry dryers and gas grills are not regulated by any South Coast AQMD rule for NOx emissions.

Proposed Method of Control

Control measurer R-CMB-04 seeks NOx emission reductions from residential -other combustion sources by: (1) requiring zero emission technologies through a regulatory approach for some emission sources in both new and existing residences; and (2) allowing low NOx technologies as an alternative for the rest of emission sources. ~~Mitigation~~ A mitigation fee may be required for certain lower NOx technology applications which will be evaluated during the future rulemaking process. The mitigation fee collected would be utilized as incentives to accelerate the adoption of zero emission units.

Although the currently available electric laundry dryers (electric resistance heating models) are considered zero NOx emission units, heat pump laundry dryers with a much higher energy efficiency would be the preferred zero emission technology for incentives.

Heat pump laundry dryer technology has been in existence for years as an alternative to electric resistance heating models. However, the market presence of this technology remains insignificant in the United States as the low number of this technology is probably due to the higher cost of this technology. Heat pump dryers may also have longer drying times than resistance heating models. This is due to a smaller heat pump that is typically used for cost and efficiency considerations.

Heat pump dryers with an integrated heat recovery exhaust condenser would increase the dryer's efficiency. This efficiency increase is a result of exhaust heat being captured and reused. As noted in the 2013 Department of Energy's study, under a demonstration project funded by the U.S. Department of Energy, a modified heat pump clothes dryer delivered 40-50 percent energy savings with 35 degrees Fahrenheit lower fabric temperatures and similar drying times for regular loads.

ENERGY STAR certified heat pump dryer models are available for the brands Asko, Beko, Blomberg, LG, Miele, Samsung, and Whirlpool.

The emerging zero emission technology for heating pools is the swimming pool heat pump. Heat pumps used for heating pools transfer heat from the outdoors into the water. Heat pump pool heaters work efficiently as long as the outside temperature remains above the 45–50 degrees Fahrenheit range. The warm climate of the South Coast AQMD area favors the application of pool heat pumps. As a pool heat pump works slower than a gas heater on heating the pool, it is better suited when a consistent pool temperature for a long period of time is desired. The most economical way to run this type of heater is to let the unit run automatically to keep "topping up" the heat.

Natural gas pool heaters are subject to Rule 1146.2 and it is certification requirement for NOx emissions. Staff reviewed source test results for Rule 1146.2 certification conducted since 2017. There are tests for six heater models identified by the vendors as pool heaters. As all six models were certified to meet the 55 ppm NOx limit, four of them showed emissions at 10 to 20 ppm. A low NOx limit may be feasible with the current technology.

With regards to gas grills, the electric-grill market is expected to continue to grow at an average rate of 7 percent a year. A regulatory approach would accelerate the turnover of some gas gills to zero emission grills. In addition to zero emission units, emission reduction could be achieved by lower emission technologies. As burner adjustment for cook equipment as proposed by control measure R-CMB-03 would lower the NOx emissions by 70 percent, this technology could be potentially applied to gas grills as well. Further evaluation during future rulemaking will be conducted.

In addition to a regulatory approach, incentives for the purchase and installation of zero emission technology or electric panel upgrade would be considered under this control measure not only for additional emission reductions, but also to encourage further development of future zero emission space heating technology for existing residential buildings. Collected mitigation fee and future allocated funding would be utilized for the incentives. More local agencies are now proposing incentives for retrofitting gas appliances, including sources for this control measure. For example, City of Santa Monica is offering a $300-400 rebate for replacing a gas dryer with an electric heat pump clothes dryer, incentives to electric panel upgrade, and rebates to other zero emission appliances. <u>During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.</u>

Incentives Implementation

Integrity Elements

Emission reductions that are projected to be achieved from the voluntary incentive measures must be demonstrated to be quantifiable, surplus, enforceable, and permanent. This demonstration must include project type(s); project life; applicable incentive program guideline(s), by title, year, chapter(s); and analysis of applicable incentive program guideline(s) for consistency with integrity elements. The following describes the definitions and provides examples of the key elements of such a demonstration:

- <u>Quantifiable</u>: Emission reductions are quantitatively measurable supported by existing and acceptable technical data. The quantification should use well-established, publicly available, and approved emission factors and accepted calculation methodology. There must be procedures to evaluate and verify over time the level of emission reductions actually achieved.

  Potential emission reductions associated with various equipment types are discussed in the Proposed Method of Control section. The following table provides an overview of the sources, emission reductions, and proposed incentives for targeted sources.

- <u>Surplus</u>: Emission reductions must be above and beyond any South Coast AQMD, State, or federal regulation. Emission reductions used to meet air quality attainment requirements are surplus as long as they are not otherwise relied on in the State Implementation Plan (SIP), SIP-related requirement, other State air quality programs adopted but not in the SIP, a consent decree, or federal rules that focus on reducing criteria pollutants or their precursors. In the event that SIP emission reductions are relied on to meet air quality-related program requirements, they are no longer surplus. In addition, the emission reductions are available only for the remaining useful life of the equipment being replaced (e.g., if the equipment being replaced had a remaining useful life of five years, the additional emission reductions from the new equipment are available for SIP or conformity purposes under this guidance for only five years).

- <u>Enforceable</u>: The South Coast AQMD will be responsible for assuring that the emission reductions credited in the SIP will occur. Emission reductions and other required actions are enforceable if:

  - They are independently verifiable;
  - Program violations are defined;
  - Those liable for emission reductions can be identified;
  - The South Coast AQMD and the U.S. EPA maintain the ability to apply penalties and secure appropriate corrective action where applicable;

- The general public have access to all the emissions-related information obtained from the source;

- The general public can file suits against sources for violations (with the exception of those owned and operated by Tribes); and

- They are practically enforceable in accordance with other U.S. EPA guidance on practicable enforceability.

Actual emission reductions, for example, can be assured through the replacement equipment registration, recordkeeping and reporting, and inspections (initial inspection after installation and subsequent on a regular basis thereafter, if needed) throughout the term. Specific enforcement mechanisms will be addressed in the guidelines for the individual incentive measures.

- Permanent: The emission reductions need to be permanent throughout the term for which the credit is generated. The emission reductions are permanent if these reductions are ensured to occur over the duration of the SIP program, and for as long as they are relied on in the SIP.

  For example, those awarded incentives would need to ensure the projects are properly implemented and the reductions are occurring and will continue to occur. Thus, recipients of the incentive awards would agree to contract provisions, such as recordkeeping and reporting to track reductions and agreements that newly installed equipment would not be removed without concurrence with the South Coast AQMD (i.e., permanent placement) and the proof that the replaced equipment would be destructed or at least not be operated any more in the Basin (e.g., pictures, certification). Detailed procedures to ensure permanent reductions will be described in the guidelines for the individual incentive measures.

Guidelines

Each SIP needs to have detailed and comprehensive guidelines that are approved by the South Coast AQMD Governing Board. The guidelines will be the protocol to implement the program, to ensure SIP applicability, and to maintain SIP approvability:

☑ SIP should demonstrate compliance with the four key elements of the SIP: quantifiable emissions plus incentive costs, surplus reductions, enforceable compliance, and permanent reductions.

☑ Working group should be established to solicit public input and feedback during SIP guideline development.

☑ Process and procedures to apply for incentives should be clearly explained in the guideline.

☑ It needs to clearly describe how incentives would be awarded (e.g., priority to high emitters and/or age of equipment, tiered process, first come first serve, or EJ area priority).

☑ It should have conditions of some form for agreement (e.g., contracts) including tracking and ensuring permanent reductions. The following forms should be prepared:

  ☑ Application Forms (samples are required).

  ☑ Contracts with Conditions (samples are required).

- ☑ Product Example.

☑ Tracking mechanism is required to ensure overall effectiveness of program and procedures to correct emission projections, such as reductions by the committed target date (e.g., 2031, 2037) and submittal to the U.S. EPA annually. Tracking checklist should include:

- ☑ Project Title.
- ☑ Product.
- ☑ Annual Emission Reductions (e.g., from 2030 to 2050, incremented by one year).
- ☑ Life of project (e.g., 10 years).
- ☑ Installation dates (e.g., fixed year 2030 or multiple installation years 2017 and 2018).

☑ Possible recordkeeping, reporting, and monitoring requirements need to be addressed.

☑ Individual outreach efforts (e.g., social media, email blasts) to promote the program, make aware of deadlines to apply, and provide timing locations of workshops.

☑ Program guidelines should be approved by the South Coast AQMD Governing Board and published online.

Emission Reductions

As this control measure covers miscellaneous sources, depending on the type of equipment, the level of focus on zero or lower NOx emission technologies could vary. Emission reductions from some sources would be more focused on implementing zero emission technologies. For example, electric laundry dryers have already been dominating the market. In addition, heat pump laundry dryers could further enhance the equipment energy efficiency. These factors will help in expanding zero emission technologies. On the other hand, emission reductions from some other sources could be achieved through implementing both zero and lower NOx emission technologies. For example, as previously discussed, pool heaters and grills have both the zero emission and potentially lower NOx technologies. An in-depth equipment specific analysis would be performed during the future rulemaking process. However, for the emission reductions addressed in this control measure, a conservative estimate has been applied for all the sources.

Staff estimates NOx emission reductions could be approximately 0.68~~0.70~~ tons per day by 2031 and 2.76~~2.80~~ tons per day by 2037, which would be achieved by a regulatory approach (See Table R-CMB-04-A). Incentive programs for accelerating zero emission technology adoption would promote further emission reductions earlier than required.

The target of this regulatory approach is to implement zero emission technologies for 50 percent of the applicable sources and implement low NOx emission technologies in conjunction with a mitigation fee at the time of replacement for the ~~rest~~ remaining 50 percent universe by 2037. The low NOx technologies could be the alternative to zero emission requirement. The collected fee could be utilized in incentive program to offset the emission reduction difference between low NOx technologies and zero emission technologies.

To implement zero emission technologies for 50 percent of the applicable sources by 2037, 10 percent would emanate from new buildings and 40 percent from existing buildings starting in year 2029. Staff recognizes that a unit replacement for existing buildings may occur at the end of the unit lifetime, which creates a natural unit turnover. With an estimated average useful lifetime around 13 years, there would be more than 40 percent natural turnover over an eight-year period by 2037 for existing buildings. Additional NOx emission reductions could be achieved with state and local incentive programs that have been launched or proposed. The South Coast AQMD will propose incentives to promote zero emission equipment, and will also seek partnerships for implementing the incentives.

For low NOx technologies in conjunction with a mitigation fee, the emission reductions are estimated based on its implementation for the remaining 50 percent of the sources by 2037, with a consideration of natural turnover by a 13-year average useful lifetime, and 70 percent of reduction for each replacement.

With the Title 24 code update for the readiness of new building electrification, the implementation for new buildings could occur earlier (e.g., 2024) than that for existing buildings. However, for a conservative emission reduction estimation, the implementation start year for new buildings would also occur in 2029 as for older buildings.

TABLE R-CMB-04-A

Emission Reduction Potential for R-CMB-04 Sources

R-CMB-04 Residential – Other Combustion sources	Proposal for Reduction			NOx Emission Reductions (tpd)	
	Current NOx Limit	Potential NOx Limit	Start of Implementation	2031	2037
Regulatory Approach – Zero Emission	TBD	0 ng/J	2029	~~0.49~~0.48	~~1.96~~1.94
Regulatory Approach – Other Technologies	TBD	70% reduction at unit replacement	2029	~~0.21~~0.20	~~0.84~~0.82
Regulatory Approach – Overall	---	---	2029	~~0.70~~0.68	~~2.80~~2.76

Rule Compliance and Test Methods

South Coast AQMD Method 100.1

Cost Effectiveness

~~The overall cost-effectiveness for this control measure has not been estimated.~~ The cost-effectiveness for this control measure is approximately $235,400 per ton of NOx reduced using the DCF method, and approximately $357,100 per ton of NOx reduced using the Modified LCF method. As this control measure covers miscellaneous sources mainly including laundry dryers, pool heaters, and grills, the cost of each individual source is discussed in this measure. A comprehensive analysis ~~would~~ will be required during the rulemaking process to ascertain the emission reductions and cost-effectiveness of each type of source~~s and therefore the cost-effectiveness~~ for this control strategy.

With regards to the cost of heat pump laundry dryer, the Home Depot website lists one heat pump laundry dryer (24 inch 3.88 cubic feet 240-volt white stackable electric ventless front load heat pump dryer) with a price at $1,094.67. On the same website, electric laundry dryers of similar size (3.5 cubic feet) are priced between $300 to $700, and a gas laundry dryer of similar size (5.9 cubic feet which is the smallest size for gas unit listed there) is around $800.

An incentive of $300 or more may offset the higher upfront cost of a heat pump laundry dryer, and thus promote its adoption. As mentioned earlier, some local agencies such as the City of Santa Monica are currently offering $300-400 rebate to each replacement with heat pump laundry dryer.

Heat pump pool heaters cost more than gas pool heaters, but they typically have much lower annual operating costs because of their higher efficiencies. With proper maintenance, heat pump pool heaters typically last longer than gas pool heaters. Therefore, consumers will save more money in the long run. Department of Energy estimates the savings of $32 to $300 for every $1,000 in annual pool heating costs using a heat pump pool heater compared to using a gas pool heater.

On the other hand, as previously mentioned, gas pool heaters certified to meet the 55 ppm NOx limit have been tested at 10 to 20 ppm. This preliminary data indicates the feasibility of a 70 percent emission reduction. Because the reductions would be based on the existing technology, the additional cost for lower NOx gas pool heaters technologies should be minimal.

With regards to grills, although gas grills are more popular, electric grills are increasing their market share by 7 percent each year. For the cost, there are websites (for example: barbecuegrillreview.com) stating the purchase cost of electric grills is cheaper, while there are some other websites (For example: diffen.com) stating gas grills are cheaper. Nevertheless, electric grills are a market acceptable technology that is a feasible zero emission solution. For lower emission grills, further evaluation would be required for its cost-effectiveness.

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from these stationary sources.

References

Paul Bendt, Chris Calwell, and Laura Moorefield. (2009). Residential clothes dryers: An investigation of energy efficiency test procedures and savings opportunities, December 6, 2009.

California Energy Commission. (2013). Codes and Standards Enhancement (CASE) Initiative for FY 2013: Title 20 Standards Development Analysis of Standards Proposal for Commercial Clothes Dryers. July 30, 2013.

ENERGY STAR. Heat pump dryer.
https://www.energystar.gov/products/heat_pump_dryer

Home Depot. Gas and electric dryers.
https://www.homedepot.com/b/Appliances/N-5yc1vZbv1w?cm_sp=d-flyout-Appliances

U.S. News. Gas vs. Electric Dryers. August 5, 2021.
https://www.usnews.com/360-reviews/dryers/gas-vs-electric

Department of Energy. Heat pump swimming pool heaters
https://www.energy.gov/energysaver/heat-pump-swimming-pool-heaters

Statista. Share of grill ownership in the United States in 2020 by type of grill.
https://www.statista.com/statistics/271755/us-grill-ownership-by-type-of-grill/

The Atlantic. The greenest way to grill.
https://www.theatlantic.com/science/archive/2021/07/grilling-emissions-environment/619394/

C-CMB-01: EMISSION REDUCTIONS FROM REPLACEMENT WITH ZERO EMISSION OR LOW NOx APPLIANCES – COMMERCIAL WATER HEATING [NOx]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	COMMERCIAL WATER HEATING			
CONTROL METHODS:	REGULATORY APPROACH: ZERO EMISSION AND LOW NOX LIMIT, AND INCENTIVE APPROACH: ZERO EMISSION TECHNOLOGY			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
NOX INVENTORY	0.56	0.46	0.45	0.42
NOX REDUCTION		0.00	0.04	0.25
NOX REMAINING		0.46	0.41	0.18
SUMMER PLANNING	2018	2031	2032	2037
NOX INVENTORY	0.56	0.46	0.45	0.42
NOX REDUCTION		0.00	0.04	0.25
NOX REMAINING		0.46	0.41	0.18
CONTROL COST:	$496,600 per ton of NOx (CARB Zero-Emission Standard for Space and Water Heaters Cost-Effectiveness, Quasi-LCF) ~~$0 to $105,000 per ton of NOx reduction~~			
INCENTIVE COST:	TBD			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

Description of Source Category

Background

Control measure C-CMB-01 seeks further NOx emission reductions from commercial building water heating sources that are subject to Rule 1146.2 - Emissions of Oxides of Nitrogen from Large Water Heaters and Small Boilers and Process Heaters.

C-CMB-01 sources were previously included under the 2016 AQMP control measure CMB-02 for NOx emission reductions from residential and commercial appliances, with a control strategy focused on a combination of long-term regulation and short-term incentives to replace existing water heaters with new zero emission or low NOx emission units.

Regulatory History

Rule 1146.2 - Emissions of Oxides of Nitrogen from Large Water Heaters and Small Boilers and Process Heaters. The provisions of this rule are applicable to manufacturers, distributors, retailers, installers, and operators of new units with a rating at or less than 2,000,000 BTU per hour, excluding units regulated by

Rule 1121. The provisions of this rule are also applicable to operators of existing units that are rated greater than 400,000 BTU per hour up to and including 2,000,000 BTU per hour. Rule 1146.2 does not regulate residential gas-fired tank type water heaters less than 75,000 BTU/hour heat input which are regulated under AQMD Rule 1121. Rule 1146.2 units are typically used for industrial and commercial water heating. Pool heaters are also regulated under Rule 1146.2. Natural gas pool heaters normally have a capacity ranging from 75,000 to 450,000 BTU per hour.

Rule 1146.2 was originally adopted in 1998 and was amended in 2006 to impose a lower NOx emission limit. The current Rule 1146.2 limit for NOx emissions is 14 ng/J (20 ppm), except for Type 1 units rated equal and greater than 400,000 BTU per hour installed prior to January 1, 2012 to which the NOx limit is 55 ppm, and for Type 2 units rated between 400,000 and 2,000,000 BTU per hour installed prior to January 1, 2010 to which the NOx limit is 30 ppm.

According to the 2018 amendment, Rule 1146.2 requires a technology assessment that is due to the South Coast AQMD Governing Board by January 2022. This technology assessment is to determine if the current NOx emission limit should apply to both RECLAIM and non-RECLAIM units, or if a BARCT assessment should be undertaken as part of the rulemaking process to seek a lower NOx emission limit. Under the BARCT assessment, the technology to achieve a lower NOx limit will need to be feasible, available, and cost-effective. This lower NOx emission limit would apply to both RECLAIM and non-RECLAIM units.

Proposed Method of Control

Control measurer C-CMB-01 seeks NOx emission reductions from commercial building water heating sources by: (1) requiring zero emission commercial water heating units through a regulatory approach for installations in both new and existing buildings; and (2) allowing low NOx technologies as a transitional alternative in lieu of installing and operating zero emission water heaters, when installing a zero emission unit is determined to be infeasible. A mitigation fee will be considered where appropriate. The mitigation fee collected would be utilized as incentives to accelerate the adoption of zero emission units.

The August 2021 amendment to the Title 24 code established electric-ready requirements for new residential and commercial buildings. The goal of these requirements is to remove some of the building electrification obstacles such as architect design, space requirement, market acceptance, and manufacturers' market direction.

For commercial buildings, the most common zero emission water heating technology include integrated heat pump with a water tank packaged with it as a single unit, and split heat pump water heater with a water tank that can be located as far as 50 feet apart. Most of the integrated heat pump water heaters are sized for residential and light commercial applications. Manufacturers such as AO Smith offer split system heat pump models available from 25,000 to 2,000,000 BTU/hour to cover a wide range of commercial water heating applications.

The largest capacity equipment is a stand-alone heat pump that the design engineer pairs with a separate storage tank or tanks. Stand-alone heat pump water heating units range in size from 15,000 BTU/hour to modular units that can be combined for capacities of over 2,000,000 BTU/hour. Many units in this category are available in either air source or water source versions. Air source units have the broadest application for stand-alone heat pump water heater use in California. Since this kind of system does not come packaged with a storage tank, the design engineer must size the heat pump and storage tank combination to meet the hot water demand calculations for the building.

To date, commercial heat pump water heaters have not been deployed in substantial quantities because of their high cost, but they are being used in some commercial facilities that have simultaneous demands for hot water and space cooling. Heat pump water heaters generate both hot water and cool air. Therefore, they can be used simultaneously for water heating and space cooling which can substantially offset their higher capital costs relative to a single function natural gas or an oil-fueled unit.

Another common zero emission water heating technology is the electric resistance water heating with storage. The 2019 cost-effectiveness study for the new non-residential construction code investigated several potential all-electric design options for commercial buildings. The study found that while heat pumps are more feasible for some commercial buildings, electric resistance water heating with storage is more feasible for other buildings.

One concern often raised is whether sufficiently high water temperatures needed to meet certain commercial applications (e.g., commercial kitchens) could be achieved by using a heat pump water heater.). There are products that can meet the high-water temperature demand. For example, heat pump water heaters by the manufacturer Colmac offer commercial and industrial users of sanitary hot water an energy efficient means of heating water to temperatures as high as 185°F (85°C) in a single pass.

The common low NOx emission water heating technologies include fuel cell water heaters and natural gas heat pump water heaters. Fuel cell technology for combined heat and power is an important commercial technology in some countries, whether supplying only single large buildings or providing heat to a wide range of properties. Natural gas heat pump systems can provide space cooling, heating, and hot water, for a wide range of buildings, that is, from single family homes to commercial buildings. However, the more common application is in commercial settings.

It is also recognized that low NOx emission technology could be achievable based on the current burner technology with or without modification. During the rule development process in 2005, staff evaluated source test results for Rule 1146.2 certification. Those test results were also utilized in the analysis for 2006 amendment. According to the evaluation, 9 out of 137 Type 1 units and 25 out of 123 Type 2 units were operating with NOx emission levels less than 12 ppm. As the average cost-effectiveness for achieving 12 ppm was estimated to be up to $31,500 per ton of NOx emissions reduced, which was much higher than the cost-effectiveness for achieving 20 ppm, so a BARCT limit of 20 ppm was recommended, rather than 12 ppm, as the new limit adopted at the 2006 amendment. However, $31,500 per ton of NOx emissions reduced is less than the recommended NOx cost-effectiveness threshold in the 2016 AQMP at $50,000 per ton of NOx emissions reduced.

Staff is currently meeting with manufacturers for Rule 1146.2 technology assessment and exploring the possibility of a lower NOx emission limit. Manufacturers explained that with more stringent energy efficiency requirements from the Department of Energy meeting a lower NOx emission limit (e.g., 12 ppm) would no longer be achievable. In addition, with California's all-electric movement, manufacturers prefer to focus on zero technology than invest for lower NOx burner development. Staff will continue to explore the potential of a lower NOx limit during this technology assessment and beyond.

This control measure focuses on a zero emission requirement. Low NOx technology in conjunction with a requirement to pay a mitigation fee could be allowed as an alternative to installing and operating a zero emission unit.

Similar to other new building control measures, there would be special considerations for implementing this proposal, such as the application in colder climate zone and equity issues. In addition, zero emission and low NOx emission technologies are generally not as mature in commercial applications as compared to residential applications. In addition, some commercial applications would need to be done on a case-by-case design. The application challenges may lengthen the implementation timeline and may require a regulatory off-ramp for some cases. An in-depth analysis during the rule development should be conducted to evaluate each of those special situations.

Finally, incentives for zero emission technology would be considered under this control measure. The incentive approach would achieve additional emission reduction, encouraging use and further technology development of zero emission water heating for existing buildings. The incentive approach also includes the funding of technology demonstration and research projects, as well as collaboration efforts with other entities whose goal is to augment the application of zero emission technologies. <u>During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.</u>

Incentives Implementation

Integrity Elements

Emission reductions that are projected to be achieved from the voluntary incentive measures must be demonstrated to be quantifiable, surplus, enforceable, and permanent. This demonstration must include project type(s); project life; applicable incentive program guideline(s), by title, year, chapter(s); and analysis of applicable incentive program guideline(s) for consistency with integrity elements. The following describes the definitions and provides examples of the key elements of such a demonstration:

- <u>Quantifiable</u>: Emission reductions are quantitatively measurable supported by existing and acceptable technical data. The quantification should use well-established, publicly available, and approved emission factors and accepted calculation methodology. There must be procedures to evaluate and verify over time the level of emission reductions actually achieved.

  Potential emission reductions associated with various equipment types are discussed in the Proposed Method of Control section. The following table provides an overview of the sources, emission reductions, and proposed incentives for targeted sources.

- <u>Surplus</u>: Emission reductions must be above and beyond any South Coast AQMD, State, or federal regulation. Emission reductions used to meet air quality attainment requirements are surplus as long as they are not otherwise relied on in the State Implementation Plan (SIP), SIP-related requirement, other State air quality programs adopted but not in the SIP, a consent decree, or federal rules that focus on reducing criteria pollutants or their precursors. In the event that SIP emission reductions are relied on to meet air quality-related program requirements, they are no longer surplus. In addition, the emission reductions are available only for the remaining useful life of the equipment being replaced (e.g., if the equipment being replaced had a remaining useful life of five years, the additional emission reductions from the new equipment are available for SIP or conformity purposes under this guidance for only five years).

- Enforceable: The South Coast AQMD will be responsible for assuring that the emission reductions credited in the SIP will occur. Emission reductions and other required actions are enforceable if:
  - They are independently verifiable;
  - Program violations are defined;
  - Those liable for emission reductions can be identified;
  - The South Coast AQMD and the U.S. EPA maintain the ability to apply penalties and secure appropriate corrective action where applicable;
  - The general public have access to all the emissions-related information obtained from the source;
  - The general public can file suits against sources for violations (with the exception of those owned and operated by Tribes); and
  - They are practically enforceable in accordance with other U.S. EPA guidance on practicable enforceability.

  Actual emission reductions, for example, can be assured through the replacement equipment registration, recordkeeping and reporting, and inspections (initial inspection after installation and subsequent on a regular basis thereafter, if needed) throughout the term. Specific enforcement mechanisms will be addressed in the guidelines for the individual incentive measures.

- Permanent: The emission reductions need to be permanent throughout the term for which the credit is generated. The emission reductions are permanent if these reductions are ensured to occur over the duration of the SIP program, and for as long as they are relied on in the SIP.

  For example, those awarded incentives would need to ensure the projects are properly implemented and the reductions are occurring and will continue to occur. Thus, recipients of the incentive awards would agree to contract provisions, such as recordkeeping and reporting to track reductions and agreements that newly installed equipment would not be removed without concurrence with the South Coast AQMD (i.e., permanent placement) and the proof that the replaced equipment would be destructed or at least not be operated any more in the Basin (e.g., pictures, certification). Detailed procedures to ensure permanent reductions will be described in the guidelines for the individual incentive measures.

Guidelines

Each SIP needs to have detailed and comprehensive guidelines that are approved by the South Coast AQMD Governing Board. The guidelines will be the protocol to implement the program, to ensure SIP applicability, and to maintain SIP approvability:

- ☑ Voluntary incentive program should demonstrate compliance with the four key elements of the SIP: quantifiable emissions plus incentive costs, surplus reductions, enforceable compliance, and permanent reductions.
- ☑ Working group should be established to solicit public input and feedback during SIP guideline development.
- ☑ Process and procedures to apply for incentives should be clearly explained in the guideline.
- ☑ It needs to clearly describe how incentives would be awarded (e.g., priority to high emitters and/or age of equipment, tiered process, first come first serve, or EJ area priority).
- ☑ It should have conditions of some form for agreement (e.g., contracts) including tracking and ensuring permanent reductions. The following forms should be prepared:
  - ☑ Application Forms (samples are required).
  - ☑ Contracts with Conditions (samples are required).
  - ☑ Product Example.
- ☑ Tracking mechanism is required to ensure overall effectiveness of program and procedures to correct emission projections, such as reductions by the committed target date (e.g., 2031, 2037) and submittal to the U.S. EPA annually. Tracking checklist should include:
  - ☑ Project Title.
  - ☑ Product.
  - ☑ Annual Emission Reductions (e.g., from 2030 to 2050, incremented by one year).
  - ☑ Life of project (e.g., 10 years).
  - ☑ Installation dates (e.g., fixed year 2030 or multiple installation years 2017 and 2018).
- ☑ Possible recordkeeping, reporting, and monitoring requirements need to be addressed.
- ☑ Individual outreach efforts (e.g., social media, email blasts) to promote the program, make aware of deadlines to apply, and provide timing locations of workshops.
- ☑ Program guidelines should be approved by the South Coast AQMD Governing Board and published online.

Emission Reductions

Staff estimates that there would not be any NOx emission reductions by 2031 and 0.25 tons per day by 2037, which would be achieved by a regulatory approach (See Table C-CMB-01-A). Incentive programs for accelerating zero emission technology adoption would promote further emission reductions earlier than required.

The target of this regulatory approach is to implement zero emission technologies for 50 percent of the applicable sources and implement low NOx water heating technologies in conjunction with a mitigation fee for the ~~rest~~ remaining 50 percent by 2037. The low NOx water heating technologies could be the alternative for applications when zero emission technologies are deemed not feasible. The alternative approach should define an emission limit (e.g., 12 ng/J) and the associated mitigation fee, if appropriate. In-depth analysis during future rule development would determine when regulatory off-ramps should be provided under certain situations.

To implement zero emission technologies for 50 percent of the applicable sources by 2037, 0 percent would emanate from new buildings and 40 percent from existing buildings starting in year 2031. Staff recognizes that a unit replacement for existing buildings may occur at the end of the unit lifetime, which creates a natural unit turnover. As a commercial water heater's useful lifetime is around 15 years, there would be about 40 percent natural turnover by 2037 for existing buildings over a six-year period of time without stimulation in the market for zero emission technologies. Additional NOx emission reductions could be achieved with state and local incentive programs that have been launched or proposed. The South Coast AQMD will propose incentives to promote zero emission technologies, and will also seek partnerships for implementing the incentives.

For low NOx commercial water heating technologies in conjunction with a mitigation fee, the emission reductions are estimated based on its implementation for the remaining 50 percent of the sources by 2037, with a consideration of natural turnover and 50 percent of reduction from 20 to 12 ppm NOx emissions for each replacement.

With the Title 24 code update for the readiness of new building electrification, the implementation for new buildings could occur earlier than that for existing buildings. However, for a conservative emission reduction estimation, the implementation start year for new commercial buildings would also occur in 2031 as for older commercial buildings.

TABLE C-CMB-01-A

Emission Reduction Potential for C-CMB-01 Sources

R-CMB-01 Commercial Water Heating	Proposal for Reduction			NOx Emission Reductions (tpd)	
	Current NOx Limit	Potential NOx Limit	Start of Implementation	2031	2037
Regulatory Approach – Zero Emission	20 ng/J	0 ng/J	2031	0.00	0.21
Regulatory Approach – Other Technologies	20 ng/J	12 ng/J	2031	0.00	0.03
Regulatory Approach – Overall	---	---	2031	0.00	0.25

Rule Compliance and Test Methods

South Coast AQMD Method 100.1

Cost Effectiveness

The CARB 2022 State SIP Strategy has proposed control measures for residential and commercial building space and water heating appliances, which align with the South Coast AQMD 2022 AQMP Control Measures R-CMB-01 (Residential Water Heating), R-CMB-02 (Residential Space Heating), C-CMB-01 (Commercial Water Heating), and C-CMB-02 (Commercial Space Heating). CARB would design any such standard in collaboration with energy and building code regulators and with air districts to ensure consistency with all state and local efforts and would work carefully with communities to consider any housing cost or affordability impacts, recognizing that reducing emissions and energy demand from these appliances can generate cost-savings and health benefits with properly designed standards. For the cost estimates of these control measures, staff will refer to the CARB analysis. All cost assumptions for CARB measures can be found in the 2022 State SIP Strategy, Appendix A: Economic Analysis.[18] The cost-effectiveness of the CARB Zero-Emission Standard for Space and Water Heaters measure is $496,600 per ton of NOx (Quasi-LCF). ~~Based on the cost and operation data utilized in the 2006 amendment to Rule 1146.2, the cost-effectiveness of lowering the NOx emissions (e.g., 12 ppm) in commercial building water heating is estimated to be $105,000 per ton of NOx reduction for Type 1 units (≤ 400,000 BTU/hour), and $44,000 per ton of NOx for Type 2 units (400,000 - 2,000,000 BTU/hour).~~

-Staff recognizes that unit capital and operation costs could have increased along with inflation. However, the cost difference between newer (e.g., 12 ppm units) and traditional technologies could be less with a longer time of newer technology deployment.

With regards to cost-effectiveness of zero emission technologies, during the California Energy Commission's analysis for the 2022 Title 24 development, the performance of heat pumps was compared to natural gas heating systems. The heat pump water heater was evaluated in commercial buildings such as schools. This evaluation determined that the heat pump water heater technology would realize cost savings over the lifetime of the equipment.

The 2019 cost-effectiveness study of the non-residential new construction code investigated the cost, performance impacts, and associated infrastructure costs associated with changing the current baseline HVAC and water heating systems to all-electric equipment. This includes heat pump space heating, electric resistance re-heat coils, electric water heater with storage tank, heat pump water heating, increasing electrical capacity, and eliminating natural gas connections that would have been present in mixed-fuel new construction. The study determined that there are cost savings for all-electric design for hot water for many commercial buildings.

Staff estimates that proposing zero emission water heating in commercial buildings would not pose an additional cost as the savings will offset the initial higher capital costs. However, heat pump installation

[18] California Air Resources Board, Proposed 2022 State SIP Strategy Appendix A: Economic Analysis, September 2022. https://ww2.arb.ca.gov/sites/default/files/2022-09/2022_State_SIP_Strategy_App_A.pdf

in some older commercial buildings may require an electric panel upgrade with an estimated cost of $4000-5000. ~~With the consideration of this additional cost, the cost-effectiveness of implementing zero emission water heating in commercial buildings is estimated to be $40,000 per ton of NOx reduction for Type 1 units, and $10,000 per son of NOx for Type 2 units.~~

~~As the cost-effectiveness could fall in the range of 0 to $105,000 ton of NOx reduction,~~ T~~t~~he preliminary data indicate that zero emission technologies for all size units and lower emission technologies Type 2 units would be more cost effective~~could be feasible~~ than Type 1 unit~~tis~~. Nevertheless, updated cost and operation data should be collected for more accurate analysis during the future rulemaking. It is also anticipated that the cost of new technologies will be lowered when the market achieves greater penetration.

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from these stationary sources.

References

South Coast Air Quality Management District. (2018). South Coast AQMD Rule 1146.2 – Emissions of Oxides of Nitrogen from Large Water Heaters and Small Boilers and Process Heaters (Amended December 7, 2018)

South Coast Air Quality Management District. (2006). Final Staff Report: Proposed Amended Rule 1146.2 – Emissions of Oxides of Nitrogen from Large Water Heaters and Small Boilers and Process Heaters. South Coast Air Quality Management District. April 2006.

South Coast Air Quality Management District. (2017). Final 2016 Air Quality Management Plan. South Coast Air Quality Management District. March 2017.

California Energy Commission. (2020). Case Report All-Electric Multifamily Compliance Pathway. September 24, 2020.

AO Smith. Commercial Heat Pump Water Heaters.
Chttps://www.hotwater.com/Water-Heaters/Commercial/Water-Heaters/Heat-Pump/

Colmac Water Heater. heat Pump Water Heaters.
https://colmacwaterheat.com/

Department of Energy. Absorption Heat Pumps
https://www.energy.gov/energysaver/absorption-heat-pumps

City of Berkeley. (2019). Staff report Adoption of Berkeley Building Codes, including Local Amendments to California Building Standards Code. December 3, 2019.

C-CMB-02: EMISSION REDUCTIONS FROM REPLACEMENT WITH ZERO EMISSION OR LOW NOx APPLIANCES – COMMERCIAL SPACE HEATING [NOx]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	COMMERCIAL SPACE HEATING			
CONTROL METHODS:	REGULATORY APPROACH: ZERO EMISSION AND LOW NOX LIMIT, AND INCENTIVE APPROACH: ZERO EMISSION TECHNOLOGY			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
NOx INVENTORY	2.47	2.06	2.03	1.89
NOx REDUCTION		0.00	0.19	1.17
NOx REMAINING		2.06	1.83	0.72
SUMMER PLANNING	2018	2031	2032	2037
NOx INVENTORY	0.45	0.37	0.37	0.34
NOx REDUCTION		0.00	0.04	0.21
NOx REMAINING		0.37	0.33	0.13
CONTROL COST:	$496,600 per ton of NOx (CARB Zero-Emission Standard for Space and Water Heaters Cost-Effectiveness, Quasi-LCF) ~~$0 to $56,000 per ton of NOx reduction~~			
INCENTIVE COST:	TBD			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

Description of Source Category

Background

Control measure C-CMB-02 seeks further NOx emission reductions from commercial building space heating sources.

Commercial buildings are structures where commercial activities take place. Generally, commercial buildings include structures used for the purpose of conducting business such as office space, retail space, and warehouses. The Southern California Gas Company defines these structures as a category of gas customers whose establishments consist of services, manufacturing nondurable goods, dwellings not classified as residential, and agricultural. As the South Coast AQMD's authority applies to emission sources, the purpose of this control measure applies to the space heating emission sources that are commonly used in commercial buildings.

There are several ways to heat a commercial building. A common means of heating these buildings is a forced air furnace as part of roof top system. As compared to a residential furnace, a commercial furnace most likely would have a higher BTU rating in that it typically provides space heating for a larger space.

Some commercial buildings use boilers for both space and water heating. However, water heating in commercial settings is addressed separately in control measures C-CMB-01.

Control measure C-CMB-02 addresses space heating sources (i.e., forced air furnaces) with a rated heat input capacity between 175,000 and 2,000,000 BTU per hour in commercial buildings. Those sources are currently unregulated by the South Coast AQMD for NOx emissions. Space heating furnaces outside of this heat input range are regulated either by Rule 1111 or Rule 1147.

Control measure C-CMB-02 sources were previously included as a part of the 2016 AQMP control measure CMB-02 for NOx emission reductions from residential and commercial appliances, with a control strategy focused on regulating those currently unregulated commercial furnaces used for space heating.

Regulatory History

Rule 1111 reduces emissions of nitrogen oxides (NOx) from gas-fired fan-type space heating furnaces in residential and light commercial applications with a rated heat input capacity of less than 175,000 BTU per hour or, for combination heating and cooling units, a cooling rate of less than 65,000 BTU per hour.

Rule 1147 reduces NOx emissions from miscellaneous combustion equipment that require a South Coast AQMD permit. This rule includes requirements for natural gas space heating units with a rated capacity of more than 2,000,000 BTU per hour.

As previously mentioned, control measure C-CMB-02 sources with a rated heat input capacity between 175,000 and 2,000,000 BTU per hour, are currently not regulated by the South Coast AQMD for NOx emissions.

Proposed Method of Control

Control measure C-CMB-02 seeks NOx emission reductions from commercial building space heating sources by: (1) requiring zero emission commercial space heating units through a regulatory approach for installations in both new and existing buildings; and (2) allowing low NOx technologies as a transitional alternative in lieu of installing and operating zero emission space heaters, when installing a zero emission unit is determined to be infeasible. A mitigation fee will be considered where appropriate. The mitigation fee collected would be utilized as incentives to accelerate the adoption of zero emission units.

According to an electrification futures study by the National Renewable Energy Laboratory (NREL), as of 2012, electricity accounted for less than 5 percent of energy use for space heating in commercial buildings. Commercial space heating thus represents a substantial opportunity for electrification through the increased adoption and use of high efficiency electric heat pumps.

California Energy Commission’s Title 24 amendment to the 2022 building codes has added new prescriptive solar photovoltaic and battery requirements for new commercial buildings that would include hotel-motel, tenant-space, office, medical office or clinic, restaurant, grocery store, retail store, school, and theater/auditorium/convention center buildings. For California cities that mandate all-electric space and water heating, more than half of those cities have the mandate not only on residential buildings but also on commercial buildings.

Heat pumps have been broadly applied in commercial applications as the primary zero emission technology. The building electrification movement and policies in California are sending a strong market signal, giving equipment manufacturers confidence regarding the demand for heat pumps for various building applications. Manufacturers are further expanding the technology profile to address special demands not only in the residential sector but also in the commercial sector. Nevertheless, the heat pump commercial market is not as mature as in the residential market. On this basis, the implementation for lower NOx emission standards for space heating and cooling at commercial buildings would start later than that for residential buildings.

There would need to be special considerations in implementing zero emission space heating. First, since the jurisdiction of the South Coast AQMD comprises of more than one climate zone, feasibility for heat pump in a cooler climate zone, such as the mountain communities, would be subject to a special evaluation. Heat pumps face a challenge in colder climates where their capacity for providing heat and the efficiency of the equipment reduces as the outdoor temperature drops. In addition, the size and location of mechanical/plumbing areas, as well as other aspects of building layout, can significantly impact the feasibility of split heat pump system and variable refrigerant flow (VRF) systems. CEC's Title 24 all-electric ready requirements recognized and provided exemptions for certain special design buildings. Moreover, other issues such as equity (e.g., buildings located in disadvantaged communities) should be evaluated during the future rulemaking effort. Regulatory off-ramps would be needed for situations in which the utilization of heat pumps is found to be infeasible.

An alternative to the zero emission requirement could be lower NOx technologies. The low NOx technologies include, but not are limited to, fuel cells, natural gas heat pumps that are scaled for commercial application, and Lower NOx furnaces.

The South Coast AQMD currently is funding a commercial furnace technology demonstration project. The project is developing a new burner emitting lower NOx emissions, based on the current market commercial furnace model platform, which was tested to be operating at average NOx emissions around 47 ng/J. For the subsequent evaluation, staff assumed commercial furnaces are likely currently operating at a 40 ng/J NOx emission level, which aligns with the previous NOx emission standard for residential furnaces. When the prototype furnace was developed with the new burner, emission tests indicated the new burners were preforming at NOx emission levels around 5 ng/J. However, due to variabilities with all commercial appliances, the burner manufacturer for the project considered an 8 ng/J NOx emission limit to be achievable.

The regulatory approach is to seek a new rule requiring zero emission and the alternative with a lower NOx emission limit (e.g., 8 ng/J) for commercial furnaces. Through a rulemaking process, in-depth BARCT analysis will be conducted for the technical feasibility and cost-effectiveness of proposed the requirements. As a new rule, other provisions such as monitoring, recordkeeping, and source testing will be included.

In addition, incentives for zero emission technology would be considered under this control measure to not only achieve additional emission reduction but encourage the continuing development and feasibility of zero emission space heating technology for existing commercial buildings. <u>During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.</u>

Incentives Implementation

Integrity Elements

Emission reductions that are projected to be achieved from the voluntary incentive measures must be demonstrated to be quantifiable, surplus, enforceable, and permanent. This demonstration must include project type(s); project life; applicable incentive program guideline(s), by title, year, chapter(s); and analysis of applicable incentive program guideline(s) for consistency with integrity elements. The following describes the definitions and provides examples of the key elements of such a demonstration:

- Quantifiable: Emission reductions are quantitatively measurable supported by existing and acceptable technical data. The quantification should use well-established, publicly available, and approved emission factors and accepted calculation methodology. There must be procedures to evaluate and verify over time the level of emission reductions actually achieved.

  Potential emission reductions associated with various equipment types are discussed in the Proposed Method of Control section. The following table provides an overview of the sources, emission reductions, and proposed incentives for targeted sources.

- Surplus: Emission reductions must be above and beyond any South Coast AQMD, State, or federal regulation. Emission reductions used to meet air quality attainment requirements are surplus as long as they are not otherwise relied on in the State Implementation Plan (SIP), SIP-related requirement, other State air quality programs adopted but not in the SIP, a consent decree, or federal rules that focus on reducing criteria pollutants or their precursors. In the event that SIP emission reductions are relied on to meet air quality-related program requirements, they are no longer surplus. In addition, the emission reductions are available only for the remaining useful life of the equipment being replaced (e.g., if the equipment being replaced had a remaining useful life of five years, the additional emission reductions from the new equipment are available for SIP or conformity purposes under this guidance for only five years).

- Enforceable: The South Coast AQMD will be responsible for assuring that the emission reductions credited in the SIP will occur. Emission reductions and other required actions are enforceable if:

  - They are independently verifiable;
  - Program violations are defined;
  - Those liable for emission reductions can be identified;
  - The South Coast AQMD and the U.S. EPA maintain the ability to apply penalties and secure appropriate corrective action where applicable;
  - The general public have access to all the emissions-related information obtained from the source;
  - The general public can file suits against sources for violations (with the exception of those owned and operated by Tribes); and
  - They are practically enforceable in accordance with other U.S. EPA guidance on practicable enforceability.

Actual emission reductions, for example, can be assured through the replacement equipment registration, recordkeeping and reporting, and inspections (initial inspection after installation and subsequent on a regular basis thereafter, if needed) throughout the term. Specific enforcement mechanisms will be addressed in the guidelines for the individual incentive measures.

- Permanent: The emission reductions need to be permanent throughout the term for which the credit is generated. The emission reductions are permanent if these reductions are ensured to occur over the duration of the SIP program, and for as long as they are relied on in the SIP.

  For example, those awarded incentives would need to ensure the projects are properly implemented and the reductions are occurring and will continue to occur. Thus, recipients of the incentive awards would agree to contract provisions, such as recordkeeping and reporting to track reductions and agreements that newly installed equipment would not be removed without concurrence with the South Coast AQMD (i.e., permanent placement) and the proof that the replaced equipment would be destructed or at least not be operated any more in the Basin (e.g., pictures, certification). Detailed procedures to ensure permanent reductions will be described in the guidelines for the individual incentive measures.

Guidelines

Each SIP needs to have detailed and comprehensive guidelines that are approved by the South Coast AQMD Governing Board. The guidelines will be the protocol to implement the program, to ensure SIP applicability, and to maintain SIP approvability:

☑ Voluntary incentive program should demonstrate compliance with the four key elements of the SIP: quantifiable emissions plus incentive costs, surplus reductions, enforceable compliance, and permanent reductions.

☑ Working group should be established to solicit public input and feedback during SIP guideline development.

☑ Process and procedures to apply for incentives should be clearly explained in the guideline.

☑ It needs to clearly describe how incentives would be awarded (e.g., priority to high emitters and/or age of equipment, tiered process, first come first serve, or EJ area priority).

☑ It should have conditions of some form for agreement (e.g., contracts) including tracking and ensuring permanent reductions. The following forms should be prepared:

  ☑ Application Forms (samples are required).

  ☑ Contracts with Conditions (samples are required).

  ☑ Product Example.

☑ Tracking mechanism is required to ensure overall effectiveness of program and procedures to correct emission projections, such as reductions by the committed target date (e.g., 2031, 2037) and submittal to the U.S. EPA annually. Tracking checklist should include:

  ☑ Project Title.

- ☑ Product.
- ☑ Annual Emission Reductions (e.g., from 2030 to 2050, incremented by one year).
- ☑ Life of project (e.g., 10 years).
- ☑ Installation dates (e.g., fixed year 2030 or multiple installation years 2017 and 2018).

☑ Possible recordkeeping, reporting, and monitoring requirements need to be addressed.

☑ Individual outreach efforts (e.g., social media, email blasts) to promote the program, make aware of deadlines to apply, and provide timing locations of workshops.

☑ Program guidelines should be approved by the South Coast AQMD Governing Board and published online.

Emission Reductions

Staff estimates that there would not be any NOx emission reductions by 2031 and 1.17 tons per day by 2037, which would be achieved by a regulatory approach (See Table C-CMB-02-A). Incentive programs for accelerating zero emission technology adoption would promote further emission reductions earlier than required.

The target of this regulatory approach is to implement zero emission technologies for 50 percent of the applicable sources and implement low NOx space heating technologies in conjunction with a mitigation fee for the ~~rest~~ remaining 50 percent by 2037. The low NOx space heating technologies could be the alternative for applications when zero emission technologies are deemed not feasible. The alternative approach should define an emission limit (e.g., 8 ng/J) and the associated mitigation fee. In-depth analysis during future rule development would determine when regulatory off-ramps should be provided under certain situations.

To implement zero emission technologies for 50 percent of the applicable sources by 2037, 10 percent would emanate from new buildings and 40 percent from existing buildings starting in year 2031. Staff recognizes that a unit replacement for existing buildings may occur at the end of the unit lifetime, which creates a unit natural turnover. As a commercial space heater's useful lifetime is around 20 years, there would be about 30 percent natural turnover by 2037 for existing buildings over a six-year period of time without stimulation in the market for zero emission technologies. It is anticipated that the remaining 10 percent turnover is achievable with state and local incentive programs that have been launched or proposed. The South Coast AQMD will propose incentives to promote zero emission technologies, and will also seek partnerships for implementing the incentives.

For low NOx commercial space heating technologies in conjunction with a mitigation fee, the emission reductions are estimated based on its implementation for the remaining 50 percent of the sources by 2037, with a consideration of natural turnover and a 50 percent ~~of~~ reduction from 40 to 8 ng/J NOx emissions for each replacement.

With the Title 24 code update for the readiness of new building electrification, the implementation for new buildings could occur earlier than that for existing buildings. However, for a conservative emission reduction estimation, the implementation start year for new commercial buildings would also occur in 2031 as for older commercial buildings.

TABLE C-CMB-02-A
Emission Reduction Potential for C-CMB-02 Sources

C-CMB-02 Commercial Space Heating	Proposal for Reduction			NOx Emission Reductions (tpd)	
	Current NOx Limit	Potential NOx Limit	Start of Implementation	2031	2037
Regulatory Approach – Zero Emission	40 ng/J	0 ng/J	2031	0.00	0.94
Regulatory Approach – Other Technologies	40 ng/J	8 ng/J	2031	0.00	0.23
Regulatory Approach – Overall	---	---	2031	0.00	1.17

Rule Compliance and Test Methods

South Coast AQMD Method 100.1

Cost Effectiveness

The CARB 2022 State SIP Strategy has proposed control measures for residential and commercial building space and water heating appliances, which align with the South Coast AQMD 2022 AQMP Control Measures R-CMB-01 (Residential Water Heating), R-CMB-02 (Residential Space Heating), C-CMB-01 (Commercial Water Heating), and C-CMB-02 (Commercial Space Heating). CARB would design any such standard in collaboration with energy and building code regulators and with air districts to ensure consistency with all state and local efforts and would work carefully with communities to consider any housing cost or affordability impacts, recognizing that reducing emissions and energy demand from these appliances can generate cost-savings and health benefits with properly designed standards. For the cost estimates of these control measures, staff will refer to the CARB analysis. All cost assumptions for CARB measures can be found in the 2022 State SIP Strategy, Appendix A: Economic Analysis.[19] The cost-effectiveness of the CARB Zero-Emission Standard for Space and Water Heaters measure is $496,600 per ton of NOx (Quasi-LCF).

[19] California Air Resources Board, Proposed 2022 State SIP Strategy Appendix A: Economic Analysis, September 2022. https://ww2.arb.ca.gov/sites/default/files/2022-09/2022_State_SIP_Strategy_App_A.pdf

According to the Center for Climate and Energy Solutions, larger commercial buildings (greater than 5,000 ft^2) consume 90 percent of the total energy by all commercial buildings and 32 percent of that energy is generated from the use of natural gas. According to the website www.reonomy.com, which lists the number of commercial buildings in each county, there are about 690,000 commercial buildings in the four counties under the South Coast AQMD jurisdiction. Therefore, staff estimates the approximately 200,000 commercial furnaces with a rated heat input capacity between 175,000 and 2,000,000 BTU per hour would be subject to control measure C-CMB-02.

In preparing the 2021 amendment to Title 24 building codes, the state conducted a feasibility analysis for all electric heat pumps in non-residential buildings. The analysis included equipment costs, labor, and installation costs taken from multiple distributor sources and several direct quotes from manufacturers. Because heat pumps do not require a gas line or connection to the gas service, avoided costs for the elimination of gas lines were included in the estimate. Gas units included in the estimate were commercial, three-phase packaged rooftop units, with capacities ranging from 2 tons to 20 tons. As a result of the analysis, heat pumps carry an incremental equipment cost increase of approximately $22 to $815 per unit compared to the rooftop units with gas heating. The additional heat pump equipment cost is expected to be offset by avoiding the installation of gas lines to the unit. Life cycle cost saving would be expected especially for buildings in mild climate zones, and in general, the South Coast AQMD jurisdiction area is considered a mild climate zone. In summary, proposing zero emission space heating for future new commercial buildings would not pose an adverse additional cost. However, heat pump installation in some older commercial buildings may require electric panel upgrade with an estimated cost of $4,000-5,000. ~~With the consideration of this additional cost, the cost-effectiveness of implementing zero emission space heating in commercial buildings is estimated to be up to $56,000 per ton of NOx reduction.~~

With regards to lower NOx technologies, the burner manufacturer for the aforementioned commercial furnace development project suggested a 5 to 10 percent cost increase for achieving 80 percent of NOx reduction (from current 40 ng/J to 8 ng/J). HVAC Direct webpage shows commercial units with capacity between 7.5 tons (210,000 BTU/hour) to 25 tons (400,000 BTU/hour) range in price from $6,400 to $20,700 for current common brand products. Consequently, there would be a $1,500 cost increase for a 400,000 BTU/hour rooftop unit for achieving 80 percent of NOx reduction~~, which means a cost-effectiveness of approximately $21,000 per ton of NOx reduced~~.

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from these stationary sources.

References

Southern California Gas Company. (2020). 2020 California gas report

South Coast Air Quality Management District. (2021). Rule 1111 – Reduction of NOx Emissions from Natural-Gas-Fired, Fan-Type Central Furnaces (Amended October 3, 2021).

South Coast Air Quality Management District. (2017). Rule 1147 – NOx Reductions from Miscellaneous Sources (Amended July 7, 2017).

South Coast Air Quality Management District. (2017). Final 2016 Air Quality Management Plan. South Coast Air Quality Management District. March 2017.

GB&D magazine. Zero Emissions Buildings. https://gbdmagazine.com/zero-emissions-buildings/

Beckett Gas Inc. (2018). Proposal: Application of Swirl-Pattern Burner Head Technology with Reduced NOx Emissions Capable of Meeting the Future Requirement of Rule 1111, RFP# P218-06. April 6, 2018.

HVAC Direct. Commercial HVAC Units (refence of commercial heat pump prices). https://hvacdirect.com/commercial-hvac-equipment/commercial-split-system-units.html

Austin Tenant Advisors. Lifespan of Commercial Heating Ventilation Air Conditioning Units. https://www.austintenantadvisors.com/blog/lifespan-of-commercial-heating-ventilation-air-conditioning-units/

Reonomy. Commercial Real Estate in California. https://www.reonomy.com/properties/commercial-real-estate/us/california/1

Jadun, Paige, Colin McMillan, Daniel Steinberg, Matteo Muratori, Laura Vimmerstedt, and Trieu Mai. (2017). Electrification Futures Study: End-Use Electric Technology Cost and Performance Projections through 2050. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-70485. https://www.nrel.gov/docs/fy18osti/70485.pdf.

Abhijeet Pande, Jingjuan (Dove) Feng, Julianna Yun Wei, and Mia Nakajima. (2021). All-Electric Multifamily CASE Report. CASE Report #2022-MF-AEP-F. April 2021.

Roger Hedrick, John Arent, Nikhil Kapur, and Rahul Athalye – NORESCO. (2021). Heat Pump Baseline for Non-Residential and High-Rise Residential Buildings Feasibility Analysis for California Energy Commission. Docketed in 21-BSTD-02 as TN 237849. July 14, 2021.

Center for Climate and Energy Solutions. (2012). Natural Gas in Commercial Buildings. October 2012. http://www.ourenergypolicy.org/wp-content/uploads/2012/10/Nat-Gas-Commercial-Buildings.pdf

C-CMB-03: EMISSION REDUCTIONS FROM COMMERCIAL COOKING DEVICES [NOx]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	COMMERCIAL COOKING DEVICES			
CONTROL METHODS:	Low NOx Burners, Induction Cooktops and Electric Cooking Devices			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	**2018**	**2031**	**2032**	**2037**
NOx INVENTORY	~~1.19~~1.31	~~1.01~~1.05	~~1.00~~1.04	~~0.95~~0.98
NOx REDUCTION		0.10	0.21	~~0.62~~0.64
NOx REMAINING		~~0.91~~0.94	~~0.79~~0.83	~~0.33~~0.34
SUMMER PLANNING	**2018**	**2031**	**2032**	**2037**
NOx INVENTORY	~~1.19~~1.31	~~1.01~~1.05	~~1.00~~1.04	~~0.95~~0.98
NOx REDUCTION		0.10	0.21	~~0.62~~0.64
NOx REMAINING		~~0.91~~0.94	~~0.79~~0.83	~~0.33~~0.34
CONTROL COST:	DCF METHOD: $751,100 ~~0 TO $290,000~~ PER TON OF NOx REDUCTION MODIFIED LCF METHOD: $1,116,400 PER TON OF NOx REDUCTION			
INCENTIVE COST:	TO BE DETERMINED			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

Description of Source Category

Control Measure C-CMB-03 seeks to achieve NOx reductions from commercial cooking devices including fryers, ovens, stoves, griddles, broilers, and others in new and existing buildings. Natural gas and electricity are the two main types of energy sources used in commercial cooking devices. Commercial gas cooking appliances use a variety of burner types that mix primary air with fuel gas to create a combustible mixture.[20] Gas cooking devices emit criteria pollutants such as NOx, particulate matter, and CO through incomplete combustion and oxidation processes. Electric cooking devices and induction cooktops that utilize electricity rather than gas does not generate NOx emissions on site. Induction cooktops are also highly energy efficient as they heat cookware directly, resulting in minimal heat loss. Replacing existing

[20] Primary air- air supplied and mixed with fuel prior to ignition that controls the amount of fuel to be burned.

gas burners with zero emission and low NOx emission appliances such as electric cooking devices, induction cooktops, or low NOx gas burners can reduce emissions from commercial cooking devices.

Some emission sources in C-CMB-03 were included in the 2016 AQMP as control measure CMB-04, which addresses NOx emission reductions from restaurant burners and residential cooking. The proposed method of control for CMB-04 in the 2016 AQMP was a combination of regulatory approaches, incentives and/or efficiency standards.

Background

There are many different types of commercial cooking devices with a variety of designs, burner types, and energy usage. Fisher-Nickel, Inc. (now Frontier Energy) conducted a study for the California Energy Commission (CEC) to characterize various commercial primary cooking equipment in California. According to the study, which quantified gas load and energy efficiency associated with commercial foodservice, 70 percent of the 795,000 total primary cooking appliances identified in 2008-2009 are reported to be gas-fueled cooking appliances.[21] This study also identified nine major commercial cooking categories - braising pans, broilers, fryers, griddles, ovens, pasta cookers, ranges, steam cookers, and steam kettles - and thirty subcategories.

Emission reductions from commercial cooking employs technology that considers equipment category and its application. Individual manufacturers of food products and foodservice establishments may set up their ovens differently in order to produce their unique product. In some applications, switching to a different type of burner and/or changing the operational characteristics of the oven and burners can change taste, texture, appearance, and other qualities of the cooked food product. In these cases, low NOx gas burners may be a more viable option to achieve emission reductions to not compromise the quality of the food products.

As part of the 2022 State Strategy for the State Implementation Plan (2022 State SIP Strategy), CARB has proposed statewide emissions standards for combustion-based appliances in residential and commercial buildings to accelerate the transition from fossil fuels. CARB proposed a statewide zero Greenhouse Gas (GHG) emission standard for space and water heaters, which would have co-benefits of reducing criteria pollutants. Beginning in 2030, 100 percent of sales of new space and water heaters would need to meet zero emission standards. This requirement applies to both new construction and replacement of burned-out equipment in existing buildings. As part of the public measure suggestions, the 2022 State SIP Strategy includes the possibility of additional emissions standards for combustion-based appliances used in buildings such as stoves, work with air districts to set further such standards, work with building and energy code agencies to ready more buildings for zero emission appliances, or take other actions (including potentially incentive programs) to accelerate the removal of fossil fuels from the building stock in both new and existing buildings. Such measures can accelerate the transition away from pollution associated with combustion in these sources while creating economic opportunities for building retrofits.[22]

[21] California Energy Commission, "Characterizing the Energy Efficiency Potential of Gas-Fired Commercial Foodservice Equipment" [CEC-500-2014-095] (2014).

[22] https://ww2.arb.ca.gov/sites/default/files/2021-10/2022_SSS_Draft_Measures.pdf

Energy Star, a joint program between the U.S. EPA and U.S. Department of Energy (DOE), identifies energy-efficient gas and electric commercial food service equipment including fryers, griddles, and ovens. Frontier Energy estimates that only 10 percent of the potential market in California uses high-efficiency Energy Star commercial gas cooking appliances. Energy-efficient gas cooking appliances can reduce energy usage and the resulting NOx emissions compared to conventional cooking appliances. Switching conventional commercial cooking devices to Energy Star-certified appliances could result in annual savings of 12-58 therms or 650-7,000 kWh/year depending on the appliance type and usage. Methods to reduce energy consumption from cooking devices include using direct-fired gas burners over standard burners, switching to high-efficiency infrared burners, and improved insulation.

Regulatory History

South Coast AQMD Rule 1153.1 – Emissions of Oxides of Nitrogen from Commercial Food Ovens limits NOx and CO emissions from the combustion of gaseous and liquid fuels in food ovens, dry roasters and smokehouses. Rule 1153.1 sets NOx emission limits of 40 to 60 ppm and a CO limit of 800 ppm. The emissions limit is segregated by temperature equal to or exceeding ~~1,200~~500 degrees Fahrenheit, where the higher 60 ppm limit applies to higher temperature. Accordingly, NOx and CO levels will vary depending upon the heat output of the burner. Based on an assessment conducted in 2021, about 240 permitted units are subject to Rule 1153.1, accounting for about 0.2 tons per day of NOx emissions.[23] Although Rule 1153.1 regulates NOx emissions from permitted food equipment, the majority of commercial cooking-related NOx emissions come from area sources that do not require a South Coast AQMD permit and are not subject to Rule 1153.1.

In the last few years, the State of California has established aggressive climate goals to reduce greenhouse gases across different sectors. State climate actions can help reduce combustion-related emissions from residential and commercial cooking appliances. Senate Bill (SB) 100 signed in 2018 increased California's Renewables Portfolio Standard to 60 percent renewable energy by 2030. California Governor's Executive Order (EO) B-55-18 established the goal for carbon neutrality and 100 percent carbon-free energy sources by 2045. The increase in renewable generation in the state will bring co-benefits of NOx emission reductions from electricity generating facilities.[24] Furthermore, Assembly Bill (AB) 3232 requires the CEC in consultation with the California Public Utilities Commission (CPUC) and CARB, to develop plans to reduce greenhouse gas emissions from California's residential and commercial buildings to 40 percent below the 1990 level by 2030. Once materialized, AB 3232 is an opportunity to bring further NOx emission reductions from residential and commercial buildings.

[23] http://www.aqmd.gov/docs/default-source/rule-book/Proposed-Rules/par-1153.1/par-1153-1---wgm-1---07-09-2021.pdf?sfvrsn=6

[24] *2021 SB 100 Joint Agency Report.* https://www.energy.ca.gov/publications/2021/2021-sb-100-joint-agency-report-achieving-100-percent-clean-electricity

Proposed Method of Control

This proposed control measure seeks NOx reductions from commercial cooking devices by replacing conventional gas-fired cooking appliances with zero and low NOx emission devices such as induction cooktops, electric cooking devices, and low NOx burner technologies.

In the South Coast Air Basin, commercial cooking accounts for about 7 percent of total emissions from commercial combustion sources in 2018. Electric cooking devices and induction cooktops offer the most reductions with no emissions on site and have been commercially available for years. Electric cooking devices include a coil or infrared heating element that generates heat by electric current and are often inexpensive due to their simple design. High efficiency induction cooktops do not have an open flame and transfer heat directly through magnetic cookware which minimizes heat loss to ambient air. Consequently, this reduces cooking times and NOx emissions and adds extra safety in food preparation. Although electric options are available for most commercial cooking appliances, in some applications, the use of electric cooking appliance may change taste, texture, appearance, and other qualities of the cooked food product.

Commercially available lower NOx burners include ribbon burners, radiant burners, in-shot burner technology, and modern power burners. Many oven burners consist of long sections of pipe with rows of holes along the length of the pipe. Gas and a small amount of air is introduced into the pipe and that mixture exits through the holes in the pipe where it is lit with a pilot flame. Combustion occurs with the air residing inside the oven and the gas that exits from the holes in the pipe. Ribbon burners are similar to this conventional style of pipe burner, but they have an insert along the length of the pipe that allows better control of the flame. The newest types of ribbon burners have better mixing of air with the fuel inside the burner and better control of the distribution of fuel gas in the burner, which result in better fuel efficiency. Food ovens can also use radiant systems to provide heat. Infrared burners made with ceramic or metal fiber that operate using direct heat through infrared radiation result in better energy efficiency and lower emissions.

Low NOx gas burners can also provide NOx reductions compared to conventional burners. Organizations such as the Lawrence Berkeley National Laboratory (LBL) have developed a low NOx Ring Burner that can be used for residential and commercial gas cooking devices, as well as other appliances such as water heaters and furnaces. The low NOx Ring Burner can achieve NOx levels of less than 20 ppm, which is about 80 percent lower than the emissions from conventional gas burners. Reductions are achieved by a ring burner design that burns a leaner premixed fuel/air mixture capable of more complete combustion and consequently lower NOx emissions. Additional research and development with an Original Equipment Manufacturer (OEM) are needed for the LBL Ring Burner to meet the American National Standards Institute (ANSI) cooktop standards for commercialization.

The South Coast AQMD is funding two burner development projects with the Gas Technology Institute (GTI) to develop, test, and demonstrate (1) a high efficiency and low NOx combo ribbon burner combustion system for commercial baking ovens and (2) two new low NOx deep fat fryer designs. The combustion burners to be demonstrated in the baking oven integrate the traditional ribbon and metal fiber infrared burner into a Combo Infrared-Ribbon (CIR) burner that creates a more uniform flame temperature and generates low NOx. This project estimates that the new combustion system could reduce NOx emissions by 25 percent and is expected to conclude in December 2022. The second project with GTI is to develop two new designs for low NOx commercial foodservice deep fat fryers that will reduce NOx emissions compared to standard fryer designs. One fryer is based on a burner design developed by Lantec Products and uses a power burner with air and fuel mixed in a blower. This technology demonstrated up to 80 percent in NOx reductions. The second fryer incorporates a commercially available fryer design from Royal Range of California with an adapted in-shot burner, which is typically used in residential furnaces. Both designs will be tested using Rule 1111 compliance methods and the American Society for Testing and Materials (ASTM) International standards for cooking performance and energy efficiency testing. This project is expected to conclude in 2022.

NOx reductions could be achieved through a combination of regulatory and incentive approaches. Proposed method of control consists of two steps: step one is a technology assessment including testing of various cooking devices to establish emissions rates. Once emissions rates are defined, step two supports future rule development and incentive programs. The first applies to manufacturers, distributors, and installers establishing emission limits and the latter intends to encourage use of zero and low NOx emission technologies. Rule working group will include a diverse group of stakeholders representing manufacturer, distributor, and installer. As for the incentive approach, the South Coast AQMD will consider funding various projects/programs to facilitate the deployment of zero emission or low NOx emission appliances, including, but not limited to technology development, public outreach to promote consumers' choice for clean technology, incentive funding for the purchase and installation of clean technology appliances. Partnerships with utilities will be pursued to implement incentive programs that maximize reductions in a cost-effective manner. Implementation of this control measure will be a combination of regulatory and incentive approaches. NOx reductions from residential cooking devices fall under R-CMB-03. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Emission Reductions

In 2018, the natural gas consumption for commercial cooking was estimated to be over 160 million therms in the South Coast Air Basin, which resulted in ~~1.19~~1.31 tons per day of NOx emissions. By 2037, emissions from commercial cooking devices account for approximately ~~0.95~~0.98 tons per day. Implementation of this control measure is expected to reduce NOx emissions by 65 percent by 2037, equivalent to about ~~0.62~~0.64 tons per day.

The target of this approach is to implement zero emission technologies for 50 percent of the applicable sources and implement low NOx burner technologies for the remaining 50 percent by 2037. To implement zero emission technologies for 50 percent of the applicable sources by 2037, 10 percent would emanate from new buildings and 40 percent from existing buildings starting in year 2031. Replacing equipment for existing buildings may occur at the end of the device's lifetime as a natural turnover. The useful lifetime of a commercial cooking appliance is around ~~12~~ 15 years, there would be more than 40 percent natural turnover over an eight-year period by 2037 from existing buildings. Additional NOx emission reductions could be achieved with state and local incentive programs that have been launched or proposed. The South Coast AQMD will propose incentives to accelerate existing gas burner replacement with zero emission and low NOx emission devices such as electric cooking devices, induction cooktops, or low NOx gas burner technologies. Partnership with public utility organizations and other regulatory agencies will be pursued actively to attract funding for incentive programs.

Rule Compliance and Test Methods

South Coast AQMD Method 100.1

Cost Effectiveness

The cost of this control measure varies depending on the type of cooking device to be installed or replaced, and whether the cooking device is in a new or existing building. Details of potential costs for converting commercial gas appliances to low NOx burner technologies, induction cooktops, or electric cooking devices are discussed below. Replacing gas cooking devices in existing buildings with zero emissions units can incur additional costs if electrical upgrades are necessary.

Low NOx Burner Technologies

Rule 1153.1 is currently under amendment to establish emissions limits for permitted commercial food ovens that represent Best Available Retrofit Control Technology (BARCT). Technological feasibility of lower emissions limits and their cost-effectiveness will be determined as part of the rulemaking process and are not addressed in this control measure. ~~.~~Other low NOx burners still under development include Lawrence Berkeley Lab's Ring Burner and GTI's low NOx burners for commercial food ovens and deep fat fryers. These technologies have been proven in demonstration projects but are not yet commercially available. Low NOx burners improve the current conventional gas burner design to burn fuel more efficiently, and minimal incremental equipment costs are expected. Any small incremental equipment costs are likely offset by utility savings resulting from the more energy-efficient design. In the case where low NOx burners become too expensive, zero emission appliances may serve as a more cost-effective option.

Induction Cooktops/Electric Cooking Devices

In contrast to the many studies that evaluate cost associated with the transition from gas to electric cooking devices in residential buildings, such information is rather limited in the commercial cooking sector. Fisher-Nickel, Inc. (now Frontier Energy) conducted a study for the CEC from 2008-2009 to characterize various commercial primary cooking equipment in California. The study identified nine major commercial cooking appliance categories and estimated that fryers, ovens, and ranges account for the largest shares of the commercial cooking inventory in the state.[25] These cooking equipment categories also have zero emissions options readily available and/or low NOx options under development (see Proposed Method of Control section above). The gas cooking equipment inventory within South Coast AQMD's jurisdiction was estimated using 47 percent of the State inventory, based on the fraction of California's population within the South Coast Air Basin. For the purpose of estimating cost-effectiveness,

[25] California Energy Commission, "Characterizing the Energy Efficiency Potential of Gas-Fired Commercial Foodservice Equipment" [CEC-500-2014-095] (2014).

equipment costs were~~are~~ obtained from ~~a~~ distributors of restaurant supplies and equipment.[26,27] These costs were individually averaged for the fryers, ovens, and ranges categories. For the remaining cooking equipment categories, a weighted average was calculated.

Equipment costs vary significantly based on equipment characteristics such as appliance type, burner output, and the number of burners, etc. In commercial kitchen applications, equipment costs for induction cooktops ranged~~s~~ from cost savings to more than double ~~compared to~~ the cost of gas cooktops. For example, a two-burner, 240V induction cooktop has an incremental equipment cost of about $3,000. For ovens and fryers, switching from gas to electric appliances may add average one-time incremental equipment costs of $2,500 and $1,000, respectively. Other electric appliances may have incremental equipment cost savings due to their simple design and lower ongoing maintenance costs. ~~equipment costs of electric appliances are typically comparable to their gas counterparts and contribute to minimal incremental equipment costs. Electric fryers may even have incremental equipment cost savings due to their simple design, and the lower ongoing maintenance costs.~~Many advantages of electric appliances are not quantifiable, such as their easiness to use and clean, increased throughput, and safer work environment with no flames and less heat.

To deploy induction cooktops or other electric cooking devices, some older commercial buildings may require an electric panel upgrade with an estimated cost of about $4,000-$5,000. For cooking appliances that use more than 18kW to operate, a 240V outlet upgrade may be required that will add a one-time incremental cost of $150 or more in older buildings.[28] For new buildings, electrical infrastructure is assumed to be sufficient. If all other appliances within the new building are also electric, the building may not require gas infrastructure to be installed at the time of construction. If gas infrastructure is not placed within the building, avoided gas infrastructure costs may result in cost savings associated with the transition from gas to electric cooking devices.

Cost-effectiveness for this control measure is mainly driven by incremental utility cost. Incremental utility cost is dependent upon appliance type and size, appliance efficiency, power output, energy usage (hours used per day and days used per year), the presence of solar panels, and other factors among food service establishments~~energy usage and efficiency per appliance type~~. Adjusting any of these factors will affect cost-effectiveness. Incremental utility cost for this control measure is calculated using an average commercial electricity rate of 16 cents per kilowatt hour (kWh)[29] and an average commercial gas rate of $1.09/therm.[30] Despite higher electricity rates compared to gas, solar panels may partially or fully offset incremental utility costs and are a requirement for new construction and alterations of existing buildings.[31] ~~induction cooktops are estimated to have minimal incremental utility costs due to their high~~

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[26] https://www.webstaurantstore.com

[27] https://www.restaurantsupply.com/commercial-cooking-equipment

[28] Residential Building Electrification in California.

[29] U.S. Energy Information Administration. https://www.eia.gov/electricity/sales_revenue_price/pdf/table7.pdf

[30] U.S. Energy Information Administration. https://www.eia.gov/dnav/ng/ng_pri_sum_a_EPG0_PCS_DMcf_a.htm

[31] California Energy Commission, Building Energy Efficiency Standards - Title 24. https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards

~~efficiency.~~ For commercial cooking appliances operating ten hours a day and six days a week, annual incremental utility costs vary for fryers ($0-$5,900), ovens ($0-$4,900) and other cooking appliances ($0-$2,700). Incremental utility costs for induction cooktops can range from $0- $1,800, but are expected to be minimal due to their high efficiency. ~~Incremental utility costs for ovens, fryers, and other cooking appliances vary due to the large range in energy consumption, frequency and duration of use, and emission rates of appliances amongst food service establishments.~~

The cost-effectiveness for this control measure is approximately $751,100 per ton of NOx reduced using the DCF method, and approximately $1,116,400 per ton of NOx reduced using the Modified LCF method~~the conversion of gas cooktops to induction cooktops in existing commercial buildings is approximately $290,000 per ton of NOx reduction~~. Costs for the conversion of gas cooking equipment to electric cooking devices vary based on appliance type and the associated incremental equipment and utility costs. Incremental utility cost is the main driver of cost-effectiveness for this control measure. ~~As cost data on commercial cooking equipment becomes available, the cost estimates will be updated.~~ Note that potential incentives or rebates are not included as part of the ~~cost-effectiveness~~ analysis. The incremental utility, equipment, and/or infrastructure costs may be partially offset by incentives provided by local or state agencies, or local utility companies. The South Coast AQMD could also propose an incentive program to lower the upfront capital costs.

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from these stationary and area sources.

References

California Energy Commission, Characterizing the Energy Efficiency Potential of Gas-Fired Commercial Foodservice Equipment, October 2014.

California Energy Commission, 2021 SB 100 Joint Agency Report, September 2021. https://www.energy.ca.gov/publications/2021/2021-sb-100-joint-agency-report-achieving-100-percent-clean-electricity

California Energy Commission, Final 2021 Integrated Energy Policy Report Volume I: Building Decarbonization, February 2022. https://efiling.energy.ca.gov/GetDocument.aspx?tn=241361

California Air Resources Board, 2022 State Strategy for the State Implementation Plan, October 2021. https://ww2.arb.ca.gov/sites/default/files/2021-10/2022_SSS_Draft_Measures.pdf

South Coast Air Quality Management District, Rule 1153.1 Draft Staff Report, September 2014. http://www.aqmd.gov/docs/default-source/rule-book/Proposed-Rules/1153-1/pr1153-1_dsr_090214.pdf?sfvrsn=2

South Coast Air Quality Management District, 2016 Air Quality Management Plan, September 2011. http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2016-air-quality-management-plan/final-2016-aqmp/final2016aqmp.pdf?sfvrsn=15

Gas Technology Institute, High Efficiency and Low NOx Combo Ribbon Burner Combustion System Demonstration, April 2018.

Gas Technology Institute, Ultra Low NOx Commercial Foodservice Deep Fat Fryer and Development, April 2018.

Lawrence Berkeley National Laboratory, Research and Development of Natural Draft Ultra-Low Emissions Burners for Gas Appliances, September 2016.

C-CMB-04: EMISSION REDUCTIONS FROM SMALL INTERNAL COMBUSTION ENGINES [NOx]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	SMALL INTERNAL COMBUSTION ENGINES			
CONTROL METHODS:	Zero Emission and Low NOx Emission Technologies			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
NOx INVENTORY	~~3.3~~3.67	~~3.3~~3.60	~~3.3~~3.58	3.47~~3.2~~
NOx REDUCTION		0	0	2.25~~2.1~~
NOx REMAINING		~~3.3~~3.60	~~3.3~~3.58	1.21~~1.1~~
SUMMER PLANNING	2018	2031	2032	2037
NOx INVENTORY	~~3.3~~3.67	~~3.3~~3.60	~~3.3~~3.58	3.47~~3.2~~
NOx REDUCTION		0	0	2.25~~2.1~~
NOx REMAINING		~~3.3~~3.60	~~3.3~~3.58	1.21~~1.1~~
CONTROL COST:	~~TO BE DETERMINED~~DCF METHOD: $446,100/TON OF NOx REDUCED MODIFIED LCF METHOD: $744,000/TON OF NOx REDUCED			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

Description of Source Category

This control measure seeks to reduce emissions from non-permitted internal combustion engines (ICEs) through replacement with zero or low ~~er~~ emission technologies where feasible.

Background

ICEs include a variety of equipment types including, but not limited to generators, pumps, and air compressors. The South Coast AQMD regulates emissions from ICEs and requires permits for ICEs rated over 50 brake horsepower (bhp). The California Air Resources Board (CARB) implements the Portable Equipment Registration Program (PERP), which allows operators of portable equipment to register ICEs as an alternative to obtaining a local air district permit. Although most small ICEs are fueled by gasoline, natural gas, or propane, some are diesel-fueled. ICEs typically have long lifespans, meaning that older, more polluting ICEs are kept in service when cleaner technologies are available.

The 2022 AQMP includes an emissions inventory for stationary sources (point and area sources) for 2018, 2031, 2032, and 2037. Point sources are larger facilities subject to the South Coast AQMD's Annual Emissions Reporting requirements. The emissions inventory for C-CMB-04 (Small Internal Combustion Engines) in the above control measure summary is based on the NOx emissions for ICEs from area sources. The area source category is more representative of small ICEs. A review of the small ICE emissions inventory will be conducted in conjunction with the implementation of this control measure and control measure L-CMB-04 (Emergency Standby Engines).

Alternative Technologies

Zero Emission Equipment

Improvements in battery technologies have resulted in improved equipment performance at reduced costs. For example, according to a 2019 California State University at Fullerton (CSUF) survey of California households, over half of lawn and garden equipment is currently zero emission. Based on historical trends identified in CARB's emission inventory modeling, the use of zero emission equipment at commercial facilities is increasing but at a much lower rate when compared to households. Battery energy storage systems (BESS) are available for applications where a small auxiliary generator is needed. Still, challenges include a higher purchase price when compared to traditional ICE generators and the ability to recharge during a power outage. Increased BESS capital costs can be partially offset through reduced maintenance costs and by charging the BESS when energy costs are low and then using the equipment as a supplemental power source for certain devices when power is most expensive. Solar panels can also be used to charge the BESS during extended power outages.

Fuel Cells

Fuel cells produce electricity by converting the chemical energy in fuel—often natural gas or hydrogen—without the presence of combustion, resulting in very low or zero emissions. Electricity is produced more efficiently with fuel cells (between 45–50 percent efficiency) than single-cycle combustion-based engines (up to 35 percent efficiency). Fuel cell technology continues to advance, and prices have come down, but fuel cells are still more expensive than ICEs. Small fuel cell generators are currently available but similar to an ICE, would require sufficient fuel to keep the equipment running for the duration of a power outage. Using fuel cells as an alternative to traditional ICEs reduces NOx emissions with a co-benefit of reducing other criteria air pollutants, toxics, and greenhouse gases.

Regulatory History

As mentioned, ICEs rated 50 bhp or less are not subject to South Coast AQMD regulations. The following is a summary of Federal and State regulations for small ICEs.

Federal Regulations

Title 40 Code of Federal Regulations, Chapter I, Subchapter C, Part 60 establishes Standards of Performance for New Stationary Sources. Subpart IIII of Part 60 became effective in July 2006 and applies to stationary compression ignition (CI) engines, also known as diesel engines. Subpart JJJJ of Part 60 became effective in March 2008 and applies to stationary spark ignition (SI) engines which generally include engines fueled by gasoline, propane, natural gas, or any other engine with a spark plug (or other sparking devices). Title 40 of the Code of Federal Regulations, Chapter I, Subchapter U includes requirements for new nonroad engines. Specifically, Part 1039 includes requirements for nonroad CI engines, Part 1048 applies to new large (>25 hp) SI engines, and Part 1054 applies to new small (≤25 hp) handheld and non-handheld SI engines. Federal regulations for small engines generally require manufacturers to certify that the engine meets the applicable emission standards. Federal regulations also include exemptions for specific engines.

State Regulations

Federal law preempts states from regulating new engines used in construction and farm equipment under 175 horsepower. CARB, however, has adopted emissions standards for small off-road engines (SORE) that are defined as spark-ignition engines with rated power at or below 19 kilowatts (25 horsepower). The CARB SORE regulations are more stringent than federal emission standards and require new engines to be certified and labeled to meet applicable emission standards. Typical equipment types that apply to CARB SORE requirements include lawn and garden equipment, portable generators, and pressure washers. The CARB SORE program is not applicable to specific engines, such as those used in air compressors and light towers. Also, police and fire departments and other entities specializing in emergency response may purchase emergency equipment powered by a non-California certified engine if such equipment with a California certified engine is unavailable.

California Executive Order N-79-20 issued in September 2020 establishes broad goals to transition the State to zero emission technologies, especially for trucks and equipment. Section 2 of the Executive Order directs CARB to work with other State agencies, the U.S. EPA, and local air districts such as the South Coast AQMD to develop and propose strategies to achieve 100 percent zero emission from off-road vehicles and equipment operations by 2035 where feasible. In December 2021, as part of Executive Order N-79-20 implementation, more stringent SORE requirements were adopted to be implemented in two phases. Under the first phase, beginning with model year (MY) 2024, emission standards will be zero for SORE equipment produced for sale in California, except generators and large pressure washers. Emission standards for generators and large pressure washers will be more stringent than existing standards starting in MY 2024. The second phase will be implemented starting in MY 2028 when the emission standards for generators and large pressure washers will be zero. Under the regulations, existing CARB-compliant gasoline-powered equipment can continue to be used.

Proposed Method of Control

Because small ICEs are not subject to South Coast AQMD regulations, this control measure is intended to develop education and outreach and financial incentive programs to encourage consumers to purchase zero emission technologies.

Education and Outreach

Purchases of ICE generators for residential uses have been increasing. For example, a manufacturer recently indicated sales of home standby generators had doubled for the first quarter of 2021, compared with the first quarter sales in 2020.[32] According to the 2019 CSUF study prepared for CARB, approximately

[32] Roth, Michael. "Booming Residential Generator Sales Propel Generac Revenue 70 Percent in First Quarter." Rental Equipment Register, May 2021. Retrieved July 14, 2021, from https://www.rermag.com/power-

40 percent of surveyed households had outdoor power equipment, including compressors, generators, pressure washers, and pumps that use ICEs. When selecting equipment, many customers may be unaware of alternatives to ICEs. Staff believes that making educational materials readily available to customers would result in an increased use of zero emission technologies. In addition to describing the emission reduction benefits, the education materials would describe other advantages of zero emission technologies. For example, it is acknowledged that zero emission technologies may have higher upfront costs when compared to traditional equipment; however, lower operating costs from reduced maintenance can result in a lower cost of ownership over the life of the equipment. The education materials would also include information on incentives available for consumers to purchase zero emission equipment. Staff would work with vendors to develop a strategy to broaden the outreach to as many customers as possible.

Financial Incentives

Incentive programs provide partial funding to consumers to offset the opening price point of new technologies, which are typically higher than ICE equipment. As an example, the South Coast AQMD and other air districts have sponsored "trade-in events" where a consumer can trade in an old gasoline lawn mower and receive a voucher for a specific dollar amount that can be used to purchase a new electric lawnmower. These vouchers are often combined with an additional manufacturer rebate, which can significantly discount the price of new electric equipment. These trade-in events have been popular and successful with high participation from residents and could be extended to other ICE equipment types. Public awareness of future regulatory actions may also increase participation in incentive programs. The above-described education and outreach programs combined with incentives can be a valuable public relations tool to make consumers more aware of cleaner alternatives to ICEs.

Incentives Implementation

Integrity Elements

Emission reductions that are projected to be achieved from voluntary incentive measures must be demonstrated to be quantifiable, surplus, enforceable, and permanent as defined by the U.S. EPA. This demonstration must include project type(s); project life; applicable incentive program guideline(s), by title, year, chapter(s); and analysis of applicable incentive program guideline(s) for consistency with integrity elements. The following describes the key elements of such a demonstration:

- Quantifiable: Emission reductions are quantitatively measurable, supported by existing and acceptable technical data. The quantification should use well-established, publicly available, and approved emission factors and accepted calculation methodology. There must be procedures to evaluate and verify over time the level of emission reductions actually achieved.
- Surplus: Emission reductions must be above and beyond any South Coast AQMD, State, or federal regulation already included in the State Implementation Plan (SIP). Emission reductions used to meet air quality attainment requirements are surplus as long as they are not otherwise relied on in the SIP, SIP-related requirements, and other State air quality programs adopted but not in the SIP, a consent

generation/article/21163426/generac-mobile-booming-residential-generator-sales-propel-generac-revenue-70-percent-in-first-quarter.

decree, or federal rules that focus on reducing criteria pollutants or their precursors. In the event that an incentive program's emission reductions are already relied on to meet air quality-related program requirements, they are no longer surplus. In addition, the emission reductions are available only for the remaining useful life of the equipment being replaced (e.g., if the equipment being replaced has a remaining useful life of five years, the additional emission reductions from the new equipment are available for SIP purposes for only five years).

- Enforceable: The South Coast AQMD will be responsible for assuring that the emission reductions credited in the SIP will occur. Emission reductions and other required actions are enforceable if:
    - They are independently verifiable;
    - Program violations are defined;
    - Those liable for emission reductions can be identified;
    - The South Coast AQMD, CARB and the U.S. EPA maintain the ability to apply penalties and secure appropriate corrective action where applicable;
    - The general public has access to all the emissions-related information obtained from the source;
    - The general public can file suits against sources for violations (with the exception of those owned and operated by Tribes); and
    - They are practically enforceable in accordance with other U.S. EPA guidance on practicable enforceability.

  Actual emission reductions, for example, can be assured through replacement or retrofit equipment registration, recordkeeping and reporting, and inspections (initial after installation and subsequent on a regular basis thereafter, if needed) throughout the term. Specific enforcement mechanisms will need to be addressed in the guidelines for the individual incentive programs.

- Permanent: The emission reductions need to be permanent throughout the term for which the credit is generated. The emission reductions are permanent if these reductions are ensured to occur over the duration of the incentive program, and for as long as they are relied on in the SIP. For example, those awarded incentives will need to ensure the projects are properly implemented and the reductions are occurring and will continue to occur. Thus, recipients of the incentive awards will agree to contract provisions, such as recordkeeping and reporting to track reductions and agreements that newly installed equipment will not be removed without concurrence with the South Coast AQMD (i.e., permanent placement) andthe proof that the replaced equipment will be destroyed or at least not be operated any more in the Basin (e.g., pictures, certification). Detailed procedures to ensure permanent reductions will be described in the guidelines for the individual incentive programs.

Guidelines

The incentive program needs to develop detailed and comprehensive guidelines that are approved by the South Coast AQMD Governing Board. The guidelines will be the protocol to implement the program, to ensure SIP applicability, and to maintain SIP approvability. Based on the U.S. EPA guidance and other South Coast AQMD incentive programs the guidelines would include:

☑ A demonstration of compliance with the four key elements of the incentive program: quantifiable emissionsplus incentive costs, surplus reductions, enforceable compliance and permanent reductions.

- ☑ Working groups will be established to solicit public input and feedback during the incentive program guideline development.
- ☑ Processes and procedures for applicants to apply for incentives.
- ☑ A description of how incentives will be awarded. Public working groups or workshops will take place todiscuss the guidelines and incentives. Facilities qualifying for incentives shall submit applications duringan open enrollment period. Projects shall be evaluated on criteria, including but not limited to, emission reductions, incentive effectiveness, age of equipment, remaining useful life of existing equipment, Environmental Justice area priority, local business, and small business status.
- ☑ Conditions for contracts including tracking to ensure permanent reductions. The following forms will be prepared:
  - ☑ Application Forms (samples are required).
  - ☑ Contracts with Conditions (samples are required).
  - ☑ Product Example.
- ☑ Tracking mechanisms to ensure overall effectiveness of program and procedures to verify and correct emission projections, such as reductions by the committed target date (e.g., 2031, 2037) and submittal to the U.S. EPA annually. Tracking checklist will at a minimum include:
  - ☑ Project Title.
  - ☑ Product (e.g. equipment type, size, fuel use, hours operated, emissions, source test reports).
  - ☑ Annual Emission Reductions (e.g., from 2030 to 2050, incremented by one year).
  - ☑ Life of project (e.g., 10 years).
  - ☑ Installation dates (e.g., fixed year 2030 or multiple installation years 2030 and 2031).
- ☑ Recordkeeping, reporting, and monitoring requirements.

Working groups would be established to solicit public input and feedback during the development of the incentive program guidelines. Individual outreach efforts (e.g., social media, email blasts) would also occur to promote the incentive program including announcement of application deadlines and workshops. The program guidelines and supporting information would also be placed on the South Coast AQMD web site.

Emission Reductions

Improved technologies and the resulting price reductions are anticipated to ease the transition from ICEs to zero emission alternatives. For this control measure, it is presumed that 50 percent of the ICEs in this category will transition to zero emission technology by 2037. It is further presumed that 30 percent of the engines will be replaced with low~~-~~ emission technology. Overall, these ~~control measure~~ control strategies are estimated to reduce 2037 NOx emissions by approximately 65 percent. Future incentive programs will include updates to the emissions inventory and an estimate of the incentive program's cost-effectiveness.

Rule Compliance and Test Methods

Manufacturers are responsible for demonstrating compliance with equipment emission standards.

Cost Effectiveness

Costs of implementing C-CMB-04 will be high based on the estimated large number of small ICEs in use. Alternative technologies are emerging, but staff anticipates that equipment costs will become more competitive in future years and that consumer acceptance will increase. Based on the best available information, the ~~Discounted Cash Flow (DCF)~~ cost effectiveness, determined using the Discounted Cash Flow (DCF) method, is estimated to be $446,100 per ton of NOx reduced; the ~~Modified Levelized Cash Flow (MLCF)~~ cost effectiveness, determined using the Modified Levelized Cash Flow (MLCF) method is estimated to be $744,000 per ton of NOx reduced. ~~The~~ A refined cost effectiveness assessment will be conducted as part of future programs to secure incentive funding. ~~Cost-effectiveness for the proposed control methods will be estimated as part of future programs to secure incentive funding.~~

Implementing Agency

The control measure does not include proposed regulations. ~~The~~ South Coast AQMD has experience in implementing educational outreach and incentive programs to reduce air pollutant emissions.

References

California Air Resources Air Board. *Fact Sheet: Small Off-Road Engines in California*. Retrieved December 7, 2021 from https://ww2.arb.ca.gov/sites/default/files/2021-10/2021%20SORE%20Fact%20Sheet_0.pdf.

California Air Resources Board (2021, March 24). *Small Off-Road Engines: 2021 Pre-Rulemaking Workshop* [PowerPoint slides]. https://ww2.arb.ca.gov/sites/default/files/2021-03/3.24.21%20Workshop%20Staff%20Presentation.pdf.

California State University at Fullerton, Social Science Research Center. (2019, May 15). *Survey of Small Off-Road Engines (SORE) Operating within California: Results from Surveys with Four Statewide Populations*. https://ww3.arb.ca.gov/msprog/offroad/sore/AbstractExecutiveSummary.pdf.

South Coast Air Quality Management District. (2017). 2016 Air Quality Management Plan, Appendix IV-A Stationary and Mobile Source Control Measures. (Published March 2017).

C-CMB-05: NOx REDUCTIONS FROM SMALL MISCELLANEOUS COMMERCIAL COMBUSTION EQUIPMENT (NON-PERMITTED) [NOx]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	SMALL MISCELLANEOUS COMBUSTION EQUIPMENT			
CONTROL METHODS:	ULTRA-LOW NO_X BURNERS, ELECTRIFICATION			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
NOx INVENTORY	~~5.82~~7.09	~~5.80~~6.78	~~5.79~~6.78	~~5.81~~6.79
NOx REDUCTION				~~4.24~~4.96
NOx REMAINING				~~1.57~~1.83
SUMMER PLANNING	2018	2031	2032	2037
NOx INVENTORY	~~5.06~~7.37	~~5.05~~7.04	~~5.05~~7.04	~~5.10~~7.05
NOx REDUCTION				~~3.72~~5.14
NOx REMAINING				~~1.38~~1.90
CONTROL COST:	DCF METHOD: $~~196~~110,000 PER TON OF NOx REDUCED MODIFIED LCF METHOD: $176,100 PER TON OF NOx REDUCED			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

Description of Source Category

Control measure C-CMB-05 seeks emission reductions of NOx by replacement with zero emission and low NOx emission technologies on miscellaneous unpermitted commercial combustion equipment. This equipment is less than 2 million Btu/hour and therefore does not require~~thus not requiring~~ a South Coast AQMD permit for most instances. Such equipment includes ovens, furnaces, dryers, and other fuel combustion equipment too small to require a permit. On an individual basis the emissions are relatively low. However, the large number of such devices accumulate to substantial NOx emissions.

Background

The South Coast AQMD has adopted a series of rules to promote clean, lower emission technologies, while encouraging economic growth and providing compliance flexibility. For existing sources, replacing older higher-emitting equipment with zero emitting equipment can apply to a single source or an entire facility. The manufacturing and deployment of zero and low NOx emission technologies will help reduce criteria pollutant emissions in the region, accelerate removal of higher-emitting equipment that can otherwise last for many decades, and advance economic development and job opportunities in the region.

Regulatory History

Small combustion and heat transfer equipment with a rated maximum heat input capacity of 2 million Btu/hour or less are exempt from permitting. Additionally, Rule 1147 – NOx Reductions from Miscellaneous Sources only applies to equipment that has a South Coast AQMD permit.

Proposed Method of Control

Zero emission technologies, including electrification will be utilized where and when technically feasible and cost-effective. This control measure will achieve reductions through point-of-sale regulations, incentives, and reassessment of permit and source specific exemption thresholds. Regulations such as Rule 219, Rule 1147, and other source specific rules can be amended to include smaller devices limiting NOx emissions through the use of low NOx burner systems. Low NOx burner (LNB) systems are combustion control technologies utilized to lower NOx emissions. A variety of factors impact the NOx emissions with LNB, such as burner orientation and arrangement, firebox size, heater type (force or natural draft), and fuel type.

Point-of-sale regulations can be established to require manufacturers of miscellaneous combustion equipment to modify the design to reduce NOx. When equipment was naturally replaced, emissions from the source category would be reduced over time. Incentives could be provided to accelerate the transition to reduced NOx equipment or to equipment that are powered electrically. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Emission Reductions

Replacing turbines with zero emission technologies is estimated to result in approximately ~~4.24~~4.96 tons per day of NOx reduced.

Rule Compliance and Test Methods

Source test methods vary depending on the type of source and quality of emissions (e.g., criteria pollutant and toxic emissions). Source test methods may include, but are not limited to, South Coast AQMD Methods 7.1, 10.1, 100.1, or other South Coast AQMD-approved test methods.

Cost Effectiveness

The overall average cost-effectiveness for this control measure is ~~$196,000~~$110,000 per ton of NOx reduced.

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from stationary sources.

References

South Coast AQMD, 2017. Rule 1147 – NOx Reductions from Miscellaneous Equipment

South Coast AQMD, 2018. Rule 219 – Equipment Not Requiring a Written Permit Pursuant to Regulation II

L-CMB-01: NOx REDUCTIONS FOR RECLAIM FACILITIES [NOx]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	VARIOUS RECLAIM NOX SOURCES INCLUDING METAL MELTING AND HEATING FURNACES, FOOD OVENS, AND NITRIC ACID TANKS			
CONTROL METHODS:	LOW NOX EMISSION TECHNOLOGIES AND OTHER TECHNOLOGIES			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
NOX INVENTORY	~~0.76~~0.65	~~0.55~~0.62	~~0.55~~0.62	~~0.55~~0.61
NOX REDUCTION	-	-	-	~~0.28~~0.28
NOX REMAINING	-	-	-	~~0.27~~0.34
SUMMER PLANNING (IF NOX/VOC)	2018	2031	2032	2037
NOX INVENTORY	~~0.83~~0.70	~~0.60~~0.70	~~0.61~~0.70	0.69~~0.60~~
NOX REDUCTION	-	-	-	0.31~~0.28~~
NOX REMAINING	-	-	-	0.38~~0.32~~
CONTROL COST:	DCF METHOD: $~~11,900~~9,500 PER TON OF NOX REDUCED MODIFIED LCF METHOD: $19,000 PER TON OF NOX REDUCED			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

Description of Source Category

There were 246 facilities in the REgional CLean Air Incentives Market (RECLAIM) program as of the end of compliance year 2019. The RECLAIM program includes facilities with NOx or SOx emissions greater than or equal to 4 tons per year in 1990 or any subsequent year. A wide range of equipment such as fluid catalytic cracking units, boilers, heaters, furnaces, ovens, kilns, coke calciners, internal combustion engines, and turbines are major sources of NOx or SOx emissions at RECLAIM facilities. The South Coast AQMD Governing Board modified the 2016 Final AQMP Resolution to direct staff to modify control measure CMB-05 – Further NOx Reductions from RECLAIM Assessment (CMB-05) to achieve the five (5) tons per day NOx emission reduction commitment as soon as feasible, and no later than 2025, and to transition the RECLAIM program to a command-and-control regulatory structure requiring Best Available Control Retrofit Technology (BARCT) level controls as soon as practicable.

This control measure targets emission reductions from the remaining source categories[33] that require RECLAIM landing rules to be amended or adopted as part of the transition to a command-and-control regulatory structure. Metal melting and heating furnaces, food ovens, and nitric acid tanks are the source categories for this control measure.

Background

On October 15, 1993, the South Coast AQMD Governing Board adopted Regulation XX – RECLAIM. Regulation XX includes rules that specify the applicability and procedures for determining NOx and SOx facility emissions allocations, program requirements, as well as monitoring, reporting, and recordkeeping requirements for sources located at RECLAIM facilities. RECLAIM was designed to provide BARCT equivalent emission reductions in the aggregate for the facilities in the program, with flexibility for each facility to find the most cost-effective approach. At the beginning of this program, facilities were issued NOx and SOx allocations, also known as RECLAIM Trading Credits (RTCs) or facility emission caps, which declined over time. To meet the declining annual facility caps, RECLAIM facilities have the option of installing pollution control equipment, changing operations, or purchasing RTCs from other facilities on the RECLAIM market. The program requires robust monitoring to ensure compliance.

The RECLAIM program is subject to several legal mandates. The Health and Safety Code requires the South Coast AQMD to monitor the advancement in BARCT, and if BARCT advances, the South Coast AQMD is required to periodically re-assess the overall facility caps, and to reduce the RTC holdings to a level equivalent to command-and-control BARCT levels. The emission reductions resulting from the programmatic RTC reductions will help the basin attain the National Ambient Air Quality Standards (NAAQS) for ozone as expeditiously as practicable. The periodic BARCT evaluations must include an evaluation of the maximum degree of reduction achievable with advanced control technologies taking into account the environmental, energy, and economic impacts for each class or category of source.

The 2019 audited NOx emissions were approximately 18 tons per day from RECLAIM facilities. The RTC holdings for the NOx RECLAIM universe in 2019 were approximately 22.6 tons per day.

Regulatory History

On October 15, 1993 when the South Coast AQMD Governing Board adopted Regulation XX – RECLAIM, the RECLAIM program included 392 NOx facilities. Regulation XX includes 15 rules that specify the applicability, definitions, allocations, trading and operational requirements, as well as monitoring, reporting, and recordkeeping requirements. Regulation XX has been revised several times, and two significant amendments to the NOx RECLAIM program (2005 and 2015) reflected a BARCT re-assessment. SOx RECLAIM allocations were re-assessed in 2010 based on BARCT. The January 2005 amendment resulted in a NOx RTC reduction target of 7.7 tons per day (tpd), approximately a 22.5 percent reduction

[33] NOx emission reductions from miscellaneous equipment subject to Rule 1147– NOx Reductions from Miscellaneous Sources are addressed in control measure L-CMB-10 – NOx Reductions from Miscellaneous Permitted Equipment.

of the RTC holdings, which was implemented in five phases: 4 tons per day by 2007 and an additional 0.925 tons per day in each of the following four years.

The December 2015 NOx amendments included a total RTC reduction of 12 tons per day, including a Regional RTC Holding account for electricity generating facilities (EGFs) to meet their NSR holding obligations. The intent of the December 2015 amendments was to ensure the RECLAIM program would maintain programmatic equivalency with BARCT-based command and control regulations as required by State law. The amendments also contained an optional off-ramp from RECLAIM for EGFs at BACT or BARCT. A Governing Board adopted resolution directed staff to further examine the issue of equipment shutdowns at RECLAIM facilities and the fate of the associated RTCs. This led to amendments in October 2016 that significantly reduced NOx RTC holdings upon facility shutdowns.

The adopted Resolution of the Final 2016 AQMP directed staff to achieve additional NOx emission reductions and to transition the RECLAIM program to a command-and-control regulatory structure as soon as practicable. On January 5, 2018, Rules 2001 and 2002 were amended to commence the initial steps of the RECLAIM transition. Rule 2001 was amended to cease any future inclusions of facilities into NOx and SOx RECLAIM. Rule 2002 was amended to establish notification procedures for RECLAIM facilities that will exit the program and address the RTC holdings for these facilities. On October 5, 2018, Rule 2001 was amended to require NOx RECLAIM facilities to comply with all NOx provisions in rules contained in Table 1 that are adopted or amended on or after October 5, 2018.

The Governing Board adopted or amended ten (10) landing rules to reduce NOx emissions and transition NOx RECLAIM facilities to a command-and-control regulatory structure.

- Rule 1109.1 – Emissions of Oxides of Nitrogen from Petroleum Refineries and Related Operations (Adopted November 5, 2021)
- Rule 1110.2 – Emissions from Gaseous- and Liquid-Fueled Engines (Amended November 1, 2019)
- Rule 1117 – Emissions of Oxides of Nitrogen from Glass Melting Furnaces (Amended June 5, 2020)
- Rule 1118.1 – Control of Emissions from Non-Refinery Flares (Adopted January 4, 2019)
- Rule 1134 – Emissions of Oxides of Nitrogen from Stationary Gas Turbines (Amended April 5, 2019)
- Rule 1135 – Emissions of Oxides of Nitrogen from Electricity Generating Facilities (Amended November 2, 2018)
- Rule 1146 – Emissions of Oxides of Nitrogen from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters (Amended December 7, 2018)
- Rule 1146.1 – Emissions of Oxides of Nitrogen from Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters (Amended December 7, 2018)
- Rule 1146.2 – Emissions of Oxides of Nitrogen from Large Water Heaters and Small Boilers and Process Heaters (Amended December 7, 2018)
- Rule 1147.1 – NOx Reductions from Aggregate Dryers (Adopted August 6, 2021)

Proposed Method of Control

Staff initiated rule development of additional RECLAIM landing rules to reduce NOx emissions and transition NOx RECLAIM facilities to a command-and-control regulatory structure requiring BARCT level controls. The proposed landing rules that address the source categories for this control measure are Proposed Rule 1147.2 – NOx Reductions from Metal Melting and Heating Furnaces (PR 1147.2), Proposed Amended Rule 1153.1 – Emissions of Oxides of Nitrogen from Commercial Food Ovens (PAR 1153.1), and Proposed Rule 1159.1 – Control of NOx Emissions from Nitric Acid Tanks (PR 1159.1). PR 1147.2, PAR 1153.1, and PR 1159.1 are scheduled to be considered for adoption at Public Hearings in 2022.

Staff is proposing a variety of different NOx control technologies depending on the type of NOx source. Metal melting and heating furnaces are expected to require selective catalytic reduction (SCR) or ultra-low NOx burners (ULNBs) to achieve the proposed NOx emission limits in PR 1147.2. Similarly, food ovens subject to PAR 1153.1 are expected to require ULNBs to achieve the proposed NOx emission limits. NOx emissions from nitric acid tanks are a result of chemical processes and will likely require different control equipment than combustion equipment such as furnaces and ovens. Staff is evaluating scrubbers as a proposed method of control for nitric acid tanks subject to PR 1159.1. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Emission Reductions

Approximately 12.37 tons per day of NOx has been reduced from RECLAIM facilities from the adoption or amendment of command-and-control rules which addresses the emission reduction commitment in CMB-05 included in the 2016 AQMP.[34] The adoption of Proposed Rules 1147.2 and 1159.1 and amendment of PAR 1153.1 are expected to result in approximately 0.28 tons per day NOx reductions by 2037 for this control measure.

[34] Some NOx emission reductions may be attributed to the 2015 RECLAIM shave.

TABLE L-CMB-01-A

Estimated Landing Rule NOx Emission Reductions from RECLAIM Facilities[35]

Rule Number(s)	NOx Emission Reductions (Tons per Day)
1109.1	7.7
1110.2	0.29
1117	0.57
1118.1	0
1134	1.8
1135	1.7
1146, 1146.1, 1146.2	0.27
1147	0.54
1147.1	0.04
1147.2, 1153.1, 1159.1	0.28
Total:	**13.19**

Rule Compliance and Test Methods

Compliance with the provisions of this control measure would be based on monitoring, recordkeeping, and reporting requirements that have been established in either the RECLAIM program or existing source specific rules and regulations. Compliance would be verified through inspections and other recordkeeping and reporting requirements.

Cost Effectiveness

The overall average cost-effectiveness for this control measure is ~~$11,900~~$9,500 per ton of NOx reduced.

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from RECLAIM facilities.

References

South Coast AQMD, 2015. Final Staff Report on Proposed Amendments to Regulation XX – NOx RECLAIM, December 4, 2015.

South Coast AQMD, 2018. Final Staff Report on Proposed Amendments to Regulation XX – NOx RECLAIM, January 5, 2018.

[35] Rules 1147, 1147.2, 1153.1, and 1153.1 have not yet had Public Hearings for adoption or amendment.

South Coast AQMD, 2018. Final Staff Report on Proposed Amendments to Regulation XX – NOx RECLAIM, October 5, 2018.

Item 30, Proposed Amendments to NOx RECLAIM Program (Regulation XX), proposed motion by Supervisor Nelson, December 4, 2015.

South Coast AQMD, 2021. Annual RECLAIM Audit Report for 2019 Compliance Year, March 5, 2021.

L-CMB-02: REDUCTIONS FROM BOILERS AND PROCESS HEATERS (PERMITTED) [NOx]

CONTROL MEASURE SUMMARY

SOURCE CATEGORY:	COMBUSTION SOURCES SUCH AS BOILERS AND PROCESS HEATERS USED IN INDUSTRIAL, INSTITUTIONAL, AND COMMERCIAL OPERATIONS			
CONTROL METHODS:	ZERO EMISSION AND LOW NOX EMISSION TECHNOLOGIES AND FINANCIAL INCENTIVE PROGRAMS			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
NOX INVENTORY	~~1.8~~2.05	~~2.0~~2.20	~~2.0~~2.21	~~1.9~~2.13
NOX REDUCTION	0	0	0	~~0.5~~0.44
NOX REMAINING	~~1.8~~2.05	~~2.0~~2.20	~~2.0~~2.21	~~1.4~~1.69
SUMMER PLANNING	2018	2031	2032	2037
NOX INVENTORY	~~1.9~~2.28	~~2.1~~2.44	~~2.1~~2.45	2.36~~2.0~~
NOX REDUCTION	0	0	0	0.48~~0.5~~
NOX REMAINING	~~1.9~~2.28	~~2.1~~2.44	~~2.1~~2.45	1.88~~1.5~~
CONTROL COST:	DCF METHOD: $~~19,000 TO $88,000~~865,400 PER TON OF NOX REDUCED MODIFIED LCF METHOD: $2,078,800 PER TON OF NOX REDUCED			
INCENTIVE COST:	TBD			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

Description of Source Category

Control measure L-CMB-02 seeks emission reductions of NOx by replacement or retrofit with zero emission and low NOx emission technologies of boilers and process heaters with a rated heat input greater than or equal to 2 million BTU per hour which combust fuel to generate heat and are used in industrial, institutional, and commercial operations. Boilers are used to produce steam or heat water. Process heaters are used to transfer heat from the combustion gases to water or process streams. Boilers and process heaters used in industrial, institutional, and commercial operations with a rated heat input greater than or equal to 2 million BTU per hour are currently regulated under Rules 1146 and 1146.1.

L-CMB-02 sources were previously included under the 2016 AQMP control measure CMB-01: Transition to Zero and Near-Zero Emission Technologies for Stationary Sources with a control strategy focused on incentives to replace existing units with new zero or low NOx emission units. The South Coast AQMD Governing Board modified the 2016 Final AQMP Resolution to direct staff to transition the RECLAIM program to a command-and-control regulatory structure requiring BARCT level controls as soon as practicable. Future reductions of NOx emissions in 2037 from all boilers and process heaters with a rated heat input greater than or equal to 2 million BTU per hour, including those at RECLAIM and former RECLAIM facilities, are the intended for this control measure.

Background

The South Coast AQMD has adopted a series of regulations to promote clean, lower emission technologies while encouraging economic growth and providing compliance flexibility. In addition, the South Coast AQMD implements incentive programs to help promote efficient, clean equipment purchases, efficiency projects, and conservation techniques that provide toxic and criteria pollutant emissions benefits, as well as greenhouse gas (GHG) emission reductions. The manufacturing and deployment of zero emission and low NOx emission technologies will help reduce criteria pollutant emissions in the region, accelerate removal of higher-emitting equipment that can otherwise last for many decades, and advance economic development and job opportunities in the region. In addition, this equipment is often located in or near environmental justice (EJ) communities and sensitive receptors.

Over the anticipated timeline of the Plan, as emerging technologies become more widely available and costs decline, the South Coast AQMD will undertake rulemaking to maximize emission reductions utilizing zero emission equipment where technically feasible and cost-effective, and low NOx emission technologies in all other applications.

Regulatory History

Control measure L-CMB-02 can lead to changes in the following existing regulations:

- Rule 1146 – Emissions of Oxides of Nitrogen from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters
- Rule 1146.1 – Emissions of Oxides of Nitrogen from Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters

Rule 1146 was adopted September 1988 and establishes NOx limits for boilers, steam generators, and process heaters greater than or equal to 5 million BTU per hour. Rule 1146.1 was adopted October 1990 and establishes NOx limits for boilers, steam generators and process heaters greater than 2 million BTU per hour and less than 5 million BTU per hour that are used in any industrial, institutional, or commercial operation. The NOx limits for Rule 1146 and Rule 1146.1 are based on the size of a unit, type of unit, and/or type of fuel used. For example, Rule 1146 has specific NOx limits for atmospheric units, thermal fluid heaters, and for boilers based on the rated heat input capacity specified for the following three groups categories:

- Group I units include any unit burning natural gas, excluding digester and landfill gases, with a rated heat input greater than or equal to 75 million BTU per hour, excluding thermal fluid heaters.
- Group II units include any unit burning gaseous fuels, excluding digester and landfill gases, with a rated heat input less than 75 million BTU per hour down to and including 20 million BTU per hour, excluding thermal fluid heaters.
- Group III units include any unit burning gaseous fuels, excluding digester and landfill gases, and thermal fluid heaters with a rated heat input less than 20 million BTU per hour down to and including 5 million BTU per hour, and all units operated at schools and universities greater than or equal to 5 million BTU per hour.

Commercial water heating units at or less than 2 million BTU per hour subject to Rule 1146.2 – Emissions of Oxides of Nitrogen from Large Water Heaters and Small Boilers and Process Heaters are covered in control measure C-CMB-01 – NOx Reductions from Commercial Water Heating.

In December 2018, Rule 1146 and Rule 1146.1 were amended to facilitate the transition of the NOx RECLAIM program to a command-and-control regulatory structure and established new BARCT NOx limits. The December 2018 amendments for Rules 1146 and 1146.1 lowered the NOx concentration limits from 9 ppmv to either 5 or 7 ppmv depending on the unit size and current NOx concentration limit. The NOx concentration limit was also lowered for thermal fluid heaters from 30 to 12 ppmv. The NOx concentration limit for Group I units, which are greater than or equal to 75 MMBtu per hour remained at 5 ppmv. Rule 1100 – Implementation Schedule for NOx Facilities established the compliance schedule for the revised BARCT NOx limits. RECLAIM facilities with Rule 1146 and/or Rule 1146.1 units had until January 1, 2022 to retrofit all existing units and until January 1, 2023 to replace any existing units, if they elected to replace their equipment instead. Any RECLAIM or non-RECLAIM equipment near the final emission limits is required to meet the lower NOx emission limit within 15 years after rule amendment or during burner replacement, whichever is earlier.

Proposed Method of Control

L-CMB-02 is designed to maximize emission reductions utilizing zero emission technologies where and when technically feasible and cost-effective, and low NOx emission technologies in all other applications. This control measure will achieve the committed NOx emission reductions through a combination of regulations and incentives. Regulations will set standards for new equipment, replacement, or retrofits with zero emission and low NOx emission technologies of boilers and process heaters. Incentives will help develop and reduce costs for technologies that currently may not be cost-effective but could become more attractive with lower costs or with a different energy portfolio, as well as and accelerate the change out of existing equipment before regulatory compliance deadlines. For emerging technologies, regulatory requirements can become feasible in the future. As regulations are amended to include new or more stringent standards, certain zero emission or low NOx technologies may not yet be cost-effective to be included as part of the regulatory requirements. Thus, incentives will encourage and/or play a significant role in making it cost-effective for facilities or equipment owners to replace existing equipment earlier with the cleanest technology available. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Zero Emission Technologies

The strategy for L-CMB-02 is to focus on technologies and implementation approaches that can be deployed by 2037. Currently, zero emission technologies are limited to specific operations and are not feasible or cost-effective for all combustion sources. Large scale implementation of zero emission technologies is also limited by the higher operating cost to operate large units on electricity versus combustion fuel. Additionally, the emissions from generating the electricity to operate a large unit can be comparably higher than the emissions from the unit operating at a stringent NOx emission limit when combusting fuel.

L-CMB-02 is designed as a combination of regulations and incentives to help deploy zero emission technologies for a greater number of stationary sources. The strategy for this control measure is to conduct future technology assessments in hopes that technological advances will help to overcome the current limitations.

Low NOx ~~Near-Zero~~ Emission Technologies

Burner Systems

Fuel combustion results in NOx emissions via three possible formation mechanisms: thermal NOx, fuel NOx, and prompt NOx. Thermal NOx is formed at high combustion temperatures from the reaction of molecular nitrogen and oxygen in the combustion air. The formation of thermal NOx is controlled by reducing the flame temperature, shortening the residence time, and increasing the fuel to air ratio. For gaseous fuels, thermal NOx is generally the largest contributor of NOx emissions. Fuel NOx is formed when the nitrogen that is chemically bonded to the fuel, such as in liquid and solid combustion fuels, reacts with oxygen in the combustion air. Formation of fuel NOx is not a concern for most gaseous fuels, such as natural gas or propane since they have little or no fuel bond nitrogen. Fuel NOx formation is a concern for sources burning distillates or residual oils with chemically bounded nitrogen. When thermal NOx and fuel NOx are suppressed, formation of prompt NOx occurs through the reaction of molecular nitrogen, oxygen, and hydrocarbon radicals. Prompt NOx is the primary NOx formation mechanism at lower combustion temperatures. Combustion control techniques are designed to reduce the formation of thermal NOx and/or fuel NOx to reduce NOx Emissions.

Burner technologies such as low NOx burner systems (LNB) or ultra-low NOx burner systems (ULNB) are combustion control technologies utilized to lower NOx emissions. A variety of factors impact the NOx emissions with LNB or ULNB, such as burner orientation and arrangement, firebox size, heater type (force or natural draft), and fuel type. Dependent on the burner configuration and operation, additional combustion controls are used to reduce NOx emissions, such as fuel and air premix, staged fuel, staged air, and flue gas recirculation.

Several commercially available burner control technologies can be utilized on existing and new boilers and process heaters that can meet NOx limit below 5 ppmv without the need to add post-combustion control equipment. These emerging burner control technologies will become more widely available at lower costs and be considered when setting new regulatory standards.

Selective Catalytic Reduction Systems

Post-combustion control techniques are used to reduce NOx emissions in the flue gas regardless of the NOx formation mechanism. Selective Catalytic Reduction (SCR) is a well-established and commonly utilized post-combustion control technology that is a commercially available to control NOx emissions from boilers and process heaters. NOx emissions are reduced with SCR by converting NOx in the flue gas into nitrogen and water with ammonia over a catalyst. Depending on the operating conditions, SCR can be utilized as a single stage control technology or combined with additional NOx controls, such as ULNB, for further reductions.

Emission Reductions

L-CMB-02 seeks an estimated 25 percent reduction from the 2037 NOx inventory. The feasibility of regulations and the number of available incentives will directly affect the level of emission reductions achieved. A combined regulatory and incentive-based approach to convert some existing stationary combustion sources to zero and low NOx emission technologies is estimated to result in ~~0.5~~0.48 tons per day of NOx in ~~emission~~ 2037. As new technologies become more established, the cost of the technology is expected to decrease, therefore providing more opportunities to transition to zero emission and low NOx technologies by 2037.

Rule Compliance and Test Methods

Source test methods vary depending on the type of source and quality of emissions (e.g., criteria pollutant and toxic emissions). Source test methods may include, but are not limited to, South Coast AQMD Methods 5.1, 25.1 25.3, 100.1, 207.1 or other South Coast AQMD-approved test methods.

Cost Effectiveness

The overall average cost-effectiveness for this control measure is ~~$19,000 to $88,000~~$865,400 per ton of NOx reduced.

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from stationary sources and will implement the transition of existing combustion sources into operating zero emission and low NOx emission technologies in cooperation with other local governments, agencies, businesses, technology manufacturers and distributors, and community groups, through incentive programs and potential regulations if required.

References

South Coast Air Quality Management District. (2020). Rule 1146 – Emissions of Oxides of Nitrogen from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters (Amended December 4, 2020).

South Coast Air Quality Management District. (2018). Rule 1146.1 – Emissions of Oxides of Nitrogen from Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters (Amended December 7, 2018).

San Joaquin Valley Unified Air Pollution Control District. (2020). Staff Report: Proposed Amendments to Rule 4306 (Boilers, Steam Generators, and Process Heaters – Phase 3) and Proposed Amendments to Rule 4320 (Advanced Emission Reduction Options for Boilers, Steam Generators, and Process Heaters Greater than 5.0 MMBtu/hr). San Joaquin Valley Unified Air Pollution Control District. November 2020.

South Coast Air Quality Management District. (2021). Staff Report: Proposed Amended Rule 1109.1 – Emissions of Oxides of Nitrogen from Petroleum Refineries and Related Operations and Proposed Rescinded Rule 1109 – Emissions of Oxides of Nitrogen from Boilers and Process Heaters in Petroleum Refineries. South Coast Air Quality Management District. November 2021.

South Coast Air Quality Management District. (2018). Staff Report: Proposed Amended Rule 1146 – Emissions of Oxides of Nitrogen from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters; Proposed Amended Rule 1146.1 – Emissions of Oxides of Nitrogen from Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters; Proposed Amended Rule 114.2 – Emissions of Oxides of Nitrogen from Large Water Heaters and Small Boilers and Process Heaters; and Proposed Rule 1100 – Implementation Schedule for NOx Facilities. South Coast Air Quality Management District. December 2018.

South Coast Air Quality Management District. (2017). Final 2016 Air Quality Management Plan. South Coast Air Quality Management District. March 2017.

L-CMB-03: NOx REDUCTIONS FROM PERMITTED NON-EMERGENCY INTERNAL COMBUSTION ENGINES [NOx]

	CONTROL MEASURE SUMMARY			
Source Category:	Non-Emergency Internal Combustion Engines rated Over 50 Brake Horse Power (BHP)			
Control Methods:	Zero Emission Technologies: Battery Cells and Electrification			
Emissions (Tons/Day):				
Annual Average	2018	2031	2032	2037
NOx Inventory	~~0.44~~0.48	~~0.86~~0.92	~~0.87~~0.92	~~0.91~~0.97
NOx Reduction				~~0.29~~0.31
NOx Remaining				~~0.62~~0.65
Summer Planning	2018	2031	2032	2037
NOx Inventory	~~0.48~~0.54	~~0.91~~0.98	~~0.92~~0.99	1.03~~0.97~~
NOx Reduction				0.34~~0.31~~
NOx Remaining				~~0.66~~0.70
Control Cost:	~~TBD~~DCF method: $321,500/ton of NOx reduced Modified LCF method: $606,700/ton of NOx reduced			
Incentive Cost:	TBD			
Implementing Agency:	South Coast AQMD			

Description of Source Category

This control measure targets emission reductions from permitted non-emergency internal combustion engines rated over 50 bhp.

Regulatory History

South Coast AQMD Rule 1110.2 – Emissions from Gaseous- and Liquid-Fueled Engines regulates NOx emissions from all stationary and portable engines that are rated greater than 50 bhp. Rule 1110.2 was adopted on August 3, 1990 by the South Coast Governing Board and has been amended eleven times since adoption. The last amendment occurred on November 1, 2019. The purpose of the November 2019 amendment was to to reduce NOx emissions and transition NOx RECLAIM facilities to a command-and-control regulatory structure ~~transition engines that were part of the Regional Clean Air Incentives Market (RECLAIM) program to a command-and-control regulatory structure~~.

As facilities transition out of the NOx RECLAIM program, a command-and-control rule that includes NOx emission standards and that reflect BARCT was needed for all equipment categories. The November 2019 amendment to Rule 1110.2 removed exemptions previously allowed under the NOx RECLAIM program for engines rated at greater than 50 bhp. As a comparison, for non-RECLAIM, non-emergency engines rated at greater than 50 bhp, Rule 1110.2 set NOx emissions to less than or equal to 11 ppmv, dry at 15 percent O2 with very limited exceptions.

Proposed Method of Control

~~The proposed method of control is to transition older and higher-emitting engines in the RECLAIM program to newer technology that can meet the NOx emission limits set forth in Rule 1110.2.~~ Low NOx and zero emission technologies are expected to be widely available in the future. Low NOx emission technologies include linear generator technology and installation of exhaust controls such as Selective Catalytic Reductions (SCRs). In addition, where appropriate, conversion to battery cells and the electrification of engines are other options for owners and operators of these engines.

As technology is demonstrated to show lower emission potential, outreach to owner and operators will be conducted by the South Coast AQMD. As engines are replaced, owners and operators will be encouraged to install cleaner engines. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Emission Reductions

The expected NOx emissions reduction from engines is estimated to be about one-third of the 2037 emissions inventory. The current Rule 1110.2 NOx emission limit of 11 ppmv, dry at 15 percent O2 may be reduced to 6 ppmv, dry at 15 percent as technology is developed and becomes commercially available.

Rule Compliance and Test Methods

Compliance with the provisions of this control measure would be based on monitoring, recordkeeping, and reporting requirements that have been established in Rule 1110.2 or by conditions contained in a permit to operate. Compliance would be verified through inspections and other recordkeeping and reporting requirements.

Cost Effectiveness

~~The overall cost-effectiveness for engines that are installed and operated is unknown at this time. As technology is developed, costs will be available then.~~The cost of implementing L-CMB-03 is expected to be high due to the costs associated with emerging technologies and the implementation of such equipment. Much has been spent already by stakeholders to achieve current regulatory limits so to meet even lower limits may also encompass significant stranded asset costs. Based on the best information available, the socio-economic analysis for this control measure has estimated the DCF cost-effectiveness to be $321,500 per ton of NOx reduced and the modified -LCF cost-effectiveness to be $606,700 per ton of NOx reduced.

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from internal combustion engines operated within its jurisdiction.

References

South Coast Air Quality Management District. (2019). Final Staff Report on Proposed Amended Rule 1110.2 – Emission Reductions from Gaseous and Liquid Fueled Engines (Amended November 1, 2019).

L-CMB-04: EMISSION REDUCTIONS FROM EMERGENCY STANDBY ENGINES (PERMITTED) [NOx, VOCs]

CONTROL MEASURE SUMMARY

Source Category: Emergency Standby Engines

Control Methods: Regulations, Zero Emission, and Low NOx Emission Technologies

Emissions (Tons/Day):

Annual Average	2018	2031	2032	2037
NOx Inventory	~~4.1~~4.15	~~3.9~~3.97	~~3.9~~3.98	~~3.9~~4.03
NOx Reduction	-	~~0.0~~0.00	~~0.0~~0.00	~~1.8~~1.81
NOx Remaining	-	~~3.9~~3.97	~~3.9~~3.97	~~2.1~~2.22
Summer Planning	2018	2031	2032	2037
NOx Inventory	~~4.6~~4.67	~~4.4~~4.47	~~4.4~~4.48	~~4.4~~4.54
NOx Reduction	-	~~0.0~~0.00	~~0.0~~0.00	~~2.0~~2.04
NOx Remaining	-	~~4.4~~4.47	~~4.4~~4.48	~~2.4~~2.50
Annual Average	2018	2031	2032	2037
VOC Inventory	~~0.3~~0.28	~~0.2~~0.25	~~0.2~~0.25	~~0.2~~0.25
VOC Reduction	-	~~0.0~~0.00	~~0.0~~0.00	~~0.0~~0.12
VOC Remaining	-	~~0.2~~0.25	~~0.2~~0.25	~~0.2~~0.13
Summer Planning	2018	2031	2032	2037
VOC Inventory	~~0.3~~0.31	~~0.3~~0.28	~~0.3~~0.28	~~0.3~~0.28
VOC Reduction	-	~~0.0~~0.00	~~0.0~~0.00	~~0.1~~0.13
VOC Remaining	-	~~0.3~~0.28	~~0.3~~0.28	0.16~~0.2~~

Control Cost: ~~To Be Determined~~DCF Method: $592,900/ton of NOx reduced
Modified LCF Method: $1,027,200/ton of NOx reduced

Implementing Agency: South Coast AQMD

Description of Source Category

Internal combustion engines (ICEs) are commonly used for emergency backup for electric power generation. The South Coast AQMD regulations require permits for stationary ICEs rated over 50 brake horsepower (bhp). Based on the South Coast AQMD's permitting database, there are over 12,000 permitted emergency ICEs at a wide range of facilities such as commercial buildings, hospitals, convalescent facility medical support systems, cell towers, police facilities, schools, etc. Although most ICEs are diesel-fueled, other fuels used include natural gas, gasoline, and propane.

Emergency ICEs typically have long lifespans, meaning that older, more polluting ICEs are kept in service when cleaner technologies are available. Staff estimates that over a third of the diesel ICEs in operation in the South Coast AQMD were manufactured in 2003 or prior. These ICE emissions are either pre-Tier 0 or Tier 0 ICEs, or they meet the Tier 1 emission standards. The Tier 1 emission standard for NOx is 6.9 grams per brake horsepower-hour (g/bhp-hr), twenty-four times greater than the lowest Tier 4 Final emission standard of 0.29 g/bhp-hr (standard varies by engine horsepower rating).

Background

Emergency standby ICEs typically operate only when backup power is needed and for testing and maintenance purposes. Under Rule 1110.2 – Emissions from Gaseous- and Liquid-Fueled Engines, emergency standby ICEs are exempt from the NOx, CO, and VOC emission limits provided they have a permit that limits use to 200 hours or less per year. Emissions from emergency standby ICEs are notable due to the large quantity of this equipment in the South Coast AQMD, as well as the advanced age of the equipment.

The 2022 AQMP includes an emissions inventory for stationary sources (point and area sources) for 2018, 2031, 2032, and 2037. The emissions inventory for L-CMB-04 (Emergency Standby Engines) in the control measure summary is based on NOx emissions from point and area source internal combustion diesel engines. To refine the emissions inventory to be specific to emergency standby ICEs, a review of data used in the permitting of emergency standby ICEs through 2018 was conducted. Results from this effort and available 2018 Annual Emission Reporting (AER) data are presented in Table L-CMB-04-A. Future rulemaking activities will further refine the inventory, which will be based on the updated methods and emissions data.

TABLE L-CMB-04-A

Summary of Permitted Emergency ICEs (2018)

Category	Pieces of Equipment	Total NOx (tons/day)
All Emergency ICEs	12,691	2.7
Diesel ICEs	11,397	2.6
Non-Diesel ICEs (natural gas, gasoline, propane, etc.)	1,294	0.1

Approximately 90 percent of permitted stationary emergency ICEs are diesel-fueled~~,~~ and are estimated to emit the vast majority of NOx emissions.

Table L-CMB-04-B presents estimates of diesel-fueled emergency ICE NOx emissions based on equipment age and Tier designation. During years 2001 to 2005, there was an overlapping period when both Tier 1 and Tier 2 engines were manufactured. For the sake of simplicity, engines permitted in 2003 and prior are assumed to be Tier 1 engines. Approximately 30 percent of engines permitted after 2003 are assumed to be older engines with administrative changes to their permits.

TABLE L-CMB-04-B

Breakdown of Permitted Diesel Emergency ICEs

Category	Pieces of Equipment	Total NOx (tons/day)
Diesel ICEs	11,397	2.6
≤ Tier 1	5,552	1.4
Permitted in 2003 and prior	3,164	0.8
Permitted after 2003	2,388	0.6
> Tier 1	5,845	1.2

Alternative Technologies

Cleaner technologies are gaining traction as alternatives for use as backup power sources, and as described below, many are currently in use in the South Coast AQMD.

Fuel Cells

Fuel cells produce electricity by converting the chemical energy in fuel—often natural gas or hydrogen—without the presence of combustion, resulting in very low or zero emissions. Electricity is produced more efficiently with fuel cells (between 45–50 percent efficiency) than single-cycle combustion-based engines (up to 35 percent efficiency). Fuel cells units are modular, providing greater flexibility for a facility's power demands to be scaled up or down as needed. Using fuel cells as an alternative to traditional ICEs reduces NOx emissions with a co-benefit of reducing other criteria air pollutants, toxics, and greenhouse gases.

Based on information from CARB's Technology Clearinghouse, there are 243 fuel cells installed in the South Coast AQMD. While some of the fuel cell installations may provide backup power, such as those installed at traffic lights, per staff's discussions with manufacturers, larger fuel cell installations typically provide continuous power to a facility to reduce electricity costs and dependence on grid power. While they have the capability to provide emergency power, these larger fuel cells are not typically installed as dedicated backup power sources.

Table L-CMB-04-C presents a summary of fuel cell installations in the South Coast AQMD based on data from CARB's Technology Clearinghouse. As shown in Table L-CMB-04-C, the units are installed at many different facilities, including data centers, telecommunications, manufacturing, arts and entertainment, and health care facilities. The installations are often composed of multiple fuel cells of varying power ratings.

TABLE L-CMB-04-C

Verified Fuel Cell Installations in the South Coast AQMD

Facility Type	Number of Individual Fuel Cells		Commonly Rated Power Installations (kW)
	Natural Gas	Hydrogen	
Arts, Entertainment, and Recreation	36	--	1200
Data Center	12	--	500
Educational Services	36	--	400 / 460 / 1200
General Backup	--	10	30 / 50
Health Care and Social Assistance	24	--	250 / 800
Manufacturing	12	--	400
Professional, Scientific, and Technical Services	24		500 / 1000
Retail Trade	12	--	250
Telecommunications	24	35	Natural Gas: 800 / 1000 Hydrogen: 6
Traffic Light	--	6	1
Other Services	12	--	400
Total # of Fuel Cells	243		

Battery Energy Storage Systems

Battery energy storage systems (BESSs), or distributed energy storage systems, utilize batteries to store and discharge electrical energy. BESSs are readily available and widely in use across a range of industries. The energy can be discharged according to a facility's needs, often during an electrical grid's peak demand periods, to reduce costs and reliance on the grid. BESSs can store energy from renewable sources—such as solar panels—or from the grid during off-peak periods, when the price of electricity is lower. The storage capacity can be sized based on a facility's needs. A portion of a BESS can be reserved to provide dedicated emergency backup power, however for lithium-ion systems, the batteries must be regularly charged and discharged to prevent premature degradation of the battery capacity. Thus, BESSs are not installed *solely* to provide emergency backup power and are not like-for-like replacements of emergency ICEs.

Gas Turbines

Gas turbines produce heat and electricity through the combustion of gaseous or liquid fuels; turbines rated at 300 kW and smaller are referred to as microturbines. Multiple microturbines can also be installed in modular packages to increase capacities. Turbines have low NOx emissions—commercially available microturbines have NOx emissions as low as 5 ppm. The exhaust heat can also be recovered to provide hot water or steam, making them well suited for combined heat and power applications. CARB's Technology Clearinghouse has documented 95 micro turbines that can provide emergency backup power in the South Coast AQMD, all of which are fueled by natural gas. However, all the units also provide a continuous baseload and do not appear to be solely used for emergency backup power.

Efforts to use Zero Emission Emergency Backup Power

Large technology companies have set goals to eliminate carbon emissions, including ending use of diesel emergency ICEs. Google and Microsoft have made commitments to eliminating carbon emissions from their operations and have made strides towards removing diesel emergency ICEs from their datacenters. Google pledged to use only carbon-free energy by 2030. As a part of that effort, it is installing a BESS to replace the diesel generators at its Belgium data center. The batteries will store power generated by the data center's existing solar plant, generating zero emissions. Microsoft has also pledged to be carbon negative by 2030 and has a specific target of eliminating its dependency on diesel fuel by 2030. Microsoft has successfully tested the use of fuel cells and is exploring hydrogen fuel cells for backup power at its data centers.

According to the data available in CARB's Technology Clearinghouse, the industry with the single--most number of documented fuel cells in use in the South Coast AQMD is the telecommunications industry. Telecommunications companies have used fuel cells as alternative backup power sources for some cellular towers. Due to recently passed legislation, staff expects these companies will use more alternative backup power sources in the future. Specifically, the California Public Utilities Commission (CPUC) initiated Rulemaking 18-03-011 in 2018 to adopt permanent rules requiring utilities to increase resiliency in the face of natural disasters. In 2020 and 2021, respectively, the CPUC passed decisions that required telecommunication companies to, in part, provide at last 72 hours of backup power to both wireless and wireline communications infrastructure sites located in fire-prone areas. The decisions also directed telecommunication companies to move away from using diesel generators and instead focus on clean backup power sources. Discussions with industry and fuel cell manufacturer representatives indicate that the configuration of fuel cells at cellular towers usually have lower kW capacities (e.g., 30 kW or lower), however staff is aware that fuel cells can be, and are, used to provide larger energy capacities.

Currently Available Lower Emission ICEs

Pre-Tier 0 and Tier 0 diesel engines were generally manufactured prior 1996 and were not subject to emission limits. Tier 1 engines are diesel engines that were manufactured roughly between 1996 and 2005 and had to meet a NOx emission limit of 6.9 g/bhp-hr. Staff estimates that nearly half of diesel engines currently in operation are Tier 1 engines or older. Recently manufactured diesel and natural gas engines have much lower emission rates than these older engines.

Engines on the South Coast AQMD's Certified Emergency ICE Generators List have been evaluated by the South Coast AQMD Engineering staff as being compliant with emissions requirements. Table L-CMB-04-D below compares emission rates for a 460 horsepower ICE for uncontrolled (Pre-Tier 0 and Tier 0) and Tier 1 engines to emission rates for certified diesel and natural gas ICEs.

TABLE L-CMB-04-D

Engine Emission Rate Comparison (g/bhp-hr NOx)

			Certified Engine Emission Rates (Range)	
Engine Horsepower (Approximate)	Uncontrolled Engine Emission Factors*	Tier 1 Emission Limit	Diesel	Natural Gas
460	7 – 11	6.9	0.02 (Tier 4) - 2.76 (Tier 3)	0.035 – 0.045

* CARB 2017 Off-Road Emission Factors

In cases where zero emission and low NOx emission technologies are not available as backup power sources, the use of the cleanest available natural gas engines and diesel engines would still lead to a large emissions decrease.

Lower Emission Fuels

As mentioned, cleaner technologies are available for use as backup power sources. However, there are also alternatives to diesel fuel meeting CARB fuel specifications (CARB diesel) that can reduce emergency ICE emissions. Renewable diesel, for example, is commercially available and is considered a "drop-in" fuel that can be blended with conventional CARB diesel in any amount and used with existing infrastructure and diesel engines. CARB has indicated that numerous evaluations show that using renewable diesel in engines without selective catalytic reduction (SCR) can reduce NOx and PM emissions by approximately 10 and 30 percent, respectively, compared to CARB diesel.

Other Emerging Technologies

There are promising technologies beginning to emerge that may serve as direct replacements for emergency standby diesel ICEs but are not commercially or widely available yet.

Hydrogen fueled engines is an example of such a technology. In 2020, engine manufacturer INNIO Jenbacher successfully bench tested a prototype engine that was designed to run on a variable mix of natural gas and hydrogen. The engine was converted from an existing natural gas fueled engine and during testing was found to be able to run on 100 percent hydrogen fuel. In the next phase of the project, the engine will operate in a pilot hydrogen cogeneration plant in Hamburg, Germany.

The linear generator is another example of an emerging technology. A linear generator directly converts motion along a straight line into electricity using chemical or thermal energy. Mainspring Energy, a manufacturer of non-combustion linear generators, made their generators commercially available in 2021. The generator is fueled with natural gas, though it is marketed as being able to use different types of fuels, including hydrogen. According to the manufacturer, the operation uses a flameless and low temperature reaction, resulting in less than 2.5 ppm of NOx emissions. The generators can be run to provide continuous baseload power but can also be used to provide emergency power. As of this writing, units are only available with a rated output of 240 kW.

Regulatory History

The South Coast AQMD includes several regulations regarding ICEs, including the following:

- Rule 1110.2 – Emissions from Gaseous- and Liquid-Fueled Engines;
- Rule 1470 – Requirements for Stationary Diesel-Fueled Internal Combustion and Other Compression Ignition Engines; and
- Rule 1472 – Requirements for Facilities with Multiple Stationary Emergency Standby Diesel-Fueled Internal Combustion Engines.

Newly permitted emergency standby ICEs must be demonstrated to meet Best Available Control Technology (BACT) emission requirements. ICEs rated 50 to 750 bhp must meet Tier 3 emission standards, and ICEs rated over 750 bhp must meet Tier 2. Rule 1110.2 exempts emergency standby ICEs from meeting the rule's NOx, VOC, and CO emission limits provided that the engine has a permit condition limiting the engine to 200 operating hours[28] or less per year. Nearly all, if not all, emergency standby ICEs are limited to 200 hours or less per year of operation. Additionally, Rule 1470 restricts operation of diesel emergency standby ICEs for maintenance and testing purposes to 50 hours a year or less. These exempted emergency ICEs are also exempt from emissions testing, monitoring, reporting, and recordkeeping requirements of Rule 1110.2.

This control measure can create new regulations or lead to changes in existing regulations.

[28] Operating hours include all operations such as emergency use, maintenance, and testing.

Proposed Method of Control

Emergency standby ICEs are used for backup power for building systems to provide assurance that life safety systems and critical equipment can continue operation during a power outage. This equipment is also used to ensure critical infrastructure such as water systems and communications equipment remain operational during emergencies. Some facilities and applications are subject to building or fire code standards that require minimum parameters for backup power, which in some cases requires an on-site fuel source or a fully operational power supply within 10 seconds. Based on the variability of equipment needs at facilities it is acknowledged that one technology is not appropriate for all facilities. This control measure lists technologies as examples that may be viable for NOx reductions at some facilities. It is anticipated that in the future when cleaner technology is more widely adopted, cost-effective and achieved in more applications, there will be more options for zero emission and low NOx emission equipment for backup power. L-CMB-04 is designed to maximize NOx emission reductions by installing alternatives to ICEs where and when technically feasible and cost-effective. L-CMB-04 would also target older, in-use ICEs for emission reductions through the use of low emission fuels or replacements with lower-emission technologies. This control measure is also intended to achieve NOx emission reductions through educational outreach as part of the permit process. The regulatory and educational outreach programs would be developed in consultation with stakeholders, manufacturers, and other regulatory agencies to ensure that the programs are workable and that the regulatory requirements can be achieved. During rule development staff will also consider other rules associated with the transitioning of NOx RECLAIM facilities to a command-and-control regulatory structure, include technical feasibility; cost-effectiveness and incremental cost-effectiveness; identify industry-specific affordability issues; and may consider alternative compliance mechanisms

Staff is proposing four potential methods that may be enacted in tandem to reduce emissions from emergency ICEs:

- Develop a rule to replace older, higher-emitting emergency standby ICEs with the cleanest technology feasible
- Conduct a feasibility assessment to identify industries or other categories of emergency standby ICEs that can move towards zero emission and low NOx technologies and develop rules based on recommendations of the feasibility assessment
- During permitting of emergency standby ICEs, provide information on non-diesel low NOx and zero emission technology options and their benefits
- Require use of renewable diesel for diesel-fueled emergency standby ICEs

Approach 1 – Replacing Old Diesel ICEs

As mentioned, the South Coast AQMD permits currently limit emergency standby ICE usage to less than 200 hours per year which includes a limit of 20 to 50 hours for maintenance and testing purposes. To seek further reductions in emissions, a potential regulatory approach would be to remove the oldest ICEs in the South Coast AQMD from operation. The approach would target the oldest diesel ICEs in operation for replacement, starting with pre-Tier 0 (pre-1988 model year) engines and then focusing on Tier 0 (1988+ model year) and Tier 1 (1996+ model year) engines. If facilities were not able to install alternatives to ICEs and sought to install new ICEs, the units would be required to be the lowest emitting diesel ICEs available or natural gas ICEs. Such a regulatory approach would be conducted through a formal rulemaking process which would include a cost-effectiveness assessment based on replacement equipment costs and the emission reductions for engines that are presently subject to annual usage limits.

Approach 2 – Feasibility Assessment to Identify Industries

Another potential regulatory approach would be to prohibit backup diesel ICE generators for new installations at specific industries or applications. As a first step, a feasibility assessment would be conducted to identify industries or specific applications (e.g., facilities with low standby power needs) that can move towards zero emission and low NOx technologies for emergency backup power. As mentioned, telecommunications have been identified as a potential industry due to recent CPUC rulings that direct telecommunication companies to make plans to phase out fossil fuel use for backup power sources. The feasibility assessment would also include a review of zero emission and low NOx backup power sources in terms of costs, performance, and reliability. A potential rule to prohibit diesel ICE generators for specified industries or applications would be based on the results of the feasibility assessment.

Approach 3 – Providing Information During Permitting Process

As mentioned, the South Coast AQMD regulations require permits for emergency standby ICEs rated above 50 horsepower. Many facility operators may be unaware of alternatives to ICEs for emergency backup power. Staff believes that making educational materials readily available to facilities during the permitting process would help to inform customers of options that may result in the installation of lower emission technologies. Accordingly, this control measure proposes to include a broad outreach program to businesses and industries that operate a backup power supply. The educational materials would provide information on the different backup power options, including costs, reliability, emissions information, and available incentives. Staff would work with vendors to develop a strategy to broaden the outreach to as many customers as possible.

Approach 4 – Use of Lower Emission Fuels

A potential regulatory approach to achieve NOx emission reductions in the near term would be to require the use of commercially available lower emission fuels in all diesel backup ICEs that do not utilize SCR. Renewable diesel is currently widely available and is a drop-in replacement for CARB diesel fuel; it can be used in ICEs immediately, without the need to modify equipment or operations. Due to the availability of credits and incentives provided by State and federal programs, the cost of renewable diesel to vehicle end-users is comparable with that of CARB diesel fuel. The South Coast AQMD can work with other relevant agencies to explore the use of credits and other incentives to ensure that the cost of renewable diesel to non-vehicular ICE end-users is also comparable to that of CARB diesel. However, without these adjustments to consumer fuel costs, renewable diesel will likely not be widely used.

As stated previously, studies based on renewable diesel fuel use found that ICE NOx emissions were reduced by 10 percent, and PM emissions by 30 percent compared to CARB diesel. These are somewhat modest emission reductions, and staff believes that the mandated use of lower emission fuels should be considered in conjunction with other regulatory measures to achieve further emission reductions.

Emission Reductions

Emission reductions would be achieved by replacing all older emergency standby ICEs starting with pre-Tier 0 (pre-1988 model year) engines and then focusing on Tier 0 (1988+ model year) and Tier 1 (1996+ model year) engines with zero emission or low NOx emission technologies. For this control measure, it is presumed that two-thirds of smaller, older ICEs would be more likely to be replaced with alternative technologies, while the remaining third are presumed to be replaced with the cleanest available ICEs. Larger, older ICEs are less likely to be replaced with alternative technologies due to lack of availability of equipment as well as cost considerations and are presumed to be replaced with ICEs that meet the cleanest emission standards. In total, NOx emissions are estimated to be reduced by 45 percent by year 2037. Though staff's estimate of the emissions inventory is different from the inventory used in the AQMP, the percentage of emission reductions should not vary. Future rulemaking activities will include updating the emissions inventory calculation methods, as well as the availability of alternative technologies.

Rule Compliance and Test Methods

Compliance with the provisions of this control measure would be based on engines meeting the most current U.S. EPA engine emission standards or the replacement of currently operating engines with zero emission and low NOx alternative technologies that are not regulated by the South Coast AQMD, as well as the use of renewable diesel that meets CARB's standards. Compliance would be verified through inspections and other recordkeeping and reporting requirements.

Mandates for increasing renewable emergency backup power generation at wireless and wireline communication facilities are being implemented through the CPUC. The South Coast AQMD will work with the CPUC and other government agencies, along with businesses and facilities, to identify opportunities to reduce the use of ICEs for emergency standby power.

Cost Effectiveness

Costs of implementing L-CMB-04 will likely be high. Alternative emergency standby power technologies are emerging and are more expensive than diesel engines. Another challenge is that many of these technologies are also currently not designed to be used solely for emergency standby power and are not like-for-like replacements of emergency standby ICEs. As technologies mature and newer technologies emerge, staff anticipates that their costs will become more competitive in future years. Based on the best available information, the cost effectiveness, determined using the Discounted Cash Flow (DCF) method is estimated to be $592,000 per ton of NOx reduced; the cost effectiveness, determined using the Modified Levelized Cash Flow (MLCF) method is estimated to be $1,027,200 per ton of NOx reduced. A refined cost-effectiveness analysis for the proposed methods of control will be developed during rule development.

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from stationary engines rated over 50 bhp.

References

Belady, C., and James, S. (2017, September 24). *Redesigning Datacenters for an Advanced Energy Future*. Microsoft. https://blogs.microsoft.com/green/2017/09/24/redesigning-datacenters-advanced-energy-future/.

California Air Resources Air Board. *Technology Clearinghouse, Emergency Backup Power Options – Commercial, Technology Installation Sites*. Retrieved October 28, 2021 from https://ww2.arb.ca.gov/our-work/programs/public-safety-power-shutoff-psps-events/emergency-backup-power-options-commercial.

California Air Resources Board. (2021, September 21). *Proposed Amendments to CARB Off-Road Diesel Regulation Workgroup* [PowerPoint slides]. https://ww2.arb.ca.gov/sites/default/files/2021-09/ORD_Amendment_Workgroup-Renewable_Diesel.pdf.

California Environmental Protection Agency. *Multimedia Evaluation of Renewable Diesel*. May, 2015. Retrieved July 23, 2021, from https://ww2.arb.ca.gov/sites/default/files/2018-08/Renewable_Diesel_Multimedia_Evaluation_5-21-15.pdf.

Coletto, V. and Pelch, P. Altergy. Video conference. (2021, July 27).

Joint Statement issued by CARB and the State Water Resources Control Board (2013, July 31). https://ww2.arb.ca.gov/sites/default/files/2018-08/Renewable_Diesel_Joint_Statement_7-31-13.pdf.

Kava, J. (2020, December 16). *Cleaner data centers, batteries included*. Google: The Keyword. https://blog.google/inside-google/infrastructure/cleaner-data-centers-batteries-included/.

Public Utilities Commission of the State of California. (2020). *Decision Adopting Wireless Provider Resiliency Strategies*. Decision 20-07-011. https:/`/docs.cpuc.ca.gov/PublishedDocs/Published/G000/M344/K021/344021480.pdf.

Public Utilities Commission of the State of California. (2021). *Decision Adopting Wireline Provider Resiliency Strategies*. Decision 21-02-029. https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M366/K625/366625041.pdf.

Simpson, E. and Khan, A. Siemens, Distributed Energy Solutions. Video conference. (2021, October 28).

South Coast Air Quality Management District. (2017). 2016 Air Quality Management Plan, Appendix IV-A Stationary and Mobile Source Control Measures. (Published March 2017).

South Coast Air Quality Management District. (2021). Best Available Control Technology Guidelines – Part D: BACT Guidelines for Non-Major Polluting Facilities (Revised 2021, February 5).

South Coast Air Quality Management District. (2016). *South Coast AMD LAER/BACT Determinations*, *I.C. Engine – Emergency, Compression Ignition*. (2016, December 2). http://www.aqmd.gov/home/permits/bact/guidelines/i---scaqmd-laer-bact

United States Environmental Protection Agency Combined Heat and Power Partnership. (2015). *Catalog of CHP Technologies, Section 5. Technology Characterization – Microturbines*. (March 2015)

L-CMB-05: NOX EMISSION REDUCTIONS FROM LARGE TURBINES [NOx]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	TURBINES SUBJECT TO RULE 1134			
CONTROL METHODS:	ZERO EMISSION TECHNOLOGIES			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
NOx INVENTORY	~~0.86~~1.23	~~0.21~~0.25	~~0.21~~0.25	~~0.21~~0.26
NOx REDUCTION	-	-	-	~~0.06~~0.07
NOx REMAINING	-	-	-	~~0.15~~0.18
SUMMER PLANNING (IF NOx/VOC)	2018	2031	2032	2037
NOx INVENTORY	~~0.87~~1.23	~~0.21~~0.25	~~0.21~~0.25	~~0.21~~0.26
NOx REDUCTION	-	-	-	~~0.06~~0.07
NOx REMAINING	-	-	-	~~0.15~~0.18
CONTROL COST:	~~$368,000 PER TON OF NOx REDUCED~~ DCF METHOD: $723,800/TON OF NOx REDUCED. MODIFIED LCF METHOD: $1,518,300/TON OF NOx REDUCED			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

Description of Source Category

There are approximately 75 permitted turbines in the South Coast AQMD subject to Rule 1134 – Emissions of Oxides of Nitrogen from Stationary Gas Turbines (Rule 1134). Rule 1134 applies to all stationary gas turbines rated greater than or equal to 0.3 Megawatts (MW), except turbines regulated by the following source specific rules: Rule 1109.1 – Emissions of Oxides of Nitrogen for Petroleum Refineries and Related Operations (Rule 1109.1), Rule 1135 – Emissions of Oxides of Nitrogen from Electricity Generating Facilities (Rule 1135), Rule 1150.3 – Emissions of Oxides of Nitrogen from Combustion Equipment at Landfills (Rule 1150.3), and Rule 1179.1 – Emission Reductions from Combustion Equipment at Publicly Owned Treatment Works Facilities (Rule 1179.1).

The South Coast AQMD Governing Board modified the 2016 Final AQMP Resolution to direct staff to transition the Regional Clean Air Incentives Market (RECLAIM) program to a command-and-control regulatory structure requiring Best Available Retrofit Control Technology (BARCT) level controls as soon as practicable. Future NOx emission reductions for turbines subject to Rule 1134, including NOx emission reductions from former RECLAIM facilities, are the source category for this control measure.

Background

The South Coast AQMD has adopted a series of rules to promote clean, lower emission technologies, while encouraging economic growth and providing compliance flexibility. For existing sources, replacing older higher-emitting equipment with zero emitting equipment can apply to a single source or an entire facility. The manufacturing and deployment of zero and ~~near-zero~~low NOx emission technologies will help reduce criteria pollutant emissions in the region, accelerate removal of higher-emitting equipment that can otherwise last for many decades, and advance economic development and job opportunities in the region.

Regulatory History

Rule 1134 was adopted on August 4, 1989. The rule applied to stationary gas turbines rated at 0.3 MW and larger that were issued a permit to operate by the South Coast AQMD prior to August 4, 1989. The origin of the rule can be traced to a 1979 United States Environmental Protection Agency (U.S. EPA) New Source Performance Standard for Stationary Gas Turbines. Rule 1134 was subsequently amended in December 1995, April 1997, and August 1997; each to provide regulatory flexibility. Rule 1134 was most recently amended on April 5, 2019 to facilitate the transition of the NOx RECLAIM program to a command-and-control regulatory structure.

Proposed Method of Control

Fuel cells and electrification are ways to shift away from combustion sources generating NOx emissions wherever feasible. Fuel cells are capable of producing power with very low pollutant emissions while producing electricity much more efficiently than turbines (between 25–35 percent efficiency). There are many installations of fuel cells across many source categories as an alternative to traditional combustion methods, resulting in a reduction of NOx emissions with co-benefit of reducing other criteria air pollutants and greenhouse gases (GHG). As older higher emitting turbines reach the end of their equipment life it is expected that some facilities will opt to replace turbines with fuel cells or electrify facility operations. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Emission Reductions

Replacing turbines with zero emission technologies is estimated to result in approximately ~~0.06~~0.07 tons per day of NOx reduced. Staff assumes that approximately 10 percent of the total wattage of Rule 1134 units will be replaced by zero emission technologies.

Rule Compliance and Test Methods

Compliance with the provisions of this control measure would be based on monitoring, recordkeeping, and reporting requirements that have been established in existing source specific rules. Compliance would be verified through inspections and other recordkeeping and reporting requirements.

Cost Effectiveness

The overall average cost-effectiveness for this control measure is $~~368~~723,800,~~000~~ per ton of NOx reduced.

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from stationary sources.

References

South Coast AQMD, 2019. Final Staff Report on Proposed Amendments to Rule 1134, April 5, 2019.

L-CMB-06: NOX EMISSION REDUCTIONS FROM ELECTRICITY GENERATING FACILITIES [NOx]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	ELECTRIC GENERATING UNITS AT ELECTRICITY GENERATING FACILITIES			
CONTROL METHODS:	LOW NOX AND ZERO EMISSION TECHNOLOGIES			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
NOx INVENTORY	1.55	~~1.53~~2.05	2.04	~~1.51~~2.03
NOx REDUCTION	-	-	0.08	~~0.48~~0.88
NOx REMAINING	-	-	1.96	~~1.03~~1.16
SUMMER PLANNING (IF NOx/VOC)	2018	2031	2032	2037
NOx INVENTORY	1.62	~~1.94~~2.16	~~1.93~~2.15	~~1.93~~2.14
NOx REDUCTION	-	-	0.09	~~0.62~~0.91
NOx REMAINING	-	-	~~1.84~~2.06	~~1.31~~1.23
CONTROL COST:	~~$722,000 PER TON OF NOx REDUCED~~ DCF METHOD: $1,512,300/TON OF NOx REDUCED. MODIFIED LCF METHOD: $2,420,000/TON OF NOx REDUCED			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

Description of Source Category

There are approximately 133 permitted electric generating units at 32 electricity generating facilities in the South Coast AQMD. Electric generating units at electricity generating facilities are regulated by Rule 1135 – Emissions of Oxides of Nitrogen from Electricity Generating Facilities (Rule 1135). Electricity generating facilities are investor-owned electric utilities, publicly owned electric utilities, or facilities with a combined electrical power generation capacity of 50 Megawatts or more for distribution in the State or local electrical grid system. Electric generating units include gas turbines including associated duct burners, boilers, and diesel internal combustion engines. Rule 1135 was amended in 2018 to require Best Available Retrofit Control Technology (BARCT) level emission limits as directed by the 2016 Final AQMP Resolution to transition equipment in the Regional Clean Air Incentives Market (RECLAIM) program to a command-and-control regulatory structure. This control measure seeks further NOx emission reductions from electric generating units using ~~near-zero~~low NOx and zero emission technologies.

Background

When RECLAIM was adopted in 1993, electricity generating facilities were initially included in NOx RECLAIM and could opt-in to SOx RECLAIM. In June 2000, RECLAIM program participants experienced a sharp and sudden increase in NOx RECLAIM trading credit (RTC) prices for both the 1999 and 2000 compliance years. Based on the 2000 RECLAIM Annual Report, electricity generating facilities reported approximately 4,400 tons per year over their initial allocation. This was primarily due to an increased demand for power generation and delayed installation of controls by electricity generating facilities. The electric power generating industry purchased a large quantity of RTCs, which depleted the available RTCs. This situation was compounded because few RECLAIM facilities added control equipment. As a result, in May 2001, the Governing Board adopted Rule 2009 – Compliance Plan for Power Producing Facilities (Rule 2009). Rule 2009 required installation of BARCT through compliance plans at electricity generating facilities.

Between 2001 and 2005, more than 35 simple and combined cycle gas turbines were repowered to BARCT levels or below. Despite the increase in NOx RTC demand, emissions from electricity generating facilities fell from 26 tons per day of NOx emissions in 1989 to less than 10 tons per day of NOx emissions by 2005. By 2017, with equipment replacement and increased reliance on renewable sources, NOx emissions had further decreased to less than 4 tons per day. With the 2018 amendment to Rule 1135, NOx emissions from electricity generating facilities are expected to be 1.8 tons per day by January 1, 2024.

Regulatory History

Rule 1135 was adopted in 1989 and applied to electric power generating steam boiler systems, repowered units, and alternative electricity generating sources. A NOx system-wide average emission limit and a daily NOx emissions cap was established for each utility system. Additionally, Rule 1135 required Emission Control Plans and continuous emissions monitoring systems (CEMS).

Rule 1135 was amended in December 1990 to resolve implementation and enforceability issues raised by the California Air Resource Board. This amendment included accelerated retrofit dates for emission controls, unit-by-unit emission limits, modified compliance plan and monitoring requirements, computerized telemetering, and an amended definition of alternative resources. Rule 1135 was amended again July 1991 to address additional staff recommendations regarding system-wide emission rates, daily emission caps, annual emission caps, oil burning, and cogeneration, along with outstanding issues related to modeling and BARCT analysis. The U.S. EPA approved Rule 1135 into the State Implementation Plan (SIP) on August 11, 1998.

In 2018, Rule 1135 was amended to establish BARCT NOx limits which are needed to transition electricity generating facilities in the NOx RECLAIM program to a command-and-control regulatory structure and to implement Control Measure CMB-05 of the 2016 AQMP. The 2018 amendment expanded Rule 1135 applicability to all electric generating units at RECLAIM NOx, former RECLAIM NOx, and non-RECLAIM NOx electricity generating facilities. The amendment updated emission limits to reflect current BARCT levels.

Rule 1135 was last amended in January 2022 to revise the emission requirements for diesel internal combustion engines located on Santa Catalina Island. Rule 1135 incorporates a compliance path for Catalina Island electric generating units to meet a NOx emission cap of 13 tons per year starting January

1, 2026, to be achieved using zero emission or low NOx emission technology with possibly diesel engine replacements in the interim. Staff is conducting an updated BARCT assessment to evaluate current and emerging low NOx and zero emission technologies and will begin the rule development process in the first quarter of 2022 to reflect the revised BARCT assessment.

Proposed Method of Control

This control measure seeks NOx emission reductions from electric generating units regulated by Rule 1135 and will focus on assessing low NOx and zero emission technologies for power generation as well as other NOx combustion reduction technologies. This measure proposes to implement ~~near-zero~~low NOx and zero emission technologies through a regulatory approach at electricity generating facilities. Electricity generating facilities operating gas-fired boilers can repower with lower-emitting turbines. Facilities operating gas-fired turbines or diesel engines can transition to electrified units, units fueled by non-fossil energy sources (e.g., hydrogen-fueled turbines), fuel cells for power generation, or gas-fired units that meet CARB's Distributed Generation Certification Regulation standards. This approach needs to consider electrical or alternative fuel infrastructure required to operate these equipment and future electrical grid stability when transitioning to zero emission electric generating units. During rule development, staff will consider technical feasibility, ~~identify industry-specific affordability issues,~~ cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Emission Reductions

Emission reductions for this control measure are estimated to be approximately ~~0.62~~0.91 tons per day by 2037. The target of this approach is to replace boiler units with lower-emitting turbines, implement zero emission technologies for 10 percent of gas-fired sources and other lower NOx emission technologies for the rest of the 90 percent of gas-fired sources at electricity generating facilities, and replace existing diesel internal combustion engines with lower-emitting technologies.

Rule Compliance and Test Methods

Compliance with the provisions of this control measure would be based on monitoring, recordkeeping, and reporting requirements that have been established Rule 1135. Compliance would be verified through inspections and other recordkeeping and reporting requirements.

Cost Effectiveness

The overall average cost-effectiveness for this control measure is ~~$722,000~~$1,512,300 per ton of NOx reduced.

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from stationary sources.

References

South Coast AQMD, 2018. Final Staff Report on Proposed Amendments to Rule 1135, November 2, 2018.

South Coast AQMD, 2022. Final Staff Report on Proposed Amendments to Rule 1135 and Proposed Rule 429.2, January 7, 2022.

L-CMB-07: EMISSION REDUCTIONS FROM PETROLEUM REFINERIES [NOx]

CONTROL MEASURE SUMMARY

SOURCE CATEGORY: REFINERY BOILERS AND PROCESS HEATERS

CONTROL METHODS: NEXT GENERATION ULTRA-LOW NOx BURNERS (ULNB), ADVANCED SELECTIVE CATALYTIC REDUCTION (SCR), AND TRANSITION TO ZERO EMISSION

EMISSIONS (TONS/DAY):

ANNUAL AVERAGE	2018	2031	2032	2037
NOx INVENTORY	~~11.7~~11.14	~~3.82~~4.74	~~3.82~~4.69	~~3.82~~4.42
NOx REDUCTION	-	-	-	~~0.77~~0.88
NOx REMAINING	-	-	-	~~3.05~~3.54
SUMMER PLANNING	**2018**	**2031**	**2032**	**2037**
NOx INVENTORY	~~11.7~~11.17	~~3.82~~4.76	~~3.82~~4.70	~~3.82~~4.44
NOx REDUCTION	-	-	-	~~0.77~~0.89
NOx REMAINING	-	-	-	~~3.05~~3.55

CONTROL COST: ~~$50,300 PER TON OF NOx REDUCED~~DCF METHOD: $43,700/TON OF NOx REDUCED
MODIFIED LCF METHOD: $70,000/TON OF NOx REDUCED

INCENTIVE COST: NA

IMPLEMENTING AGENCY: SOUTH COAST AQMD

Description of Source Category

Background

Control measure L-CMB-07 seeks a 20 percent NOx emission reduction from petroleum refineries, primarily from large boilers and process heaters, e.g., units with a maximum rated heat input of 40 million British thermal units per hour (MMBtu/hr) or larger.~~, as they~~ These units account for nearly 64 percent of the NOx emissions from petroleum refineries. Refinery boilers and process heaters are currently regulated under Rule 1109.1 – Emissions of Oxides of Nitrogen from Petroleum Refineries and Related Operations (Rule 1109.1) with a NOx limit of 5 parts per million by volume (ppmv) for most units. L-CMB-07 seeks further NOx emission reductions from these large sources using next generation ultra-low NOx burner (ULNB), advanced Selective Catalytic Reduction (SCR) design, and zero emission technologies.

Regulatory History

On November 1, 1985, the South Coast AQMD adopted the Rule 1109 – Emissions of Oxides of Nitrogen from Boilers and Process Heaters in Petroleum Refineries (Rule 1109) and was last amended on August 5, 1988. Rule 1109 was applicable to all boilers and process heaters in petroleum refineries and established a NOx refinery-wide emission limit of 0.14 pounds per million Btu (lb/MMBtu) (approximately 120 ppmv NOx corrected to 3 percent O_2) for the units operated on gaseous fuel, 0.308 lb/MMBtu (approximately 250 ppmv NOx corrected to 3 percent O_2) for the units operated on liquid fuel, and the weighted average of these limits for the units operated concurrently on both liquid and gaseous fuels when the units are firing at the maximum rated capacity. After December 31, 1995, the limit for gaseous fuels was reduced to 0.03 lb/MMBtu when firing at the maximum rated capacity. The Regional Clean Air Incentives Market (RECLAIM) was adopted in 1993 and all facilities that were subject to Rule 1109 opted to transition to RECLAIM so the 1995 NOx standard of 0.03 lb/MMBtu was never implemented.

RECLAIM Program

The RECLAIM program, which is under Regulation XX, is a market-based emissions trading program designed to reduce NOx and Sulfur Oxides (SOx) emissions. The intent of RECLAIM was to reduce NOx and SOx emissions through a market-based approach for facilities with NOx or SOx emissions greater than or equal to four tons per year. The program replaced a series of existing and future command-and-control rules and was designed to provide facilities with compliance flexibility. RECLAIM was designed to achieve emission reductions in aggregate equivalent to what would occur under a command-and-control regulatory approach. When the NOx RECLAIM program was adopted, facilities were issued an annual allocation of RECLAIM Trading Credits (RTCs), which declined annually from 1993 until 2003 and remained constant after 2003. At the end of each compliance year, facilities in the RECLAIM program must hold RTCs that are equal to or greater than the facility's actual emissions. Facilities have the option to purchase RTCs, reduce throughput, implement process modifications, or install pollution controls to reduce emissions. RECLAIM is designed to achieve BARCT in the aggregate. When RECLAIM was adopted, all petroleum refineries and facilities with operations related to petroleum facilities (related facilities) transitioned to this market-based program.

Pursuant to Health and Safety Code Section 40440 and 39616, the South Coast AQMD is required to periodically assess the advancement in control technologies that are representative of BARCT to ensure that RECLAIM facilities achieve the same emission reductions that would have occurred under a command-and-control approach. Over the course of RECLAIM, there have been two BARCT reassessments for NOx in 2005 and 2015. The 2005 NOx shave target was 7.7 tons per day from 2007 to 2011 and the 2015 NOx shave was 12 tons per day from 2016 to 2022.

Petroleum refineries and facilities with related operations to petroleum refineries represent the largest source of NOx emissions in the RECLAIM program. Based on 2017 RECLAIM NOx emissions of 19.9 tons per day, petroleum refineries and facilities with related operations to petroleum refineries accounted for 12.4 tons per day (62 percent) of the total NOx emissions of the program with 7.1 tons per day attributed to the large boilers and process heaters source category.

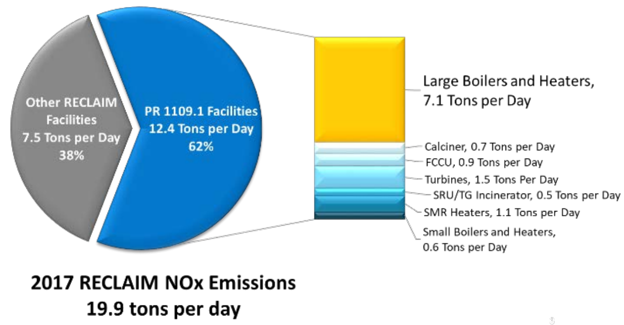

FIGURE L-CMB-07-A

Percentage of NOx Emissions by Equipment Category

Sunsetting RECLAIM

During the adoption of the 2016 AQMP, the Governing Board approved a resolution that directed staff to "modify the 2016 AQMP control measure CMB-05 to achieve five tons per day of NOx emission as soon as feasible, and no later than 2025, and to transition the RECLAIM program to a command-and-control regulatory structure requiring BARCT level controls as soon as practicable." Furthermore, on July 26, 2017, California State Assembly Bill 617 – Nonvehicular Air Pollution: Criteria Air Pollutants and Toxic Air Contaminants (AB 617) was approved by the Governor, which addresses nonvehicular air pollution (criteria pollutants and toxic air contaminants). RECLAIM facilities that are in the cap-and-trade program are subject to the requirements of AB 617. Requirements include an expedited schedule for implementing BARCT for cap-and-trade facilities and a requirement for the air districts throughout California to adopt an expedited BARCT schedule by January 1, 2019, to implement BARCT no later than December 31, 2023, by assigning the highest priority to those permitted units that have not modified emissions related permit conditions for the greatest period.

Rule 1109.1

Rule 1109.1 – Emissions of Oxides of Nitrogen from Petroleum Refineries and Related Operations was adopted on November 5, 2021. The rule will facilitate the transition of petroleum refineries and facilities with related operations to a command-and-control regulatory structure and partially implement Control Measure CMB-05 of the 2016 AQMP. The provisions of Rule 1109.1 are applicable to NOx emitting combustion equipment at 16 facilities which include petroleum refineries, asphalt plants, biofuel plants, hydrogen production plants, facilities that operate petroleum coke calciners, sulfuric acid plants, and sulfur recovery plants. Rule 1109.1 establishes NOx concentration limit for six major source categories: boilers and process heaters, gas turbines, Fluid Catalytic Cracking Units (FCCUs), Sulfur Recovery Unit/Tail Gas (SRU/TG) incinerators, vapor incinerators, and petroleum coke calciners. Rule 1109.1 is projected to reduce between 7.7 to 7.9 tons of NOx per day, with approximately 5 tons per day from the large boilers and process heaters based on single-stage SCR installations.

Proposed Method of Control

Control measure L-CMB-07 seeks NOx emission reductions from boilers and process heaters greater than or equal to 40 MMBtu/hr located at petroleum refineries and will focus on:

Next Generation Ultra-Low NOx Burners;
Advanced SCR; and
Transition to Zero Emission Technology.

NOx Control technologies used for boiler and process heater applications at petroleum refineries can be classified in two main categories: combustion control and post-combustion control. Combustion control refers to reducing NOx at the point of formation by reducing the peak flame temperature utilizing various techniques, and post-combustion control involves treatment of the flue gas by chemically converting the NOx into nitrogen and water. NOx control technologies such as ultra-low NOx burners, low NOx burners, and SCRs have been in use for more than 30 years, but the technology continues to evolve and improve resulting in significant advancements in performance and NOx removal efficiencies. During rule development staff will consider other rules associated with the transitioning of NOx RECLAIM facilities to a command-and-control regulatory structure, include technical feasibility; cost-effectiveness and incremental cost-effectiveness; ~~identify industry-specific affordability issues;~~ and may consider alternative compliance mechanisms.

Next Generation Ultra-Low NOx Burners

During the development of Rule 1109.1, the South Coast AQMD assessed burner technologies that were in the development stages that are considered emerging technologies. Emerging technologies have limited real-world installations but have shown promise of further commercialization and future installations. Rule 1109.1 only relied on emerging burner technology to achieve 9 ppmv NOx limits for small process heaters (less than 40 MMBtu/hour) effective 10 years from rule adoption and upon burner replacement. Due to the promise of these next generation low NOx burners, this technology may be feasible for a wider range of process heaters at petroleum refineries in the future.

Conventional ULNB typically operates between 30 to 50 ppmv when retrofitted into a refinery process heater and may also encounter challenges such as flame dimension and space availability. Next generation ULNB such as ClearSign™ and Solex™ by John Zink Hamworthy can potentially alleviate some of challenges of conventional ULNBs and achieve a NOx concentration of 9 ppmv or less using refinery fuel gas.

ClearSign™

The ClearSign™ technology utilizes a porous ceramic surface where combustion is sustained. The combustion occurs inside the pores of the ceramic tile, resulting in reduced flame height and improved heat radiation. In addition, the fuel, air, and entrained flue gas are premixed prior to combustion at the ceramic surface resulting in lower flame temperatures and reaction times which reduce thermal NOx formation.

SOLEX™ burner technology

The SOLEX™ burner technology promises to achieve 5 ppmv or less regardless of fuel composition, which is a major challenge of refinery fuel gas, the major source of combustion fuel for process heaters. To achieve the performance, the SOLEX™ burners requires advanced combustion control scheme along with a forced and induced draft fan. SOLEX™ burners can be retrofitted in up-fired, down-fired, and horizontally fired configurations, thus fitting multiple process heater applications within a petroleum refinery.

The design of both burners also allows for a direct replacement within the existing burner footprint and address many of the short comings of conventional ULNB design and safety concerns associated with retrofit applications. Both burner technologies also offer SCR level NOx emission reductions for much lower costs.

Advanced SCR

SCR technology is a well-established and mature technology for controlling NOx emissions with the potential to achieve greater than 95 percent control efficiency. Over the past three decades, SCR system designers and catalyst manufacturers have made advancements using computational fluid dynamics and cold flow modeling to aid in ammonia injection grid (AIG) optimization for uniform contact and mixing between the ammonia and flue gas. In addition, recent SCR installations are utilizing advanced feedback controls that modulate the ammonia injection to reduce overall ammonia consumption and minimizes ammonia emissions while maintaining high NOx removal efficiencies. There are also existing SCR installations that use a dual stage SCR reactor design to maximize NOx reductions. These dual reactor arrangements are commonly installed at nitric acid plants where the NOx emissions can exceed 2,000 ppmv. These arrangements can have removal efficiencies up to 99 percent, thus a dual stage SCR system utilizing AIG optimization and state-of-the art control systems installed on a petroleum refinery boiler or process heater could achieve NOx emissions of 2 ppmv or less. Since SCR technology is post combustion control, it is applicable to both boilers and process heaters; however, a case-by-case evaluation will be needed to assess the feasibility due to the additional footprint requirements associated with a dual stage SCR arrangement.

Zero Emission Technologies

This alternative would seek ways to require electrification of some petroleum refinery boilers or process heaters operated with gaseous fuel NOx emission reduction can be achieved through electrification of steam-driven equipment, such as pumps or blowers, which will reduce or eliminate the demand of some steam boilers and allow older higher polluting gas-fired boilers to be decommissioned. Alternatively, if a facility cannot eliminate the need for gas-fired boilers, replacement with electric boilers may also be an option. Rondo Energy offers a modular heat battery system that may be a potential option for replacement of steam boilers. The system uses an electrical input to generate and store thermal energy in bricks at temperatures up to 2,100 °F. Air is passed over through the bricks and can be used to generate steam through a boiler package. The modular design allows for integration into a refinery steam system. Similarly, process heaters can potentially be replaced with electrified versions to heat process fluids. Process heaters are designed to supply the heat necessary to heat process fluids or feed stocks to distillation or reaction temperatures. Much like their gas-fired counterparts, electric process heaters are designed and engineered for site specific requirements. A fired process heater often has a relatively low thermal efficiency because of loss with the flue gases, especially in those without any preheater to cool the stack gases and recover the heat. A properly designed electric process heater with proper insulation can achieve much higher efficiencies. Most of the process heaters utilized in a petroleum refinery are radiant furnaces where the heat generated from combustion is transferred to the process tubes in which the fluid is contained. Electrical radiant furnaces can be designed in a similar arrangement which consist of a heating coil to contain the process fluid being heated surrounded by radiant electric heating elements that can achieve temperatures up to 2,300 °F. This alternative needs to consider electrical infrastructure and potential impacts on refinery fuel gas balance as there may be an excess of waste refinery fuel gas if combustion equipment is replaced with electrified versions.

Emission Reductions

Emission reductions for this control measure are estimated to be approximately ~~0.77~~0.89 tons per day by 2037 utilizing next generation ULNBs. NOx reductions can also be achieved with advanced SCR design and electrification. Staff anticipates rule development to be initiated between 2025 to 2027 to achieve emission reductions by 2037 due to the complexity and long implementation timelines required to achieve emission reductions at petroleum refineries.

Rule Compliance and Test Methods

South Coast AQMD Method 100.1

Cost Effectiveness

Staff based the cost-effectiveness by using cost estimates from manufacturers and applying three times multiplier as a contingency factor due to increased costs at petroleum refineries. Staff estimated the most cost-effective option to be next generation ULNB with an approximate cost of $~~3~~ 2.8 million per process heater. Staff estimates the average cost-effectiveness for reducing the NOx limit from 5 ppmv to 2 ppmv for 130 process heaters to be approximately $~~50,300~~43,700 per ton of NOx reduced.

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from these stationary sources.

References

South Coast Air Quality Management District. (2021). South Coast AQMD Rule 1109.1 – Emissions of Oxides of Nitrogen from Petroleum Refineries and Facilities with Related Operations (Adopted November 5, 2021)

South Coast Air Quality Management District. (2006). Final Staff Report: Proposed Rule 1109.1 – Emissions of Oxides of Nitrogen from Petroleum Refineries and Facilities with Related Operations. South Coast Air Quality Management District. November 2021.

South Coast Air Quality Management District. (2017). Final 2016 Air Quality Management Plan. South Coast Air Quality Management District. March 2017.

L-CMB-08: NOX EMISSION REDUCTIONS FROM COMBUSTION EQUIPMENT AT LANDFILLS AND PUBLICLY OWNED TREATMENT WORKS [NOx]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	COMBUSTION EQUIPMENT SUBJECT TO RULES 1150.3 AND RULE 1179.1			
CONTROL METHODS:	LOW NOX EMISSION TECHNOLOGIES AND OTHER TECHNOLOGIES			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
POLLUTANT INVENTORY	~~1.37~~1.34	~~1.28~~1.27	~~1.28~~1.27	~~1.29~~1.28
POLLUTANT REDUCTION	-	-	-	~~0.33~~0.32
POLLUTANT REMAINING	-	-	-	0.96
SUMMER PLANNING (IF NOX/VOC)	2018	2031	2032	2037
POLLUTANT INVENTORY	~~1.40~~1.37	~~1.31~~1.29	~~1.31~~1.29	~~1.32~~1.31
POLLUTANT REDUCTION	-	-	-	0.33
POLLUTANT REMAINING	-	-	-	~~0.99~~0.98
CONTROL COST:	~~$20,000 PER TON OF NOX REDUCED~~ DCF METHOD: $79,000/TON OF NOX REDUCED. MODIFIED LCF METHOD: $126,400/TON OF NOX REDUCED			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

Description of Source Category

This control measure aims to reduce NOx emissions from biogas fueled combustion equipment – specifically boilers, turbines, and engines – regulated by Rule 1150.3 – Emissions of Oxides of Nitrogen from Combustion Equipment at Landfills (Rule 1150.3) and Rule 1179.1 – Emission Reductions from Combustion Equipment at Publicly Owned Treatment Works Facilities (Rule 1179.1). There are approximately 120 biogas fueled boilers, turbines, and engines permitted in the South Coast AQMD.

Background

Anaerobic digestion of organic material from Publicly Owned Treatment Works Facilities (POTWs) and the decomposition of waste at landfills are sources of biogas. Biogas that would otherwise be flared can be directed to combustion equipment, such as boilers, engines, and turbines, to provide power to the facility, generate electricity for sale, be cleaned to be used as a vehicle fuel, or piped into existing natural gas pipelines. Biogas differs from other process gases because it contains unique contaminants which can damage equipment used in energy production. Rule 1150.3 and Rule 1179.1 are industry-specific rules which regulate combustion equipment at landfills and POTWs, respectively.

Regulatory History

Biogas fueled boilers, process heaters, engines, and turbines were originally regulated by the following source-specific South Coast AQMD rules: Rule 1146 – Emissions of Oxides of Nitrogen from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters (Rule 1146), Rule 1146.1 - Emissions of Oxides of Nitrogen from Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters (Rule 1146.1), Rule 1110.2 – Emissions from Gaseous - and Liquid-Fueled Engines (Rule 1110.2), and Rule 1134– Emissions of Oxides of Nitrogen from Stationary Gas Turbines.

During the rulemaking for the December 2018 amendments to Rule 1146, Rule 1146.1, and Rule 1146.2 – Emissions of Oxides of Nitrogen from Large Water Heaters and Small Boilers and Process Heaters, staff received comments from industry representatives describing the unique challenges with biogas that are different than natural gas. As a result, staff recommended a separate rulemaking for combustion equipment at landfills and POTWs.

Rule 1179.1 was adopted on October 2, 2020 and applies to digester gas fired boilers, process heaters, engines, and turbines located at POTWs.

During the rulemaking for Rule 1150.3, stakeholders provided input to exclude landfill gas engines from Rule 1150.3; landfill gas engines continue to be regulated under Rule 1110.2. Rule 1150.3 was adopted on February 5, 2021 and applies to landfill gas fired boilers, process heaters, and turbines located at landfills and landfill gas to energy facilities.

Proposed Method of Control

Boilers

Low NOx burners control the air-fuel mixture during combustion and modify the shape of the flame or number of flames to reduce NOx formation and maintain efficiency. During the rule development for Rule 1179.1, a burner supplier stated that 9 parts per million by volume (ppmv) NOx burners for digester gas fueled boilers would be available in the next few years.

Turbines

Selective catalytic reduction (SCR) is a post-combustion control technology for NOx reduction and can reduce 90–95 percent of post-combustion NOx. SCR reduces NOx to nitrogen and water through a reaction with ammonia and oxygen. However, the catalyst used for the reaction is susceptible to fouling if the gas contains contaminants such as siloxanes or hydrogen sulfide. Biogas combustion equipment utilizing SCR would require enhanced gas treatment to preserve the catalyst. SCR may be used in combination with combustion control technologies, such as lean premixed combustion, to achieve greater NOx reductions.

Lean premixed combustion is a NOx control technology commonly used for turbines and microturbines. This control technology premixes gaseous fuel and compressed air which minimizes localized hot spots that produce elevated combustion temperatures. This control technology requires that the combustor is an intrinsic part of the turbine design and is not available as a retrofit technology.

Turbines with lean premixed combustion can reduce NOx to approximately 12.5 ppmv at 15 percent oxygen on a dry basis for turbines firing landfill gas and does not require an enhanced gas treatment system. Existing turbines at landfills with rated output ≥ 0.3 MW with post- combustion control and firing ≥ 75 percent landfill gas currently utilize SCR as a control technology. However, the facility does not utilize an enhanced gas treatment system and source test results show NOx concentrations between 21.2 and 24.2 ppmv. Installing an enhanced gas treatment system to meet a 12.5 ppmv NOx limit was determined to be greater than $50,000 per ton of NOx reduced.

New turbines, such as turbines with lean premixed combustion, in combination with SCR can reduce NOx to approximately 5 ppmv at 15 percent oxygen on a dry basis for turbines firing digester gas. There are currently six turbines subject to Rule 1179.1 with rated output ≥ 0.3 MW. Three turbines at one facility utilize SCR as a control technology but will require new turbines to reduce inlet NOx concentrations to meet a 5 ppmv NOx limit. The other facility operates 3 turbines that will require SCR and an enhanced gas treatment system to meet a 5 ppmv NOx limit.

Renewable Natural Gas Pipeline

Alternatively, biogas can be treated using enhanced gas treatment systems to achieve pipeline quality natural gas. Pipeline quality biogas can then be sold to utilities and piped into existing natural gas pipelines.

During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Emission Reductions

This control measure will result in approximately 0.33 tons per day NOx emission reductions. A NOx concentration limit of 9 ppmv at 3 percent oxygen on a dry basis for digester gas boilers will result in approximately 0.004 tons per day NOx emission reductions. A NOx concentration limit of 12.5 ppmv at 15 percent oxygen on a dry basis for turbines with rated output ≥ 0.3 MW with post- combustion control and firing ≥ 75 percent landfill gas will result in approximately 0.16 tons per day NOx emission reductions. A NOx concentration limit of 5 ppmv at 15 percent oxygen on a dry basis for turbines rated ≥ 0.3 MW and firing 60 percent digester gas or more will result in approximately 0.17 tons per day NOx emission reductions.

Rule Compliance and Test Methods

Compliance with the provisions of this control measure would be based on monitoring, recordkeeping, and reporting requirements that have been established in existing source specific rules. Compliance would be verified through inspections and other recordkeeping and reporting requirements.

Cost Effectiveness

Turbines with rated output ≥ 0.3 MW with post- combustion control and firing ≥ 75 percent landfill gas were installed in 2012; there will be no stranded asset costs by 2037. The cost-effectiveness for digester gas boilers assumes a 15-year equipment life; there will be no stranded asset costs by 2037. The cost-effectiveness for Rule 1179.1 turbines rated output ≥ 0.3 MW ~~is approximately $36,000 per ton of NOx reduced and~~ accounts for stranded asset costs for turbines. The cost-effectiveness of L-CMB-08 is approximately $~~20~~79,000 per ton of NOx reduced.

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from stationary sources.

References

South Coast AQMD, 2020. Final Staff Report on Proposed Amendments to Rule 1179.1, October 2, 2020.

South Coast AQMD, 2021. Final Staff Report on Proposed Rule 1150.3, February 5, 2021.

L-CMB-09: NOX REDUCTIONS FROM INCINERATORS [NOx]

CONTROL MEASURE SUMMARY				
Source Category:	Incinerators and Other Combustion Equipment			
Control Methods:	Selective Catalytic Reduction and Ultra-Low NOx Burners			
Emissions (Tons/Day):				
Annual Average	2018	2031	2032	2037
NOx Inventory	~~0.98~~1.11	~~1.01~~1.13	~~1.02~~1.13	~~1.19~~1.15
NOx Reduction	-	-	-	~~0.89~~0.86
NOx Remaining	-	-	-	~~0.30~~0.29
Summer Planning	2018	2031	2032	2037
NOx Inventory	~~0.95~~1.16	~~0.99~~1.18	~~0.96~~1.18	~~1.00~~1.20
NOx Reduction	-	-	-	~~0.75~~0.90
NOx Remaining	-	-	-	~~0.25~~0.30
Control Cost:	~~$2,500 per ton of NOx reduced~~ DCF method: $900/ton of NOx reduced. Modified LCF method: $1,500/ton of NOx reduced			
Implementing Agency:	South Coast AQMD			

Description of Source Category

Control measure L-CMB-09 seeks emission reductions of NOx by replacement or retrofits with zero emission and low NOx emission technologies on incinerators and other combustion equipment associated with incinerators. Incinerators are used to burn waste material at high temperatures until reduced to ash.

Background

The South Coast AQMD has adopted a series of rules to promote clean, lower emission technologies, while encouraging economic growth and providing compliance flexibility. For existing sources, replacing older higher-emitting equipment with zero emitting equipment can apply to a single source or an entire facility. The manufacturing and deployment of zero emission and low NOx emission technologies will help reduce criteria pollutant emissions in the region, accelerate removal of higher-emitting equipment that can otherwise last for many decades, and advance economic development and job opportunities in the region.

Regulatory History

Incinerators are regulated by Rule 476 – Steam Generating Equipment last amended in 1976. Rule 476 limits NOx emissions to 225 parts per million by volume (ppmv) NOx corrected to three percent oxygen.

Proposed Method of Control

Burner technologies such as low NOx burner systems (LNB) or ultra-low NOx burner systems (ULNB) are combustion control technologies utilized to lower NOx emissions. A variety of factors impact the NOx emissions with LNB or ULNB, such as burner orientation and arrangement, firebox size, heater type (force or natural draft), and fuel type. Dependent on the burner configuration and operation, additional combustion controls are used to reduce NOx emissions, such as fuel and air premix, staged fuel, staged air, and flue gas recirculation. Other zero emission and low NOx emission technologies including electrification, next generation ultra-low NOx burners, or non-fossil fuel energy sources, may feasible. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Emission Reductions

Replacing or retrofitting incinerators and associated combustion equipment with low NOx burners is estimated to result in approximately ~~0.89~~0.90 tons per day of NOx reduced.

Rule Compliance and Test Methods

Source test methods vary depending on the type of source and quality of emissions (e.g., criteria pollutant and toxic emissions). Source test methods may include, but are not limited to South Coast AQMD Methods 5.1, 25.1 25.3, 100.1, 207.1 or other South Coast AQMD-approved test methods.

Cost Effectiveness

The overall average cost-effectiveness for this control measure is $~~2,500~~900 per ton of NOx reduced.

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from stationary sources.

References

South Coast AQMD, 1978. Rule 476 – Steam Generating Equipment

L-CMB-10: NOX REDUCTIONS FROM MISCELLANEOUS PERMITTED EQUIPMENT [NOx]

CONTROL MEASURE SUMMARY

SOURCE CATEGORY: NOx REDUCTIONS FROM MISCELLANEOUS PERMITTED EQUIPMENT

CONTROL METHODS: ULTRA-LOW NOx BURNERS (ULNB), LOW NOx BURNERS (LNB), SELECTIVE CATALYTIC REDUCTION (SCR), AND TRANSITION TO ZERO EMISSION

EMISSIONS (TONS/DAY):

ANNUAL AVERAGE	2018	2031	2032	2037
NOx INVENTORY	~~2.02~~1.64	~~1.45~~1.09	~~1.45~~1.09	~~1.45~~1.09
NOx REDUCTION	-	-	-	~~1.16~~0.87
NOx REMAINING	-	-	-	~~0.29~~0.22
SUMMER PLANNING	**2018**	**2031**	**2032**	**2037**
NOx INVENTORY	~~2.02~~1.76	~~1.45~~1.27	~~1.45~~1.27	~~1.45~~1.27
NOx REDUCTION	-	-	-	~~1.16~~1.01
NOx REMAINING	-	-	-	~~0.29~~0.25

CONTROL COST: DCF METHOD : $28,700 ~~5,600 to $49,000~~ PER TON OF NOx REDUCED.
MODIFIED LCF METHOD: $84,800/PER TON OF NOx REDUCED.

INCENTIVE COST: NA

IMPLEMENTING AGENCY: SOUTH COAST AQMD

Description of Source Category

Background

Control measure L-CMB-10 seeks 80 percent NOx emission reductions ~~from NOx Reductions~~ from Miscellaneous Permitted Equipment. Miscellaneous permitted equipment is regulated under Rule 1147 – NOx Reductions from Miscellaneous Sources with NOx limits of between 30 to 60 ppm depending on equipment category. Rule 1147 NOx emission limits are corrected to 3 percent O_2 dry basis and does not apply to equipment with rated heat input of less than 325,000 British thermal units per hour (Btu/hr). L-

CMB-10 seeks further NOx emission reductions from these sources with ULNB, LNB, SCR systems, and zero emission technologies.

Regulatory History

Rule 1147 establishes NOx limits for a wide variety of miscellaneous combustion sources at non-Regional Clean Air Incentives Market (non-RECLAIM) facilities. Rule 1147 applies to ovens, dryers, dehydrators, heaters, kilns, calciners, furnaces, crematories, incinerators, heated pots, cookers, roasters, fryers, closed and open heated tanks and evaporators, distillation units, afterburners, degassing units, vapor incinerators, catalytic or thermal oxidizers, soil and water remediation units and other combustion equipment with NOx emissions that require a South Coast AQMD permit and are not specifically required to comply with a NOx emission limit designated by other South Coast AQMD Regulation XI rules. The regulatory history is as follows:

December 2008 - Rule 1147 was adopted.

September 2011 – In this amendment Rule 1147 in delayed compliance dates as well as provided alternative compliance pathways and reduced testing requirements for impacted equipment. This rule amendment also required staff to conduct a technology assessment for small combustion sources impacted by the rule.

February 2017 - Staff conducted a technology assessment focused on low-use equipment emitting less than one-pound NOx per day. The completed Technology Assessment was reviewed by an independent third-party consultant as well as the Rule 1147 Task Force.

July 2017 - Rule 1147 was amended to reflect findings and recommendations from the Technology Assessment conducted in February 2017. This amendment provided additional compliance flexibility by including an exemption for equipment with heat input ratings of less than 325,000 Btu/hr. The amendment also removed the in-use requirement for low-use equipment, modified emission limits for various equipment categories in line with findings from the February 2017 Technology Assessment, and provided additional compliance options for impacted equipment.

Under Rule 1147, applicable equipment subject to 1147 with total heat input greater than or equal to 325,000 Btu/hr must meet Rule 1147 NOx limit depending on equipment category and process temperature as shown in Table L-CMB-10-A - NOx Emission Limit for Unit Heat Ratings ≥ 325,000 Btu/hr.

TABLE L-CMB-10-A

NOx Emission Limit for Unit Heat Ratings ≥ 325,000 Btu/hr

Equipment Category(ies)	NOx Emission Limit PPM @ 3% O_2, dry or Pound/mmBtu heat input		
	Process Temperature		
Gaseous Fuel-Fired Equipment	≤ 800° F	> 800 ° F and < 1200° F	≥ 1200 ° F
Asphalt Manufacturing Operation	40 ppm	40 ppm	
Afterburner, Degassing Unit, Remediation Unit, Thermal Oxidizer, Catalytic Oxidizer or Vapor Incinerator [1]	60 ppm or 0.073 lb/mmBtu	60 ppm or 0.073 lb/mmBtu	60 ppm or 0.073 lb/mmBtu
Burn-off Furnace, Burnout Oven, Incinerator or Crematory with or without Integrated Afterburner	60 ppm or 0.073 lb/mmBtu	60 ppm or 0.073 lb/mmBtu	60 ppm or 0.073 lb/mmBtu
Evaporator, Fryer, Heated Process Tank, or Parts Washer	60 ppm or 0.073 lb/mmBtu	60 ppm or 0.073 lb/mmBtu	
Metal Heat Treating, Metal Melting Furnace, Metal Pot, or Tar Pot	60 ppm or 0.073 lb/mmBtu	60 ppm or 0.073 lb/mmBtu	60 ppm or 0.073 lb/mmBtu
Oven, Dehydrator, Dryer, Heater, Kiln, Calciner, Cooker, Roaster, Furnace, or Heated Storage Tank	30 ppm or 0.036 lb/mmBtu	30 ppm or 0.036 lb/mmBtu	60 ppm or 0.073 lb/mmBtu
Make-Up Air Heater or other Air Heater located outside of building with temperature controlled zone inside building	30 ppm or 0.036 lb/mmBtu	30 ppm or 0.036 lb/mmBtu	
Tenter Frame or Fabric or Carpet Dryer	30 ppm or 0.036 lb/mmBtu		
Other Unit or Process Temperature	30 ppm or 0.036 lb/mmBtu	30 ppm or 0.036 lb/mmBtu	60 ppm or 0.073 lb/mmBtu
Liquid Fuel-Fired Equipment	≤ 800° F	> 800 ° F and < 1200° F	≥ 1200 ° F
All liquid fuel-fired Units	40 ppm or 0.053 lb/mmBtu	40 ppm or 0.053 lb/mmBtu	60 ppm or 0.080 lb/mmBtu

1. Emission limit applies to burners in units fueled by 100% natural gas that are used to incinerate air toxics, VOCs, or other vapors; or to heat a unit. The emission limit applies solely when burning 100% fuel and not when the burner is incinerating air toxics, VOCs, or other vapors. The unit shall be tested or certified to meet the emission limit while fueled with natural gas.

All in-use equipment subject to Rule 1147 with total heat input greater than 325,000 Btu/hr and emitting one pound or more of NOx per day must demonstrate compliance with Rule 1147 limits according to the schedule outlined below in Table L-CMB-02-B – Rule 1147 Compliance Schedule.

TABLE L-CMB-10-B

Rule 1147 Compliance Schedule (≥1 pound per day of NOx)

Equipment Category(ies)	Submit Permit Application	Unit Shall Be in Compliance
Specific UNIT		
Remediation UNIT manufactured and installed prior to March 1, 2012	Seven months prior to a combustion system modification, combustion system replacement or unit replacement or a relocation.	Upon combustion system modification, combustion system replacement or unit replacement or relocation beginning March 1, 2012
Evaporator, heated process tank, or parts washer with a District permit issued and operating prior to January 1, 2014	Seven months prior to combustion system modification, combustion system replacement or unit replacement	Upon combustion system modification, combustion system replacement or unit replacement
Tar Pot		All new permit applications beginning January 1, 2013
UNIT with Emissions ≥1 Pound/Day		
Afterburner, degassing unit, catalytic oxidizer, thermal oxidizer, vapor incinerator, fryer, or spray booth make-up air heater manufactured prior to 1998	December 1, 2013	July 1, 2014
Other UNIT manufactured prior to 1986	December 1, 2011	July 1, 2012
Other UNIT manufactured prior to 1992	December 1, 2011	July 1, 2012
Other UNIT manufactured prior to 1998	December 1, 2012	July 1, 2013
Any UNIT manufactured after 1997	December 1 of the year prior to the compliance date	July 1 of the year the unit is 15 years old

As of July 1, 2022, it is expected that the majority of non-RECLAIM equipment with daily NOx emissions greater than or equal to one pound subject to Rule 1147 would have implemented the NOx emission limits of Table L-CMB-10-B.

RECLAIM Program

The RECLAIM program, which is under Regulation XX, is a market-based emissions trading program designed to reduce NOx and Sulfur Oxides (SOx) emissions. The intent of RECLAIM was to reduce NOx and SOx emissions through a market-based approach for facilities with NOx or SOx emissions greater than or equal to four tons per year. The program replaced a series of existing and future command-and-control rules and was designed to provide facilities with compliance flexibility. RECLAIM was designed to achieve emission reductions in aggregate equivalent to what would occur under a command-and-control regulatory approach. When the NOx RECLAIM program was adopted, facilities were issued an annual allocation of RECLAIM Trading Credits (RTCs), which declined annually from 1993 until 2003 and remained constant after 2003. At the end of each compliance year, facilities in the RECLAIM program must hold

RTCs that are equal to or greater than the facility's actual emissions. Facilities have the option to purchase RTCs, reduce throughput, implement process modifications, or install pollution controls to reduce emissions. RECLAIM is designed to achieve Best Achievable Retrofit Control Technology (BARCT) in the aggregate.

Pursuant to Health and Safety Code Section 40440 and 39616, the South Coast AQMD is required to periodically assess the advancement in control technologies that are representative of BARCT to ensure that RECLAIM facilities achieve the same emission reductions that would have occurred under a command-and-control approach. Over the course of RECLAIM, there have been two BARCT reassessments for NOx in 2005 and 2015. The 2005 NOx shave target was 7.7 tons per day from 2007 to 2011 and the 2015 NOx shave was 12 tons per day from 2016 to 2022.

Sunsetting RECLAIM

During the adoption of the 2016 AQMP, the Governing Board approved a resolution that directed staff to "modify the 2016 AQMP control measure CMB-05 to achieve five tons per day of NOx emission as soon as feasible, and no later than 2025, and to transition the RECLAIM program to a command-and-control regulatory structure requiring BARCT level controls as soon as practicable." Furthermore, on July 26, 2017, California State Assembly Bill 617 – Nonvehicular Air Pollution: Criteria Air Pollutants and Toxic Air Contaminants (AB 617) was approved by the Governor, which addresses nonvehicular air pollution (criteria pollutants and toxic air contaminants). RECLAIM facilities that are in the cap-and-trade program are subject to the requirements of AB 617. Requirements include an expedited schedule for implementing BARCT for cap-and-trade facilities and a requirement for the air districts throughout California to adopt an expedited BARCT schedule by January 1, 2019, and to implement BARCT no later than December 31, 2023, by assigning the highest priority to those permitted units that have not modified emissions related permit conditions for the greatest period.

Proposed Amended Rule 1147

Proposed Amended Rule 1147 – NOx Reductions from Miscellaneous Sources (PAR 1147) was~~is scheduled to be~~ amended on April 1, 2022, and will facilitate the transition of facilities with applicable equipment to a command-and-control regulatory structure and partially implement Control Measure CMB-05 of the 2016 AQMP. The provisions of PAR 1147 are applicable to NOx emitting combustion equipment at approximately 3,000 facilities which include 85 RECLAIM facilities. PAR 1147 establishes tightened NOx concentration limit for 13 equipment categories and is projected to reduce approximately 1.59 tons of NOx per day by full implementation date of July 1, 2057.

Proposed Method of Control

Control measure L-CMB-10 seeks NOx emission reductions from miscellaneous permitted equipment greater than or equal to 325,000 Btu/hr located and will focus on:

Ultra-Low NOx Burners;
Low NOx Burners;
Selective Catalytic Reduction (SCR); and
Transition to Zero Emission Technology.

NOx Control technologies used for miscellaneous combustion applications focus on combustion control, which refers to reducing NOx at the point of formation by reducing the peak flame temperature utilizing various techniques. NOx control technologies such as ultra-low NOx burners and low- NOx burners have been in use for more than 30 years, but the technology continues to evolve and improve resulting in significant advancements in performance and NOx reduction efficiencies.

Ultra-Low NOx Burners (ULNB)

During the development of PAR 1147, NOx emissions observed from equipment source tests show NOx emissions of between 20 to 60 ppm depending on application; however, burner technologies observed from the development of Rule 1109.1 - Emissions of Oxides of Nitrogen from Petroleum Refineries and Related Operations (Rule 1109.1) observed next generation burner technologies capable of lower NOx emission potential. During the development of Rule 1109.1, the South Coast AQMD assessed burner technologies that were in the development stages that are considered emerging technologies. Emerging technologies have limited real-world installations but show promise of further commercialization and future installations. The next generation of ULNBs have a high potential for a wide range of applications in different types of processes.

Conventional ULNB typically operate between 20 to 60 ppmv when retrofitted into processes subject to Rule 1147. During rule development there may be encountered such challenges as flame dimension and space availability. Next generation ULNB such as ClearSign™ and Solex™ by John Zink Hamworthy can potentially alleviate some of these potential challenges and achieve a lower NOx concentration than conventional burners.

ClearSignTM

The ClearSign™ technology utilizes a porous ceramic surface where combustion is sustained. The combustion occurs inside the pores of the ceramic tile, resulting in reduced flame height and improved heat radiation. In addition, the fuel, air, and entrained flue gas are premixed prior to combustion at the ceramic surface resulting in lower flame temperatures and reaction times which reduce thermal NOx formation.

SOLEX™ burner technology

The SOLEX™ burner technology promises to achieve 5 ppmv or less regardless of fuel composition. To achieve the performance, the SOLEX™ burners requires advanced combustion control scheme along with a forced and induced draft fan. SOLEX™ burners can be retrofitted in up-fired, down-fired, and horizontally fired configurations.

The design of both burners also allows for a direct replacement within the existing burner footprint and address many of the short comings of conventional ULNB design and safety concerns associated with retrofit applications. Both burner technologies also offer the same level of reduction as selective catalytic reduction (SCR) systems for potentially much lower costs; however, these burner technologies are also being installed at heavy industrial processes such as refinery operations which are generally larger than the equipment currently regulated under Rule 1147. It is unknown at this time whether the technologies can be scaled to smaller processes seen in Rule 1147.

Zero Emission Technologies

This alternative would seek ways to require electrification of some combustion operations currently fired with gaseous or liquid fuel. NOx emission reduction can be achieved through electrification of various heat transfer equipment such as ovens, autoclaves, kilns, process heaters, or dryers. There are already instances of electric heat transfer equipment such as ovens and autoclaves operating within the South Coast AQMD. Much like their gas-fired counterparts, electric ovens and autoclaves are designed and engineered for site specific requirements. A fired process heater often has a relatively low thermal efficiency because of loss with the flue gases, especially in those without any preheater to cool the stack gases and recover the heat. Electric heaters also have potential for higher temperature applications such as kilns or tunnel kilns. A properly designed electric heating process with proper insulation can also achieve much higher efficiencies. Electrical radiant furnaces can be designed in a similar arrangement which consist of a heating coil to contain the process fluid being heated surrounded by radiant electric heating elements that can achieve temperatures up to 2,300 °F. This alternative needs to consider the load on existing electrical infrastructure if large quantities of combustion equipment are replaced with electrified versions.

Emission Reductions

Emission reductions for this control measure are estimated to be approximately ~~1.16~~1.01 tons per day by 2037 utilizing ULNBs and LNBs. NOx reductions can also be achieved with applications of SCR and electrification. Proposed Amended Rule 1147 seeks to reduce emissions of permitted miscellaneous combustion sources by 15 percent before 2025 with total reductions of 45 percent by full implementation in 2057. Staff anticipates rule development to be initiated between 2027 to 2030 to achieve emission reductions by 2037 by assessing the progress of SCR and zero emission technologies. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Rule Compliance and Test Methods

South Coast AQMD Method 100.1

Cost Effectiveness

The overall average cost-effectiveness for this control measure is $28,700 per ton of NOx reduced. Cost-effectiveness for this control measure can be considered similar to the cost-effectiveness for Proposed Amended Rule 1147 ~~in 2021~~ where the range of cost-effectiveness is dependent on the equipment class and category. ~~PAR 1147 estimated cost-effectiveness to be between $5,600 to $49,000 per ton of NOx reduced.~~ Some equipment with no changes to existing limits are determined to have no additional cost to comply; however, depending on the equipment category and associated technology assessment the cost could potentially increase or decrease.

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from these stationary sources.

References

South Coast Air Quality Management District. (2017). Final Staff Report Proposed Rule 1147 – NOx Reductions from Miscellaneous Sources. South Coast Air Quality Management District. June 2017.

South Coast Air Quality Management District. (2017). Final 2016 Air Quality Management Plan. South Coast Air Quality Management District. March 2017.

ECC-01: CO-BENEFITS FROM EXISTING AND FUTURE GREENHOUSE GAS PROGRAMS, POLICIES, AND INCENTIVES [NOx]

CONTROL MEASURE SUMMARY

SOURCE CATEGORY:	GHG PROGRAMS, POLICIES AND INCENTIVES				
CONTROL METHODS:	REDUCTIONS FROM PROGRAMS THAT REDUCE GHGS ALSO REDUCE CRITERIA POLLUTANTS				
EMISSIONS (TONS/DAY):					
ANNUAL AVERAGE		2018	2031	2032	2037
NOx INVENTORY		N/A	N/A	N/A	N/A
NOx REDUCTION			TBD	TBD	TBD
NOx REMAINING			TBD	TBD	TBD
SUMMER PLANNING		2018	2031	2032	2037
NOx INVENTORY		N/A	N/A	N/A	N/A
NOx REDUCTION			TBD	TBD	TBD
NOx REMAINING			TBD	TBD	TBD
CONTROL COST:	N/A				
INCENTIVE COST:	N/A				
IMPLEMENTING AGENCY:	VARIOUS AGENCIES				

Description of Source Category

Sources of greenhouse gases (GHG) are typically also emission sources of criteria pollutants. Federal, State, and local mandates and programs to reduce GHG emissions provide co-benefits of criteria pollutant reductions. This control measure targets to capture the co-benefits from existing and future GHG programs, policies, and incentives.

Background

The State of California has a successful history of fighting climate change and reducing GHG emissions. Significant efforts are currently being undertaken and planned to further reduce GHGs under the State's 2030, 2045, and 2050 targets. To help achieve GHG reductions, many different regulations, market mechanisms, and incentive programs are being implemented in California. As these GHG reduction efforts are undertaken across all sectors, the co-benefit reductions of criteria pollutants will be accounted for under this control measure.

Regulatory History

The State of California adopted the Global Warming Solutions Act of 2006 (AB 32) to develop regulations and programs that reduce California's GHG emissions 20 percent below 1990 levels by 2020, along with authorizing a Cap and Trade program. Under the Cap and Trade program, an emissions limit is placed on the largest stationary sources of GHGs, fuel providers, and imports of electricity. The emissions cap on these sources is lowered over time and entities under the cap may choose to reduce their emissions or purchase allowances from the market to cover their emissions. Under AB 32, CARB must develop a Scoping Plan every five years that describes the approach to meeting the State's GHG reduction targets. Since the adoption of AB 32 several regulations and programs have been implemented along with executive orders to reduce GHG levels in California 80 percent below 1990 levels by 2050 and a midterm target of 40 percent by 2030. California has also successfully reduced GHG emissions from the electricity generating facilities. Prior to the adoption of AB 32, California established a 20 percent renewable portfolio standard (RPS) mandate for investor-owned utilities in 2010. The RPS mandate was then expanded in 2011 to include municipal owned utilities along with establishing a new mandate of 33 percent by 2020. The three large investor-owned utilities and the majority of municipal owned utilities either met or surpassed the 2020 annual RPS target of 33 percent in 2020.[29] In 2015, as part of SB 350, the RPS mandate was expanded to be 50 percent by 2030 along with increasing efficiency of existing buildings (see ECC-02 for more details on energy efficiency measures).

In the last few years, California Legislature passed a suite of bills that seek to continue to reduce greenhouse gas emissions from various sectors including electricity generation as well as residential and commercial buildings. In 2018, California passed SB 100 (California Renewables Portfolio Standard Program: Emissions of Greenhouse Gases), which sets new standards to California's renewable portfolio by requiring the State to use 50 percent renewable electricity by 2026, 60 percent renewable electricity by 2030, and 100 percent carbon-free electricity by 2045. In addition, two new laws directed towards the State's building sector, AB 3232 (Zero-emissions Buildings and Sources of Heat Energy) and SB 1477 (Low-emissions Buildings and Sources of Heat Energy), were signed in 2018. AB 3232 requires the California Energy Commission (CEC) to assess, by January 1, 2021, the potential for reducing GHG emissions from California's residential and commercial buildings to 40 percent below 1990 levels by 2030. The assessment[30] identified key options and policies for increasing heating efficiency while reducing carbon emissions from the State's commercial and residential buildings. SB 1477 helps promote and implement clean heating technology in the State by providing $50 million per year through 2023 to encourage market-based development and adoption of low-emission, clean heating technologies for buildings. As part of the implementation of SB 1477, the CPUC created the Technology and Equipment for Clean Heating (TECH) Program and the Building Initiative for Low Emissions Development (BUILD) Program. The two programs are designed to provide incentives to reduce carbon emissions in buildings. In 2018, Governor

[29] https://www.cpuc.ca.gov/-/media/cpuc-website/industries-and-topics/documents/energy/rps/cpuc-2021-rps-annual-report-to-legislature.pdf.

[30] https://www.energy.ca.gov/data-reports/reports/building-decarbonization-assessment.

Brown also signed Executive Order B-55-18, committing California to total, economy-wide carbon neutrality by 2045.

At the federal level, the U.S. EPA is establishing regulations to limit the emissions of GHGs from stationary and transportation sources. Recently, federal targets have been established to achieve a 50-52 percent reduction from 2005 levels in economy-wide GHGs by 2030, create a carbon pollution-free power sector by 2035, and net zero emissions economy-wide by 2050.

Proposed Method of Control

GHG reductions being implemented through federal, State, and local programs are being implemented across multiple energy sectors and are generally mandated by law. The GHG emission reductions are being implemented through several mechanisms such as market programs, renewable energy targets, incentive and rebate programs, and promoting implementation and development of new technologies.

Within California, market mechanisms such as the Cap and Trade program provide GHG emissions monitoring, emissions caps, and emissions trading for required entities. Revenues generated from the Cap and Trade program are mandated to be further invested in GHG reductions. Other programs such as the Renewable Portfolio Standards require the procurement of renewable power onto the electrical grid. While many regulations are already in place, more regulations will likely be implemented at the State and federal levels along with new mechanisms for GHG emission reductions. Overall, California sets ambitious goals to promote clean technologies and reduce GHG emissions across all sectors. These State climate policies will result in NOx reduction co-benefits in the mid to long term time frame.

Under this control measure, the criteria pollutant co-benefits associated with GHG reductions will be quantified and accounted for towards attainment of federal ozone standards. Existing and future incentives, programs, and partnerships will be evaluated for reduction of emissions of both GHGs and criteria pollutants. The South Coast AQMD will also work closely with other agencies and stakeholders to focus GHG reduction programs within the South Coast Basin to maximize emission reductions across all pollutants. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Emission Reductions

TBD.

Rule Compliance and Test Methods

Performance of GHG reductions and criteria pollutant co-benefits will be measured through the relevant agencies' enforcement of GHG requirements as well as the South Coast AQMD and State agencies emission inventories along with reductions achieved through specific programs.

Cost Effectiveness

Because this control measure relies on other programs, no additional costs other than relatively minor administrative costs are anticipated as a direct result of this control measure.

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from stationary sources and will work with other regulatory agencies, businesses, and other stakeholders in implementation and program enhancements for the both the transportation and stationary sectors.

References

California's 2030 Climate Commitment: Double Energy Savings in Existing Buildings & Develop Cleaner Heating Fuels by 2030: http://www.arb.ca.gov/html/fact_sheets/2030_energyefficiency.pdf

U.S. EPA, "Roadmap for Incorporating Energy Efficiency/Renewable Energy Policies into State and Tribal Implementation Plans," 2012.

SB350 Clean Energy and Pollution Reduction Act of 2015: http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350

California's Existing Buildings Energy Efficiency Action Plan: http://www.energy.ca.gov/ab758/

2015 Draft Integrated Energy Policy Report (CEC-100-2015-001-CMD): http://www.energy.ca.gov/2015_energypolicy/

2015-2025 California Energy Demand Updated Forecast (CEC-200-2014-009-CMF): http://www.energy.ca.gov/2014publications/CEC-200-2014-009/CEC-200-2014-009-CMF.pdf

ECC-02: CO-BENEFITS FROM EXISTING AND FUTURE RESIDENTIAL AND COMMERCIAL BUILDING ENERGY EFFICIENCY MEASURES [NOx, VOCs]

CONTROL MEASURE SUMMARY

SOURCE CATEGORY: EXISTING RESIDENTIAL AND COMMERCIAL POWER AND FUEL USE

CONTROL METHODS: REDUCED ENERGY USE

EMISSIONS (TONS/DAY):

ANNUAL AVERAGE	2018	2031	2032	2037
NOx INVENTORY	33.46~~32.3~~	28.04~~27.1~~	27.65~~26.7~~	26.22~~25.3~~
NOx REDUCTION		TBD	TBD	TBD
NOx REMAINING		TBD	TBD	TBD
SUMMER PLANNING	2018	2031	2032	2037
NOx INVENTORY	24.51~~22.8~~	22.25~~21.0~~	22.12~~20.8~~	21.55~~20.3~~
NOx REDUCTION		TBD	TBD	TBD
NOx REMAINING		TBD	TBD	TBD
ANNUAL AVERAGE	2018	2031	2032	2037
VOC INVENTORY	4.45~~3.9~~	4.58~~3.9~~	4.59~~3.9~~	4.62~~3.9~~
VOC REDUCTION		TBD	TBD	TBD
VOC REMAINING		TBD	TBD	TBD
SUMMER PLANNING	2018	2031	2032	2037
VOC INVENTORY	4.01~~3.4~~	4.18~~3.5~~	4.19~~3.5~~	4.23~~3.6~~
VOC REDUCTION		TBD	TBD	TBD
VOC REMAINING		TBD	TBD	TBD

CONTROL COST: N/A

INCENTIVE COST: N/A

IMPLEMENTING AGENCY: VARIOUS AGENCIES

Description of Source Category

Energy consumption in existing residential and commercial buildings results in direct and indirect emissions of criteria pollutants, toxics, and greenhouse gases. Direct emissions result from combustion of fuels such as natural gas, propane, and wood. -Indirect emissions are a result of energy use requiring electricity production from power sources, many of which burn fossil fuels. Improvements in residential weatherization and other efficiency measures provide emission reductions through reduced energy use for heating, cooling, lighting, cooking, and other needs.

Background

In 1978, California adopted the of the California Code of Regulations building energy standards. The building energy standards adopted within Title 24 have been routinely made stronger since that time. The strengthening of Title 24 standards along with new building materials and more efficient appliances has resulted in newly constructed residences and commercial buildings being more efficient than previous constructions.

In addition to the Title 24 building energy standards, there are multiple programs that provide incentives, rebates, and loans for efficiency projects on residential and commercial structures. These assistance programs are largely administered through servicing utilities for the property and are voluntary. Despite the availability of multiple assistance programs and the many benefits from undertaking energy savings measures, there remain many barriers to overcome. -One of the challenges is increasing energy efficiency within rental and leased properties where tenants are often responsible for utility costs. Within the Basin it is estimated that 48 percent of the residential properties are occupied by tenants. Other barriers to undertaking these projects are identifying the most worthwhile and cost-effective projects, finding suited contractors, and capital to fund the projects.

In California and the Basin there is significant potential to achieve large energy reductions from retrofitting existing buildings. Within the Basin, about 60 percent of the residential structures were constructed before 1979 when the California Title 24 building energy standard was first implemented. Additionally, energy efficiency measures provide cumulative benefits when implemented. Increased deployment and accelerating the rate of implementation of existing programs provides benefits in reduced energy costs, energy infrastructure needs, and emissions of greenhouse gases, toxics, and criteria pollutants. To further realize these benefits the State of California passed the Clean Energy Pollution Reduction Act of 2015 (SB 350) that sets a path to double the energy efficiency savings for electricity and natural gas use by retail customers and increase renewable energy sources from 33 to 50 percent by 2030. The bill establishes a legal mandate by requiring the State Energy Resources Conservation and Development Commission (California Energy Commission or CEC) to establish annual targets for statewide energy efficiency savings and demand reduction that will achieve a cumulative doubling of statewide energy efficiency savings in electricity and natural gas final end uses of retail customers by January 1, 2030. The bill would require the Public Utilities Commission to establish efficiency targets for electrical and gas corporations consistent with this goal. The bill would also require local publicly owned electric utilities to establish annual targets for energy efficiency savings and demand reduction consistent with this goal.

Regulatory History

The U.S. EPA has recognized the importance of efficiency and renewable energy efforts in reducing emissions. In July 2012, the U.S. EPA released the Roadmap for Incorporating Energy Efficiency/Renewable Energy Policies into State and Tribal Implementation Plans. Under the guidance of this document, the emissions benefits not yet accounted for within the baseline inventory from efficiency measures set into action can be accounted for within State Implementation Plans as control measures. Emission reductions from efficiency efforts of SB 350 are reflected in the 2020 California Gas Report[31] and the baseline inventory for 2022 AQMP. Meanwhile, significant efforts are currently being undertaken and planned to further reduce GHGs under the State's 2030, 2045, and 2050 targets. In the last few years, California Legislature passed a suite of bills that seek to reduce greenhouse gas emissions from various sectors including electricity generation as well as residential and commercial buildings. In 2018, California passed SB 100 (California Renewables Portfolio Standard Program: Emissions of Greenhouse Gases), which sets new standards to California's renewable portfolio by requiring the State to use 50 percent renewable electricity by 2026, 60 percent renewable electricity by 2030, and 100 percent carbon-free electricity by 2045. In addition, two new laws directed towards the State's building sector, AB 3232 (Zero-emissions Buildings and Sources of Heat Energy) and SB 1477 (Low-emissions Buildings and Sources of Heat Energy), were signed in 2018. AB 3232 requires the California Energy Commission (CEC) to assess, by January 1, 2021, the potential for reducing GHG emissions from California's residential and commercial buildings to 40 percent below 1990 levels by 2030.[32] The assessment identified key options and policies for increasing heating efficiency while reducing carbon emissions from the State's commercial and residential buildings. SB 1477 helps promote and implement clean heating technology in the State by providing $50 million per year through 2023 to encourage market-based development and adoption of low-emission, clean heating technologies for buildings. In 2018, Governor Brown also signed Executive Order B-55-18, committing California to total, economy-wide carbon neutrality by 2045.

Overall, California sets ambitious goals to promote clean technologies and decrease energy use in California's existing and new building stock. Reducing, managing, and changing the way energy is used in the commercial and residential sectors can provide additional emission reductions, reduce energy costs, and provide multiple environmental benefits. These State climate policies will result in NOx reduction co-benefits in the mid to long term time frame.

Proposed Method of Control

The South Coast AQMD has worked with the local utilities and contractors to implement weatherization programs within the Environmental Justice Communities of Coachella Valley, Boyle Heights, San Bernardino and San Fernando Valley areas. South Coast AQMD staff will work with agencies, utilities, and

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[31] 2020 California Gas Report. https://www.socalgas.com/sites/default/files/2020-10/2020_California_Gas_Report_Joint_Utility_Biennial_Comprehensive_Filing.pdf

[32] California Building Decarbonization Assessment- Final Commission Report. https://efiling.energy.ca.gov/GetDocument.aspx?tn=239311&DocumentContentId=72767

other stakeholders to further implement weatherization and other measures that provide energy savings along with emission reductions within the Basin.

Co-benefits from other existing and future residential and commercial building energy efficiency measures, such as Title 24 building energy standards, and incentive programs such as the Building Initiative for Low-Emissions Development (BUILD) Program will be monitored, and the energy savings and criteria pollutant emission benefits will be quantified. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Emission Reductions

Weatherization and other efficiency measures are typically permanent measures that provide cumulative benefits. The existing energy efficiency programs are having impacts on emission reductions, such as implementation of SB 350, are generally taken into account within the baseline emissions inventory. Any future federal, State or local programs that significantly enhances the State's renewable energy and efficiency targets will result in co-benefits of NOx/VOC reductions. The emission benefits from other existing and future energy efficiency measures would result in less fuel use such as natural gas usage. The South Coast AQMD will continue to evaluate opportunities for additional feasible NOx reductions in existing and new residential and commercial buildings through regulatory or incentive-based programs, and an evaluation of the benefits of these existing and emerging energy programs not reflected in the baseline inventory will be evaluated and quantified.

Rule Compliance and Test Methods

N/A

Cost Effectiveness

No additional costs are anticipated beyond those that would otherwise be allocated to reduce GHG emissions through State programs. This measure seeks merely to quantify criteria pollutant reductions from these GHG programs. Furthermore, weatherization and efficiency measures, when appropriately applied, can realize short payback periods from reduced energy costs (two–seven years).

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from stationary sources and will work with other regulatory agencies to help implement this control measure.

References

California's 2030 Climate Commitment: Double Energy Savings in Existing Buildings & Develop Cleaner Heating Fuels by 2030: http://www.arb.ca.gov/html/fact_sheets/2030_energyefficiency.pdf

U.S. EPA, "Roadmap for Incorporating Energy Efficiency/Renewable Energy Policies into State and Tribal Implementation Plans," 2012.

SB350 Clean Energy and Pollution Reduction Act of 2015:
http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350

California's Existing Buildings Energy Efficiency Action Plan: http://www.energy.ca.gov/ab758/

SB100: California Renewables Portfolio Standard Program: Emissions of Greenhouse Gases (2018):
https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB100

AB3232: Zero-Emissions Buildings and Sources of Heat Energy (2018):https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB3232

2020 California Gas Report: https://www.socalgas.com/sites/default/files/2020-10/2020_California_Gas_Report_Joint_Utility_Biennial_Comprehensive_Filing.pdf

2021 Draft Integrated Energy Policy Report (CEC-100-2020-001-V3-CMD):
https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2021-integrated-energy-policy-report

2021-2035 California Energy Demand Updated Forecast:
https://efiling.energy.ca.gov/GetDocument.aspx?tn=241239

ECC-03: ADDITIONAL ENHANCEMENTS IN REDUCING EXISTING RESIDENTIAL BUILDING ENERGY USE

[NOx, VOCs]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	EXISTING RESIDENTIAL POWER AND FUEL USE			
CONTROL METHODS:	REDUCED ENERGY USE BEYOND EXISTING REGULATIONS			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	**2018**	**2031**	**2032**	**2037**
NOx INVENTORY	18.36~~18.96~~	14.09~~14.50~~	~~14.16~~13.77	12.67~~13.02~~
NOx REDUCTION		TBD	TBD	TBD
NOx REMAINING		TBD	TBD	TBD
SUMMER PLANNING	**2018**	**2031**	**2032**	**2037**
NOx INVENTORY	11.15~~11.49~~	9.73~~10.01~~	9.64~~9.90~~	9.29~~9.53~~
NOx REDUCTION		TBD	TBD	TBD
NOx REMAINING		TBD	TBD	TBD
ANNUAL AVERAGE	**2018**	**2031**	**2032**	**2037**
VOC INVENTORY	1.21~~1.27~~	1.18~~1.23~~	1.18~~1.22~~	1.17~~1.20~~
VOC REDUCTION		TBD	TBD	TBD
VOC REMAINING		TBD	TBD	TBD
SUMMER PLANNING	**2018**	**2031**	**2032**	**2037**
VOC INVENTORY	0.85~~0.89~~	0.84~~0.86~~	0.84~~0.87~~	0.83~~0.85~~
VOC REDUCTION		TBD	TBD	TBD
VOC REMAINING		TBD	TBD	TBD
CONTROL COST:	TO BE DETERMINED			
INCENTIVE COST:	TO BE DETERMINED			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

Description of Source Category

Energy consumption in residential and commercial buildings results in direct and indirect emissions of criteria pollutants, toxics, and greenhouse gases. Direct emissions result from combustion of fuels such as natural gas, propane, and wood. Indirect emissions are a result of electricity generation with fossil fuel. Efficiency improvements within the residential sector provide emission reductions along with reducing energy costs and help alleviate the need for additional energy infrastructure. Efforts in the residential sector under this control measure include weatherization, the use of energy efficient appliances and addition of solar thermal and solar photovoltaic systems. Co-benefit reductions from existing and future energy efficiency programs are accounted for in control measure ECC-02 (Co-benefits from Existing and Future Residential and Commercial Building Energy Efficiency Measures).

ECC-03 seeks to maximize emission reductions by implementing advanced highly efficient zero emission appliance technologies and efficiency measures when cost-effective and feasible, including weatherization along with renewable energy sources and low NOx emission technologies, such as renewable gas, in all other applications. This measure is designed to reduce end use energy consumption and provide emission reductions within existing residences. Implementation will be coordinated with utilities and other agencies to leverage and enhance existing programs, and maximize energy savings and emission reductions.

Background

Improved appliance efficiencies, declining renewable energy prices, weatherization, and other demand-side energy measures have been shown to reduce the need for new energy infrastructure. The building energy standards adopted in California's Title 24, along with Title 20 appliance efficiency standards, have routinely become more efficient. In California, the strengthening of these building energy and appliance codes has resulted in newly constructed residences and buildings being more efficient than previous construction. Within the Basin, there is extremely high potential to reduce end use residential and commercial energy usage. Over 60 percent of the residential structures in Southern California were built before 1979 when the California Title 24 building energy standard was first implemented.

There are multiple programs that provide incentives, rebates, and loans for efficiency projects on residential and commercial structures that can assist in going beyond current regulations and enhance existing programs. One such opportunity could be targeting increased energy efficiency within rental and leased properties (approximately 48 percent in the region) where tenants are often responsible for utility costs. In California and the Basin, there is significant potential to achieve large energy reductions from retrofitting existing buildings. Additionally, energy efficiency measures provide cumulative long-term benefits once implemented. Accelerating implementation of these measures provides additional benefits in reduced energy costs, energy infrastructure needs, and reductions of emissions of greenhouse gases, toxics, and criteria pollutants.

Combustion appliances within residences account for the majority of direct emissions within the residential sector. Appliances are considered durable goods and most appliances last one or two decades before needing replacement. The South Coast AQMD has several regulations including Rules 1121, 1146.2, and 1111, which establish limits on NOx emissions from combustion sources such as water heaters, pool heaters, and furnaces. Other residential combustion sources include cook stoves, and fireplaces. While the South Coast AQMD regulations established NOx emission thresholds, there are zero and ~~near-zero~~low NOx appliances that can provide further emission reductions and energy efficiency co-benefits beyond most existing and replacement appliances. This is especially true when appliances are coupled with renewable resources such as solar photovoltaic and/or solar thermal systems. Payback periods from these actions with small incentives can be as short as 2 to 3 years depending on the cost of the equipment, available incentives, efficiency gains, and energy prices.

Many appliances such as water heaters are now available with energy factors (EF) greater than 0.8 for natural gas pilotless storage and EF levels over 2.4 for heat pump storage systems. While these highly efficient water heaters have higher upfront costs, savings from efficiency gains often make them attractive options. These longer-term benefits from higher efficiency appliances are often not apparent to consumers who generally look at upfront purchase prices. Therefore, the voluntary incentive program will encourage the purchase of these higher efficiency appliances in the Basin. High efficiency pool heaters, furnaces, and cook stoves are also available.

Declining costs in renewable energy and solar thermal heating sources can be coupled with existing appliances and/or be implemented with new appliances along with weatherization efforts. In the residential sector, solar thermal heating can help offset heating energy needs from water heaters, pool heaters, and, in some instances, clothes dryers. Solar thermal energy sources can range from rooftop heating systems to pool covers.

Traditionally, adding solar photovoltaics was done after load reductions occurred through weatherization and appliance upgrades. However, rapidly declining costs in solar photovoltaics provides an inexpensive technology to add electrical generation that can be coupled with highly efficient appliances, such as heat pump furnaces and water heaters, which help reduce electricity costs. A households' potential for improving appliance efficiency and weatherization could be coupled with the evaluation of solar opportunities when contractors review residences for solar panel additions. Sizing of the solar panel installations could then be adjusted for efficiency gains or increased electrical loads resulting from appliance replacements. A similar approach can be taken with solar thermal hot water heaters.

The increased appliance efficiencies and emission reductions within this measure will be surplus to current South Coast AQMD regulations and existing efficiency programs. This measure will be implemented in collaboration with State agencies and local utilities to develop incentive efforts. Additionally, other technologies and market programs, such as energy storage and smart grid measures like grid connected electric water heaters are expected to become less costly and incentivized more widely by utilities. The use of appliances as grid resources will be evaluated and considered during the development and implementation phases of this measure. Other residential combustion appliances, such as fireplaces, furnaces, space heaters, outdoor heaters will also be evaluated for energy efficiency and eligibility for potential incentives.

The R-CMB control measure series primarily focuses on NOx reduction however, all regulations, actions, and incentive programs directed at residential appliances will consider both energy efficiency and NOx emissions. Zero emission and high efficiency applications will be prioritized to the extent they are feasible and cost-effective at the time of implementation. Lastly, the South Coast AQMD will collaborate with utilities, agencies, and other organizations to attract funding and distribute them in coordination with similar existing programs.

Regulatory History

The U.S. EPA provided a guidance to acknowledge emission benefits from energy efficient measures and renewable energy mandates. While such measures are reflected in the baseline emissions, such as reduced natural gas consumption due to the requirement of energy efficiency, not all of them may be reflected in the baseline emissions due to challenges in quantifying such reductions. In such case, those reductions will be quantified to the extent feasible and reflected as benefit from this control measure. Emission reductions from efficiency efforts beyond current requirements and the use of smart grid technology will primarily be achieved through ambitious incentives and outreach.

Proposed Method of Control

The South Coast AQMD has worked with local utilities and contractors to implement weatherization programs within the Environmental Justice Communities of Coachella Valley, Boyle Heights, San Bernardino and San Fernando Valley areas, helping to lower the implementation barrier of weatherization and smart grid efforts within Environmental Justice Communities.

South Coast AQMD staff will work with agencies, utilities, and other stakeholders to further implement weatherization and other measures that provide energy savings focusing on emission reductions within the Basin. South Coast AQMD staff will also assist in developing new tools or improving current tools that help effectively implement efficiency measures along with quantifying energy savings, emissions benefits along with educating consumers about short payback periods and cost savings opportunities.

Implementation of smart grid technology and other energy efficiency weatherization programs for residential buildings can be incentivized through voluntary public participation. To obtain credit in the SIP with emission reductions resulting from implementation, the integrity elements must be satisfied that are described in detail in the "Incentives Implementation" section. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Incentives Implementation

The proposed weatherization, smart grid and efficiency measures would be implemented through voluntary incentive programs and resulting emission reductions must satisfy the following *Integrity Elements* criteria for SIP credit to be given for emission reductions. In addition, individual ~~VIPs~~ voluntary incentive programs should be developed according to specific guidelines.

Integrity Elements

Emission reductions that are projected to be achieved from the voluntary incentive measures must be demonstrated to be quantifiable, surplus, enforceable, and permanent. This demonstration must include project type(s); project life; applicable incentive program guideline(s), by title, year, chapter(s); and analysis of applicable incentive program guideline(s) for consistency with integrity elements. For the purposes of this demonstration, the following provides examples of the key elements:

Quantifiable: Emission reductions are quantitatively measurable and are supported by existing and acceptable technical data. The quantification should use well-established, publicly available, and approved emission factors and accepted calculation methodology. In developing the quantification methodologies, the guidance provided within the *EPA Roadmap for Incorporating Energy Efficiency/Renewable Energy Policies into State and Tribal Implementation Plans* will be followed. There must be procedures to evaluate and verify over time the level of emission reductions actually achieved.

Example (1): A residence is having solar panels installed and has an older gas storage water heater. The South Coast AQMD, through outreach and/or partnerships with solar panel installation companies, is incentivizing the replacement of older inefficient water heaters. The panel installers while installing panels can also provide a quote for a new water heater and/or pool heater, which will be installed if the homeowner agrees. Knowing the make and model of the existing water heater along with the efficiency and any emissions of the new high efficiency water heater provides a basis for calculating the reductions.

Example (2): Within an area, there are existing residences that are in need of weatherization along with other efficiency efforts and have rooftops conducive for solar panels and/or solar thermal systems. Undertaking this control measure within large residential areas can be quantified before and after implementation from aggregated utility data.

Surplus: Emission reductions must be above and beyond any existing district, State, or federal regulation and not included in the baseline inventory. Emission reductions used to meet air quality attainment requirements are surplus as long as they are not otherwise relied on in the SIP, SIP-related requirement, other State air quality programs adopted but not in the SIP, a consent decree, or federal rules that focus on reducing criteria pollutants or their precursors. In the event that a voluntary incentive program's emission reductions are relied on to meet air quality-related program requirements, they are no longer surplus. In addition, the emission reductions are available only for the remaining useful life of the equipment being replaced (e.g., if the equipment being replaced had a remaining useful life of five years, the additional emission reductions from the new equipment are available for SIP purposes under this guidance only for five years).

Enforceable: The South Coast AQMD will be responsible for assuring that the emission reductions credited in the SIP will occur. Emission reductions and other required actions are enforceable if:

- They are independently verifiable;
- Program violations are defined;
- Those liable for emission reductions can be identified;
- The South Coast AQMD and the U.S. EPA maintain the ability to apply penalties and secure appropriate corrective action where applicable;
- The general public have access to all the emissions-related information obtained from the source;
- The general public can file suits against sources for violations (with the exception of those owned and operated by Tribes); and
- They are practically enforceable in accordance with other U.S. EPA guidance on practicable enforceability.

Actual emission reductions, for example, can be assured through replacement equipment registration, recordkeeping and reporting, and inspections (initial inspection after installation and subsequent on a regular basis thereafter, if needed) throughout the term. Specific enforcement mechanisms will be addressed in the guidelines for the individual incentive measures.

Permanent: The emission reductions need to be permanent throughout the term for which the credit is generated. The emission reductions are permanent if these reductions are ensured to occur over the duration of the ~~VIP~~voluntary incentive program, and for as long as they are relied upon in the SIP.

For example, those awarded incentives will ensure the projects are properly implemented and the reductions are occurring and will continue to occur. Thus, recipients of the incentive awards would agree to a third-party inspection along with contract provisions, such as recordkeeping and reporting to track reductions and agreements that newly installed equipment would not be removed without the South Coast AQMD's concurrence (i.e., permanent placement) and the proof that the replaced equipment would be destroyed or at least not be operated within the Basin (e.g., pictures, certification). Detailed procedures to ensure permanent reductions will be described in the guidelines for the Individual Incentive Program.

Guidelines

Each voluntary incentive program needs to have detailed and comprehensive guidelines that are approved by the South Coast AQMD Governing Board. The guidelines will include the protocol to implement the program, to ensure SIP approvability:

Voluntary incentive program should demonstrate compliance with the four key elements of the ~~VIP~~voluntary incentive program: quantifiable emission reductions plus incentive costs, surplus reductions, enforceable compliance and permanent reductions.

Working group should be established to solicit public input and feedback during ~~VIP~~ voluntary incentive program guideline development.

Process and procedures to apply for incentives should be clearly explained in the guideline.

It needs to clearly describe how incentives would be awarded (e.g., priority to high emitters and/or age of equipment, tiered process, first come first serve, or EJ area priority).

It should have conditions of some form for agreement (e.g., contracts) including tracking and ensuring permanent reductions. The following forms should be prepared:

Application Forms (samples are required).

Contracts with Conditions (samples are required).

Product Example.

Tracking mechanism is required to ensure overall effectiveness of program and procedures to correct emission projections, such as reductions by the committed target date and submittal to the U.S. EPA annually. Tracking checklist should include:

Project Title.

Product.

Annual Emission Reductions (e.g., from 2023 to 2037, incremented by one year).

Life of project (e.g., 10 years).

Installation dates (e.g., fixed year 2023 or multiple installation years 2023 and 2024).

Possible recordkeeping, reporting, and monitoring requirements need to be addressed.

Individual outreach efforts (e.g., social media, email blasts) to promote the program, make aware of deadlines to apply, and provide timing locations of workshops.

Program guidelines should be approved by the South Coast AQMD Governing Board and published online.

Emission Reductions

Weatherization, high efficiency appliances, renewable energy and smart grid measures are typically long-term measures that provide cumulative benefits. Existing energy efficiency programs with impacts on emission reductions are generally incorporated into the baseline emissions inventory. Emission benefits expected from actions going beyond SB 350 and Title 24 building energy standards are not yet within the 2022 AQMP future year emissions inventory. Accelerated focused deployment, additional programs, and additional incentives within the Basin can achieve NOx emission reductions beyond existing efficiency programs and regulations. The reduction in NOx emissions would largely be the result of less natural gas and electricity usage, and the magnitude of these benefits will be evaluated and quantified.

Rule Compliance and Test Methods

Not Applicable.

Cost Effectiveness

Cost-effectiveness is the cost of the control measure per reduction of emissions of a particular pollutant, represented by the unit of dollar per ton of pollutant reduced. The cost-effectiveness of this control measure varies based on many factors including the type of appliance to be replaced, infrastructure of the existing building, and the potential change in utility cost. ECC-03 pursues to maximize emission reductions by implementing advanced highly efficient zero emission appliance technologies and efficiency measures such as enhanced weatherization when cost-effective and feasible. Electric heat pump space and water heaters are found to be the most cost-effective high efficiency appliances, along with incorporating pool heaters and covers under current market and technology conditions. ~~For example, in control measure R-CMB-01, the cost-effectiveness for heat pump water heating was determined to be $0 to $230,000 per ton of NOx reduced. Similar cost analysis was done for heat pump space heating under R-CMB-02, where the cost-effectiveness ranges from $0 to $200,000 per ton of NOx reduced.~~ Adding solar thermal or solar photovoltaic systems can reduce energy costs, making these technologies more affordable in the long-term.

On the other hand, incentives such as rebates could lower the upfront cost. Incremental cost may be partially offset by local utility companies and State agencies who have proposed incentives for heat pumps (e.g., California TECH Initiative) or panel upgrades. Income-qualified homeowners in disadvantaged communities can be qualified for a free solar panel system to offset incremental utility costs. Incentivizing the purchase of a pool cover is the most cost-effective option at the lower end of the incentive cost range while weatherizing an entire existing home or installing a solar thermal pool heating system is at the higher end of the incentive cost range. The cost for heat pumps might be lowered when the market achieves greater penetration. Technology advancement in residential appliances may also lower the cost of equipment.

Overall, cost-effectiveness for this control measure varies depending on the type of appliance to be replaced, existing infrastructure, the potential change in utility cost, and the availability of incentives from other programs. As a result, the cost-effectiveness will be determined as incentive programs and projects are developed.

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from stationary sources and will work with other regulatory agencies, utilities, industry groups, and stakeholders to help develop and implement incentives under this control measure.

References

California's 2030 Climate Commitment: Double Energy Savings in Existing Buildings & Develop Cleaner Heating Fuels by 2030: http://www.arb.ca.gov/html/fact_sheets/2030_energyefficiency.pdf

U.S. EPA, Roadmap for Incorporating Energy Efficiency/Renewable Energy Policies into State and Tribal Implementation Plans, July 2012. https://www.epa.gov/sites/default/files/2016-05/documents/eeremanual_0.pdf

SB350 Clean Energy and Pollution Reduction Act of 2015: http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350

California's Existing Buildings Energy Efficiency Action Plan: http://www.energy.ca.gov/ab758/

Opportunities for Energy and Economic Savings by Replacing Electric Resistance Heat with Higher Efficiency Heat Pumps, American Council for an Energy-Efficient Economy, Report #A1603, May 2016.

Gas Swimming Pool Heaters, Department of Energy: energy.gov/energysaver/gas-swimming-pool-heaters

SB100: California Renewables Portfolio Standard Program: Emissions of Greenhouse Gases (2018): https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB100

AB3232: Zero-Emissions Buildings and Sources of Heat Energy (2018):https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB3232

2020 California Gas Report: https://www.socalgas.com/sites/default/files/2020-10/2020_California_Gas_Report_Joint_Utility_Biennial_Comprehensive_Filing.pdf

2021 Draft Integrated Energy Policy Report (CEC-100-2020-001-V3-CMD): https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2021-integrated-energy-policy-report

2021-2035 California Energy Demand Updated Forecast: https://efiling.energy.ca.gov/GetDocument.aspx?tn=241239

California Energy Commission, Building Energy Efficiency Standards - Title 24. https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards

Energy-Solution, California TECH Initiative. https://energy-solution.com/tech/

Navigant Consulting, Inc., Impacts of Residential Electrification, August 2018.
https://efiling.energy.ca.gov/GetDocument.aspx?tn=224761

Energy and Environmental Economics, Inc., Residential Building Electrification in California, April 2019.
https://www.ethree.com/wp-content/uploads/2019/04/E3_Residential_Building_Electrification_in_California_April_2019.pdf

GRID Alternatives, Disadvantaged Communities - Single-family Solar Homes (DAC-SASH) Program.
https://www.gridsolar.org/sceresidentialpage/

FUG-01: IMPROVED LEAK DETECTION AND REPAIR [VOCs]

CONTROL MEASURE SUMMARY

SOURCE CATEGORY:	FUGITIVE EMISSION SOURCES			
CONTROL METHODS:	IMPROVED/EXPANDED LEAK DETECTION PROGRAMS			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
VOC INVENTORY	~~3.58~~3.72	~~4.01~~4.24	~~4.28~~4.26	~~4.16~~4.41
VOC REDUCTION	-	-	0.6	0.6
VOC REMAINING	-	~~3.41~~4.24	~~3.68~~4.26	~~3.56~~3.81
SUMMER PLANNING	2018	2031	2032	2037
VOC INVENTORY	~~3.59~~3.73	~~4.03~~4.25	~~4.29~~4.27	~~4.17~~4.42
VOC REDUCTION	-	-	0.6	0.6
VOC REMAINING	-	~~3.43~~4.25	~~3.69~~4.27	~~3.57~~3.82
CONTROL COST:	~~$18,600 PER TON OF VOC REDUCED~~ DCF METHOD: $30,000/TON OF VOC REDUCED. MODIFIED LCF METHOD: $47,800/TON OF VOC REDUCED			
INCENTIVE COST:	N/A			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

Description of Source Category

This proposed control measure would reduce emissions of volatile organic compounds (VOC) from fugitive leaks from process and storage equipment from a variety of sources including, but not limited to, oil and gas production, petroleum refining, chemical products processing, storage and transfer, marine terminals, and other. Some of these facilities are subject to leak detection and repair requirements established by the South Coast AQMD and the U.S. EPA that include periodic VOC concentration measurements using an approved portable organic vapor analyzer (OVA) to identify leaks. This measure would implement the use of advanced leak detection technologies including optical gas imaging (OGI) devices, open path detection devices, and gas sensors for earlier detection of VOC emissions from leaks.

Background

Fugitive VOC leaks have been the subject of control measures in previous AQMPs since VOCs are ozone and PM 2.5 precursors and some VOCs have toxic properties. Several South Coast AQMD rules affect petroleum and chemical plants and have requirements for periodic component leak inspections. These facilities are often located in or near environmental justice (EJ) communities, and the reduction of toxic VOCs has direct benefits for the communities surrounding them.

Fugitive leaks are generally detected with handheld OVA monitors that measure the VOC concentration of the vapor emitted from a component, using the U.S. EPA Reference Method 21. This current leak detection method has been successful in significantly reducing fugitive VOC emissions from a variety of sources. However, the latest technology provides opportunities for further improvements in the efficiency of the conventional leak detection and repair (LDAR) programs and for further emissions and cost reductions.

In the early 1970s, the U.S. EPA initiated the Petroleum Refinery Assessment Study, which developed average emission factors for each type of piping component (valve, flange, pump, etc.) and concluded that mass emissions rates are dependent on the phase of the process stream (gas/vapor, light liquid and heavy liquid) and the relative volatility of the liquid stream. Mass emissions from fugitive leaks can be calculated based on data from the 1994 Refinery Equipment Leak Report, which are specific to each type of component, such as valve, flange, pump, compressor, etc. Newer leak detection technologies have the ability to identify and measure mass emission rates of leaks.

In the past few years, the South Coast AQMD funded two optical remote sensing demonstration studies to determine the feasibility of emissions monitoring using different optical remote sensing techniques at large refineries. Overall, these projects have demonstrated that ORS techniques can be successfully used to accurately characterize and quantify emissions. It was also concluded that longer term measurements (e.g., one month to one year), combined with more detailed wind profile information, are needed to increase robustness of emissions estimates.

Based on data gained from remote sensing fenceline monitoring studies and a pressing need for early detection capabilities and improved estimates of fugitive emissions, the South Coast AQMD conducted a comprehensive measurement campaign aimed to fully characterize remote sensing technologies that quantify and track fugitive emissions from large refineries, marine vessels and small stationary sources including oil wells and gas stations. The optical remote sensing techniques used in the studies included solar occultation flux (SOL), differential optical absorption spectroscopy (DOAS), differential absorption lidar (DIAL), and Fourier transform spectroscopy (FTIR). The study commenced in September and concluded in October 2015 and revealed a discrepancy between reported emissions and measured emissions with reported emissions being lower than emissions measured with remote sensing technologies. Variables throughout the study, such as weather conditions, may have attributed to the discrepancy in emissions. The South Coast AQMD committed to conducting another study, eliminating variables that may have contributed to the findings in the previous 2015 study. This study is currently in progress and data gathering is anticipated to conclude in 2022.

In 2008, the U.S. EPA established Alternative Work Practice (AWP) that allowed optical gas imaging inspection to be conducted in lieu of Method 21 inspections. Optical gas imaging has been an accepted method for leak detection for over one decade. In more recent years, the use of optical gas imaging has been the preferred method for leak detection. On June 3, 2016, the U.S. EPA finalized 40 CFR Part 60 Subpart OOOO. – Crude Oil and Natural Gas Production, Transmission and Distribution for Which Construction, Modification, or Reconstruction Commenced after August 23, 2011 and on or before September 18, 2015. This amendment established optical gas imaging as the primary leak detection method and best system of emission reduction (BSER) for well sites and compressor stations, whereas, Method 21 is allowed as an alternative leak detection method.

In September 2014, the U.S. EPA finalized a rule imposing more stringent fugitive emission control requirements of hazardous air pollutants (HAPs) for flares, coking units and catalytic reforming unit vents of petroleum refineries. To ensure that proposed standards are being met, and to protect the public from exposure to HAPs, no later than three years after the effective date of the final rule, the U.S. EPA will require monitoring of benzene concentrations at the fenceline of refineries using passive sensors networks, collecting 2-week rolling averaged benzene concentrations. The not to exceed two-week rolling average benzene concentration at the refinery fenceline is set at 9 µg/m^3 (equivalent to approximately 3 ppb). In recognition of recent advances in ORS technology, the new rule also allows facilities to use alternative test methods in order to satisfy the benzene monitoring requirements.

Regulatory History

Fugitive emissions are currently regulated under various South Coast AQMD rules. Leak detection and repair requirements include monitoring methods and frequency, recordkeeping, reporting, and repair timeframes. These requirements vary between rules. In some rules, self-inspections or inspections conducted by certified personnel may be required. The following rules address fugitive emissions in this manner: Rules 462 – Organic Liquid Loading, 463 – Storage of Organic Liquids, 1142 – Marine Vessel Tank Operations, 1148.1 Oil Well Enhanced Drilling, 1173 – Control of Volatile Organic Compound Leaks and Releases from Components at Petroleum and Chemical Plants, 1176 – Sumps and Wastewater Separators, and 1178 – Further Reductions of VOC Emissions from Storage Tanks at Petroleum Facilities.

Proposed Method of Control

There are numerous U.S. EPA air pollution standards as well as South Coast AQMD rules that require specific leak detection and repair work practices. This work practice is based on 30-year-old technology. While this technology still proves to be beneficial for detecting leaks, there are limitations and advantages to this technology as well as newer technology. Limitations with current leak detection technology is the ability to continuously monitor, accurately identify leak sources, and monitor unsafe or hard to access components. Newer leak detection technologies provide options for monitoring where U.S. EPA's Method 21 is limited. Additional benefits of newer technologies include improvement of efficiency and cost-effectiveness.

This control measure will explore the potential for newer leak detection technologies to improve current LDAR requirements and minimize the emissions impact from leaking components and seals. Optical gas imaging devices, open path detection devices, and stationary gas sensors will be assessed. Inspection methods utilizing these technologies will also be assessed. Methods include continuous emissions monitoring, self-inspections, and third-party monitoring services. Implementation of newer technologies will be pursued in a public process allowing interested stakeholders to participate in the rule development process.

This control measure will be implemented with the review and identification of industries currently subject to LDAR programs and identification of those where the new Smart LDAR technology may be utilized. Based on the results, VOC rules will be amended as appropriate to enhance or incorporate an LDAR program to achieve emission reductions. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Rule 1178 – Further Reductions of VOC Emission from Storage Tanks at Petroleum Facilities includes an LDAR program and is currently proposed to be amended. Staff is exploring the possibilities for continuous monitoring, third party inspection services, and incorporating optical gas imaging devices into self-inspections. Quantification of leaks, comprehensive reporting, and leak and repair tracking will also be considered as part of an enhanced LDAR program.

Additional rules that will be evaluated are Rules 463 – Storage of Organic Liquids, 1173 – Control of Volatile Organic Compound Leaks and releases from Components at Petroleum and Chemical Plants, 1176 – Sumps and Wastewater Separators, 462 – Organic Liquid Loading, 1142 – Marine Vessel tank Operations and 1148.1 – Oil Well Enhanced Drilling.

Rules 463 – Storage of Organic Liquids, 1173 – Control of Volatile Organic Compound Leaks and releases from Components at Petroleum and Chemical Plants, and 1176 – Sumps and Wastewater Separators incorporate an LDAR program. Under this control measure, these rules may be amended for further improvements in current work practices by incorporating new detection technology.

Rules 462 – Organic Liquid Loading, 1142 – Marine Vessel Tank Operations, and 1148.1 – Oil Well Enhanced Drilling require owner or operators to inspect, repair and maintain equipment in good operating order when the equipment is operating. Under this control measure, the work practices for these rules would be upgraded to require repairs and maintenance to be documented with records and, where appropriate, reported. Some of these programs could be enhanced by incorporating newer leak detection technologies into monitoring and inspection requirements.

Emission Reductions

Implementing an enhanced LDAR program for source categories will reduce fugitive emissions and leaks by improving repair timelines with early leak detection. In addition, LDAR programs would ensure that leaks and repairs are well documented and additional follow up inspections on repaired components are conducted. Enhanced LDAR will ensure leaks are identified and repairs are conducted quickly and effectively. The current VOC inventory of reported fugitive losses is ~~3.6~~3.7 tons per day. These losses are from sources such as well cellars, valves, pumps, fittings, compressors, and oil and water separators. Other sources of emissions may contribute to the current VOC inventory and include storage tank rim seal systems and malfunctioning storage or process equipment. It is estimated that the VOC inventory including emissions from these sources is more than ~~3.6~~3.7 tons per day. Early leak detection devices are anticipated to identify approximately 20 percent of fugitive emissions in real time and reduce leak emissions that would go undetected. Estimated emission reduction from this control measure is 0.6 tons per day of VOCs from fugitive losses and additional reductions from leaks occurring from tank rim seal systems and other tank components.

Rule Compliance and Test Methods

Rule compliance would be met with monitoring, reporting and recordkeeping. Similar compliance requirements exist under Rules 462, 463, 1142, 1149, 1148.1, 1173, 1176, and 1178. Revisions to monitoring, reporting, and recordkeeping requirements would be determined based on technologies and methods implemented in each rule.

Test methods include the following:

U.S. EPA Reference Method 21 – Determination of Volatile Organic Compounds Leaks;

Federal Register Vol. 71, No. 66 April 6, 2006 – Alternative Work Practice to Detect Leaks from Equipment; and~~o~~

Test methods for monitoring techniques not listed above would be in accordance with federal or manufacturer guidelines.

Cost Effectiveness

Enhanced leak detection and repair programs that incorporate Smart LDAR technology would initially be required at 31 petroleum or petroleum-related facilities. Optical gas imaging continuous monitoring systems range in costs depending on size of facilities and quantity of equipment to be monitored. ~~Annualized costs for continuous monitoring of storage tanks at petroleum facilities totals $2,036,600 It is estimated that the annualized costs to monitor other process equipment is approximately the same as monitoring storage tanks at petroleum facilities.~~ Overall cost-effectiveness for implementing enhanced leak detection at facilities affected by this control measure is estimated to be ~~$18,600~~$30,000 per ton of VOC reduced.

Implementing Agency

The South Coast AQMD has authority to regulate VOC emissions from non-vehicular sources.

References

South Coast AQMD – VOC Controls White Paper, 2015.

U.S. EPA – Protocol for Equipment Leak Emission Estimates, November 1995.

Federal Register/Vol. 71, No. 66/April 6, 2006, Alternative Work Practice to Detect Leaks from Equipment.

FUG-02: EMISSION REDUCTIONS FROM INDUSTRIAL COOLING TOWERS [VOCs]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	INDUSTRIAL PROCESS COOLING TOWERS			
CONTROL METHODS:	LEAK IDENTIFICATION, MINIMIZATION, AND REPAIR			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
VOC INVENTORY	0.4	0.4	0.4	0.4
VOC REDUCTION		TBD	TBD	TBD
VOC REMAINING		TBD	TBD	TBD
SUMMER PLANNING	2018	2031	2032	2037
VOC INVENTORY	0.4	0.4	0.4	0.4
VOC REDUCTION		TBD	TBD	TBD
VOC REMAINING		TBD	TBD	TBD
CONTROL COST:	TO BE DETERMINED			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

Description of Source Category

This control measure seeks reductions of VOC emissions from industrial cooling towers.

Background

Industrial cooling towers are used to remove large amounts of heat absorbed in the circulating cooling water systems at power plants, petroleum refineries, petrochemical plants, natural gas processing plants, and a wide variety of industrial operations. As described in control measure BCM-02 (Emission Reductions from Cooling Towers) from the 2016 AQMP, industrial cooling towers can be mainly classified into dry cooling towers and wet cooling towers.

Wet Cooling Towers

Wet cooling (direct or open circuit cooling tower) are enclosed structures containing a labyrinth-like packing or “fill” and are operated on the principle of latent and sensible cooling. The sensible cooling occurs as the air temperature increases by absorbing heat from the process water. The latent cooling occurs as some of the process water evaporates. As a result, hot water from the process stream is cooled as it descends through the fill while in direct contact with air that passes through it. The cooled water is collected in a cold water basin and is recycled to absorb more heat. The heated air leaving the fill is discharged to the atmosphere. Wet cooling towers can be further categorized as mechanical-draft and natural-draft cooling towers.

Mechanical-draft cooling towers use large fans to force or draw air through the cooling towers and are referred to as forced or induced-draft. Mechanical forced-draft cooling towers use mounted fans from the sides to force air into the towers. The more common induced-draft towers use mounted fans at the top to draw air in through the sides and expel it through the top of the towers. The induced draft towers discharge warm air at higher velocities, resulting in better dispersion of the expelled air, minimizing re-circulation of discharged air flow back into the air intake, thus maximizing cooling towers performance.

Natural-draft cooling towers generate airflow from natural driving pressure caused by the difference in density between the outside cool air and the inside hotter, humid air. The driving pressure is a function of the outside and inside air density and the height of the cooling tower. Natural-draft cooling towers require significant height (can be in excess of 500-feet in height) to generate the required airflow through the tower and is less aesthetically desirable.

Dry Cooling Towers

Dry cooling towers are closed systems where circulating water does not interact with ambient air and heat rejection occurs through sensible heat transfer. Sensible heat transfer is achieved by passing the circulating water through finned tubes over which ambient air is passed. Sensible heat transfer limits the maximum attainable water outlet temperature to the local ambient dry bulb temperature.

Although dry cooling towers do not directly emit any pollutants to the atmosphere, they generate indirect emissions due to additional parasitic losses and reduced heat transfer efficiency. Parasitic losses result from the additional fan load required to move more air in dry cooling towers. Reduced heat transfer efficiency and parasitic losses will require increased fuel consumption to attain an equivalent power output. In addition, according to the U.S. EPA, the installation cost of a dry cooling tower would be approximately 3.3 times that of an equivalent wet cooling tower.

VOC Emissions from Wet Cooling Towers

According to the U.S. EPA AP-42, contaminants can enter the cooling water system from leaking heat exchangers and condensers. Atmospheric emissions from cooling towers consist of fugitive VOCs and gases stripped from the cooling water as the air and water come in contact. AP-42 identifies the applicable VOC control strategy for cooling towers to be the minimization of hydrocarbon leaks into cooling water systems and monitoring of cooling water for hydrocarbons.

Refineries and industrial facilities report VOC emissions from cooling towers under the South Coast AQMD's Annual Emission Reporting (AER) program. Table FUG-02-A presents annual VOC emissions from industrial cooling towers at ten refineries and 12 other facilities (primarily chemical plants) for 2015 through 2020. As shown in Table FUG-02-A, cooling tower VOC emissions at refineries are higher than those reported from all other industrial facilities. Table FUG-02-A also shows that cooling tower VOC emissions can vary year by year and emissions from individual facilities can represent a large part of the total annual emissions.

TABLE FUG-02-A

Annual Cooling Tower VOC Data 2015-2020*

Reporting Year	VOC Emissions (tons/year)	
	Refineries	Other Facilities
2015	80.27	2.57
2016	83.19	2.52
2017	75.88	2.56
2018	148.93**	2.72
2019	294.56***	2.23
2020	32.71	2.23

* Based on annual emissions reporting

** 80 percent of emissions from Refinery A

*** 90 percent of emissions from Refinery B

Regulatory History

South Coast AQMD Regulations

Cooling towers are largely exempt from permits per Rule 219 – Equipment Not Requiring a Written Permit Pursuant to Regulation II, which exempts towers that are not used to cool process water by evaporation and do not use chromium compounds to treat circulating water.

Rule 1404 – Hexavalent Chromium Emissions from Cooling Towers was amended in April 1990 and prohibits the use of hexavalent chromium-containing water treatment chemicals from being added to cooling tower circulating water.

Rule 222 – Filing Requirements for Specific Emission Sources Not Requiring a Written Permit Pursuant to Regulation II was amended in May 2017, establishing a registration program for industrial cooling towers. An industrial cooling tower is defined as a cooling tower located at a chemical plant, refinery or other industrial facility that is not used for comfort cooling. Under the registration program, facilities are required to submit information on water circulation rates and the average amount of total dissolved solids in the water for all their industrial cooling towers as a method of estimating PM emissions. Information specific to VOC emissions was not collected as a part of the registration program.

Federal Regulations

The U.S. EPA has promulgated 40 CFR 63, subpart CC National Emission Standards for Hazardous Air Pollutants from Petroleum Refineries (MACT[33] CC). Section 63.654 (Heat Exchange Systems) requires refineries to conduct periodic monitoring of heat exchangers in organic hazardous air pollutant service. Section 63.654 requires leaks to be repaired as soon as practicable after discovered but no later 45 days after detecting the leak unless the repair is not feasible. Not all refinery cooling towers are subject to the leak monitoring and repair requirements of Section 63.654.

Proposed Method of Control

Heat exchanger leaks may not occur on a regular basis, but leaks can result in large quantities of organic compounds to be stripped from the cooling water and emitted to the atmosphere.

In 2015, the Bay Area AQMD adopted amendments to Rule 11-10 (Hexavalent Chromium Emissions from All Cooling Towers and Total Hydrocarbons from Petroleum Refinery Cooling Towers) to minimize total hydrocarbon emissions through leak monitoring and repair requirements. The regulation was amended again in 2018 to modify and clarify leak monitoring, action, and reporting requirements consistent with the provisions of an Enforcement Agreement. Under Rule 11-10, a leak is determined by sampling the cooling tower water at each cooling tower return line and/or at each heat exchanger exit line prior to exposure to air. Sampling frequency is based on the cooling tower recirculation rate but is generally once per week, but this can be reduced if sampling results are below the leak action level for a specified consecutive time period. The leak action level threshold is 84 parts per billion by weight (ppbw) (as methane) in the cooling tower water for existing units in operation prior to July 1, 2016 and 42 ppbw (as methane) for new or modified cooling towers. The Rule also allows use of a continuous hydrocarbon analyzer to monitor hydrocarbon concentrations. The leak action level threshold for stripped air as measured by a continuous hydrocarbon analyzer (or an alternative method approved by the Air Pollution Control Officer) is 6 parts per million by volume (ppmv) (as methane). Rule 11-10 specifies that if the hydrocarbon concentrations exceed any leak action level, the facility is required to minimize the leak within seven days and conduct leak repair or removal of the defective piece of equipment from service within 21-calendar days after identification the leak. A delay in the completion of a leak beyond 21 days must meet the criteria included in 40 C.F.R. 63-654(f)-(g). Additionally, Rule 11-10 requires the facility to conduct an analysis to speciate and quantify the Toxic Air Contaminates from leaks within 72 hours of discovering the leak. Rule 11-10 also includes reporting requirements for facilities when sampling of cooling tower water exceeds an applicable leak action level.

This control measure will be implemented in two phases. Phase I will consist of an assessment to evaluate the need for additional controls and practices that can reduce VOC emissions from Industrial cooling towers. The Phase I assessment will include an emissions inventory review based on throughput information from Rule 222 registration program and AER data. The Phase I assessment will also include

[33] Maximum Achievable Control Technology.

an evaluation of control requirements established by other jurisdictions. Evaluation of costs for purchase, installation, and operation and maintenance of the monitoring equipment will also be assessed.

The findings from the Phase I assessment will be the basis for potential future control requirements. Phase II will be the final technical and economic feasibility analysis in conjunction with potential rule development to establish requirements for industrial cooling towers, if the results from the Phase I assessment suggest the need for controls. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Emission Reductions

Additional monitoring and leak repair requirements have the potential to reduce excess VOC emissions.

Rule Compliance and Test Methods

Compliance requirements for this control measure would depend on the control strategy implemented, if necessary, based on the findings from the Phase I assessment. Bay Area AQMD Rule 11-10 included three options for facilities to conduct monitoring of cooling water.

Cost Effectiveness

Cost impacts would be analyzed as part of a potential future rule development process.

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from stationary sources such as industrial cooling towers.

References

Bay Area Air Quality Management District. (2018). *Final Staff Report for Proposed Amendments to Rule 6-5: Particulate Emissions from Refinery Fluidized Catalytic Cracking Units, Rule 11-10: Hexavalent Chromium Emissions from All Cooling Towers and Total Hydrocarbon Emissions from Petroleum Refinery Cooling Towers, and Rule 12-15: Petroleum Refining Emissions Tracking*. https://www.baaqmd.gov/~/media/dotgov/files/rules/regulation-6-rule-5/documents/20181221_1_final-staff-report_refinery-rules-amendments-pdf.pdf?la=en.

South Coast Air Quality Management District. (2017). 2016 Air Quality Management Plan, Appendix IV-A Stationary and Mobile Source Control Measures. (Published March 2017).

United States Environmental Protection Agency. (2015). *Compilation of Air Pollutant Emission Factors (AP-42), Fifth Edition, Volume I: Stationary Point and Area Sources, Chapter 5.1 Petroleum Refining*. https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors.

CTS-01: FURTHER EMISSION REDUCTIONS FROM COATINGS, SOLVENTS, ADHESIVES, AND LUBRICANTS [VOCs]

CONTROL MEASURE SUMMARY

SOURCE CATEGORY:	MISCELLANEOUS COATINGS, SOLVENTS, ADHESIVES, AND LUBRICANTS			
CONTROL METHODS:	REDUCE THE ALLOWABLE VOC CONTENT IN PRODUCT FORMULATIONS OR PROVIDE INCENTIVES FOR VOLUNARY REDUCTIONS			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
POLLUTANT INVENTORY	19	20	20	20
POLLUTANT REDUCTION		0.5	0.5	0.5
POLLUTANT REMAINING		19.5	19.5	19.5
SUMMER PLANNING (IF NOX/VOC)	2018	2031	2032	2037
POLLUTANT INVENTORY	19	20	20	21
POLLUTANT REDUCTION		0.5	0.5	0.6
POLLUTANT REMAINING		19.5	19.5	20.4
CONTROL COST:	~~TO BE DETERMINED~~ DCF METHOD: $20,800/TON OF VOC REDUCED. MODIFIED LCF METHOD: $27,600/TON OF VOC REDUCED			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

Description of Source Category

This proposed control measure seeks volatile organic compound (VOC) emission reductions by focusing on select coating, adhesive, solvent and sealant categories by further limiting the allowable VOC content in formulations or incentivizing the use of super-compliant technologies. Categories to be considered include but are not limited to, metal part and product coatings, automotive refinishing coatings, adhesives, and sealants. Reductions could be achieved by lowering the VOC content of the coatings, solvents, adhesives and sealants where possible, but reductions could also be achieved by promoting the use of alternative low VOC products or non-VOC product/equipment at industrial facilities.

Background

Use of super-compliant zero and low VOC emission materials, such as powder coating, aqueous coatings, and some ultraviolet light, electron beam, and light emitting diode (UV/EB/LED) cured coatings, eliminate or substantially reduce emissions compared to similar products that are not zero or low emission products. There are several product categories where these materials perform as well as traditional products and are widely available in the market.

Over the years, the South Coast AQMD Governing Board has adopted numerous rules to reduce the VOC emissions from the use of coatings, solvents, adhesives, and sealants in commercial and industrial applications. Subsequent amendments to these rules achieved further VOC emission reductions primarily through product reformulations using low VOC technologies including alternative resin chemistries, aqueous and bio-based products, and exempt solvents.

Recent sales and emissions reporting programs have led to improved understanding of the VOC inventory, incentivized clean technology through fee structures, and better-focused future enforcement and regulatory actions. These approaches not only ensure that the reductions assumed in the AQMP are actually occurring, but also allow analysis of market trends and compliance margins that go beyond the regulatory requirements.

In later years following the promulgation of the 2016 AQMP, two chemicals with EPA exempt-VOC status, parachlorobenzotrifluoride (PCBTF) and tertiary-Butyl Acetate (tBAc), have been found to be carcinogenic and inhalation unit risk factors have been adopted by the California Office of Environmental Health and Hazard Assessment (OEHHA). PCBTF is considered an exempt VOC in several South Coast AQMD rules including Rule 1113 – Architectural Coatings and Rule 1151 – Motor Vehicle and Mobile Equipment Non-Assembly Line Coating Operations. tBAc is also considered an exempt VOC in Rule 1113 for industrial maintenance and non-sacrificial anti-graffiti coatings and Rule 1151 for automotive coatings other than color coatings and clear coatings.

Inhalation unit risk factors, which are estimate lifetime cancer risks associated with inhalation exposure to a carcinogen for use in the Air Toxics Hot Spots Program, were adopted for PCBTF in August 2020 and for tBAc in August 2018. Due to OEHHA's determinations, phase-out of the exemption status of PCBTF and tBAc in architectural coatings including industrial maintenance and non-sacrificial anti-graffiti coatings, automotive coatings, paint thinners, multi-purpose solvents, and adhesives is needed to decrease toxic risk for workers and the general public.

The 2022 AQMP control strategy continues to focus on NOx reductions, with additional strategic and cost-effective VOC reductions, as the best way to minimize the general public's exposure to unhealthy ozone pollution not only in the target attainment year, but also during the course of the control effort. The analysis in the VOC Controls White Paper (SCAQMD, 2015) indicates that a NOx-heavy strategy accompanied by more modest VOC reductions will help to avoid temporary increases in ozone concentrations in the western side of the Basin. A strategic VOC control program is recommended for the 2022 AQMP to first maximize co-benefits of NOx, greenhouse gases (GHGs), and air toxic controls, followed by controls that could create a "win-win" "business case" for the affected entities, incentives for super-compliant products, while ensuring and capturing benefits from implementation of existing rules. Particular VOC reductions that lead to the increased use of chemicals that are known or suspected to be toxic should be avoided until it can be demonstrated that these replacement products do not lead to increased toxic risk for workers or the general public. When additional VOC controls are still needed, it is recommended to prioritize controls that will produce co-benefits for air toxics and GHGs, with a focus on VOC species that are most reactive in ozone and/or PM2.5 formation. Removal of the VOC exemption status for PCBTF and tBAc exemption may result in some increases to VOC emissions from coating, solvent, and adhesive product categories that solely rely on formulations using PCBTF or tBAc to achieve lower VOC contents. It is anticipated that pathways to reformulate products using these chemicals and identifying areas for additional VOC reductions to offset potential VOC emission increases and achieve further VOC reductions, such as lowering VOC content limits in existing regulated coating and adhesive categories, will be considered.

Regulatory History

Some VOC emission increases are projected to come from amending certain VOC rules including Rules 1107, 1113, 1143, 1151, and 1168 to address toxicity concerns with PCBTF and tBAc in metal part coatings, architectural coatings, multi-purpose solvent, automotive coatings, and adhesive and sealant applications. These emission increases will be offset and additional emission reductions achieved with amendments to the following VOC rules:

Rule 1107 – Coating of Metal Parts and Products
Consider reducing VOC content limits for categories where use of water-based coatings is prevalent.

Rules 1115 – Motor Vehicle Assembly Line Coating Operations and 1124 – Aerospace Assembly and Component Manufacturing Operations
Evaluate whether both rules satisfy RACT requirements.

Rule 1128 – Paper, Fabric, and Film Coating Operations
Evaluate applicability of spray booths or non-coating line processes used in paper, fabric, and film coating operations.

Rule 1151 – Motor Vehicle and Mobile Equipment Non-Assembly Line Coating Operations
Consider reducing VOC content limits for categories where use of water-based coatings is prevalent.

Rule 1168 – Adhesive and Sealant Applications
Consider reducing VOC content limits from select adhesive and sealant categories based on forthcoming technology assessments.

Rule 1136 – Wood Product Coatings
Consider restriction or elimination of potential loopholes and evaluate toxic emissions resulting from furniture stripping.

Rules 314 – Fees for Architectural Coatings, 1113 – Architectural Coatings, 1143 – Consumer Paint Thinners and Multi-Purpose Solvents, and 1171 – Solvent Cleaning Operations
Assess the potential to achieve SIP reductions through certification programs (e.g., Clean Air Solvent, Clean Air Choices Cleaner Product Certification, or a coatings certification program) or reporting programs.

Rules 1107 – Coating of Metal Parts and Products, 1124 - Aerospace Assembly and Component Manufacturing Operations, 1136 - Wood Product Coatings, 1145 – Plastic, Rubber, Leather, and Glass Coatings, and 1171 - Solvent Cleaning Operations
Consider prohibition of sale, distribution, and applicable of materials that do not meet the VOC limits and restriction or elimination of potential loopholes.

Proposed Method of Control

Reductions would be achieved by lowering the VOC content for a select few categories where most products are already meeting lower VOC limits or incentivizing use of zero and ~~near-zero~~low VOC materials and technologies such as powder coatings, aqueous technologies, ultraviolet light, electron beam, and light emitting diode cured coatings.

Powder coatings are a type of coating that is applied electrostatically as a free-flowing, dry powder subsequently cured with heat or energy. Because there is no solvent, minimal VOC is emitted. Aqueous technologies are inks, paints, coatings, and adhesives that utilize water instead of VOC-containing solvents as the liquifying agent. Energy-curable products are liquids that when exposed to energy, a polymerization reaction starts which converts the liquid to a hard, tough cured solid film in a fraction of a second. This process typically results in significantly lower VOC emissions and a lower carbon footprint compared to solvent-based products. The most common means used to cure the products are UV/~~,~~ EB/~~, and~~ LED. Technical innovations allow these technologies to be applied to almost any substrate. Use of super-compliant zero and ~~near-zero~~low VOC materials eliminate or substantially reduce emissions compared to similar products that are not zero or ~~near-zero~~low VOC products. There are several product categories where these materials perform as well as, or better than traditional products and they are widely available in the market.

SIP credit may also be achieved through contractual agreements with manufacturers of low VOC South Coast AQMD certified products. The proposal is anticipated to be accomplished with a multi-phase adoption and implementation schedule. On a rule-by-rule basis, toxicity concerns of PCBTF and tBAc will be addressed by removing their VOC exemption status and seeking proposals (e.g., higher VOC limits or longer implementation time) for products that may be currently formulated with these toxics to ensure continued compliance. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Emission Reductions

Current estimates are that there is a potential VOC emission reduction of 0.5 tons per day by 2037.

Rule Compliance and Test Methods

Rule compliance would be similar to compliance requirements and required test methods in existing South Coast AQMD rules on coatings, adhesives, solvents, and sealants.

Cost Effectiveness

Cost-effectiveness of this control measure will be determined based on the availability and technical feasibility of low or zero VOC technologies to achieve further VOC emission reductions and alternative solvents that can be used to reformulate products currently relying on PCBTF or tBAc. Staff will conduct technology assessments of the select coating, adhesive, and sealant categories and evaluate potential health and worker safety impacts of low or zero VOC alternatives on a rule-by-rule basis. Overall cost-effectiveness for this control measure is estimated to be $20,800 per ton of VOC reduced.

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from area sources and stationary point sources.

References

OEHHA p-Chloro-α,α,α-trifluorotoluene (p-Chlorobenzotrifluoride, PCBTF) Cancer Inhalation Unit Risk Factor Technical Support Document (2020)

OEHHA Tertiary-Butyl Acetate Cancer Inhalation Unit Risk Factor Technical Support Document (2018)

VOC Controls White Paper (2015)

SCAQMD Staff Reports for Coatings, Solvents, Adhesive and Sealant Rules

https://www.aqmd.gov/home/rules-compliance/compliance/vocs/adhesive-and-sealants/rule-1168-compliant-products#SuperCompliant

FLX-02: STATIONARY SOURCE VOC INCENTIVES [VOCs]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	RESIDENTIAL, COMMERCIAL, INDUSTRIAL SOURCES			
CONTROL METHODS:	FINANCIAL INCENTIVE PROGRAMS			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
POLLUTANT INVENTORY	~~220~~219	239	241	249
POLLUTANT REDUCTION		TBD	TBD	TBD
POLLUTANT REMAINING		TBD	TBD	TBD
SUMMER PLANNING (IF NOX/VOC)	2018	2031	2032	2037
POLLUTANT INVENTORY	218	~~238~~239	240	~~248~~249
POLLUTANT REDUCTION		TBD	TBD	TBD
POLLUTANT REMAINING		TBD	TBD	TBD
CONTROL COST:	NOT DETERMINED			
INCENTIVE COST:	NOT DETERMINED			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

*Emissions inventory and reductions cannot be quantified at this time due to the nature of the measure as it is uncertain exactly what programs will be implemented.

Description of Source Category

Many existing homes and businesses look to update and improve their residences and places of business by using clean, lower emission and less toxic alternative processes and materials. However, since many of these lower emission, less toxic process options are not always the lowest cost option, incentivizes may be required.

Background

In the past, the South Coast AQMD has adopted a series of programs to promote clean, low emission technologies while encouraging economic growth and providing compliance flexibility. The South Coast AQMD continues to implement incentive programs to help promote efficient, clean equipment purchases, efficiency projects, and conservation techniques that provide toxic and criteria pollutant emission reduction benefits, as well as greenhouse gas emission reduction benefits. The manufacturing and deployment of zero emission and low emission technologies will help reduce criteria pollutant emissions in the region, accelerate removal of older higher emitting equipment or materials that have been in place for many decades, and advance economic development and job opportunities in the region.

Regulatory History

The South Coast AQMD currently offers a number of funding and grant resources to encourage the immediate use of cleaner low emission technologies. The incentive programs, which include incremental funding or subsidies, are designed to promote voluntary introduction of alternative improved practices and new technologies on an accelerated schedule. Examples of such funding programs include:

Financial Assistance for Alternative Dry-Cleaning Equipment Purchases;

Wood Stove and Fireplace Change-Out Incentive Program;

Residential energy upgrades in the Coachella Valley and San Fernando Valley;

CLEANair Furnace Rebate Program for consumer rebates on ultra-low NOx high altitude and weatherized furnaces, and replacement of gas-fired furnaces with all-electric heat pump system

Electrification of gas dryer, cooking equipment, space heating; and

Carl Moyer Memorial Air Quality Standards Attainment Program for vehicle retrofit and replacement.

Additionally, regulatory relief incentives have been incorporated into several South Coast AQMD rules including:

Reduced recordkeeping for Super-Compliant coatings, adhesives and solvents in Rule 109 (Recordkeeping for Volatile Organic Compound Emissions);

Reduced fees for ultra-low VOC architectural coatings in Rule 314 (Fees for Architectural Coatings);

Less frequent source testing for low-emitting point sources in Rule 1420.2 (Emission Standards for Lead from Metal Melting Facilities); and

Less frequent inspection schedules for high-compliance facilities in Rule 1173 (Control of Volatile Organic Compound Leaks and Releases from Components at Petroleum Facilities and Chemical Plants).

However, incentivizing the use of cleaner, less polluting, products and equipment requires additional efforts to broaden the scope of stationary source incentives.

Proposed Method of Control

This control measure would seek to incentivize VOC emission reductions from various stationary and area sources through incentive programs for the use of cleaner, low emission and less toxic processes or materials. Qualifying facilities would be able to eligible for incentive funding if they utilize cleaner, low emission and less toxic processes or materials, or accept permit conditions that result in cost-effective emission reductions that are beyond existing permit requirements. The program would establish procedures for quantifying emissions benefits from clean technology implementation and develop cost-effectiveness thresholds for funding eligibility.

Mechanisms will be explored to incentivize residences and businesses to choose the cleanest technologies as they replace equipment or materials and upgrade facilities, and to provide incentives to encourage businesses to move into these technologies sooner. Although replacement of older, higher emitting sources is expected to have the greatest potential for emission reductions, providing incentives and eliminating barriers for new sources to manufacture and use ultra-clean technologies is also important.

Industrial Facility Modernization can result in substantial emission reductions, especially if the cleaner equipment or material is at zero or low emission levels. Efforts to encourage clean manufacturing facilities to site and operate in the Basin can result in emission reduction benefits as well as other co-benefits to the local economy, particularly to the surrounding community. Consistent with this effort, there are two primary objectives:

Provide incentives to replace older higher-emitting equipment or materials with newer lower emitting equipment or materials for area and stationary sources,

Encourage new businesses that use and/or manufacture ~~near-zero~~low and zero emission technologies to site in the Basin.

Through the years, a variety of incentives have been implemented, such as exempting cleaner sources from permitting, implementing measures to streamline permit processing for cleaner sources, use of short-term mobile source credits, mitigation fee programs, the Air Quality Investment Program (AQIP), and emissions averaging provisions in rules. The incentive programs, which include incremental funding or subsidies, are designed to promote voluntary introduction of new technologies on an accelerated schedule. These programs may also provide manufacturers with incentives to accelerate the deployment of cleaner technologies. Such an example is the use of energy-curing technologies which includes ultraviolet light (UV), electron beam (EB), heat and light emitting diode (LED) and even solar cured coatings. Some radiation cured inks and coatings are low VOC, 100 percent solid products that do not cure by solvent evaporation but are cured through exposure to radiation which causes a polymerization reaction to convert the liquid coating into a solid film. Another example is the use of powder coatings, a viable alternative to wet coating applications that are normally applied by pressure assisted spray application. The powder medium, which are dry, free-flowing powders, typically do not contain any volatiles and the powder media is applied using electrostatic technology and then cured in an oven using either natural gas fired burners or electric heating elements. One barrier to more widespread adoption of these low VOC technologies is the upfront cost of the application and curing equipment, making these technologies attractive candidates for incentive measures.

For stationary sources, South Coast AQMD staff has compiled a list of potential incentives to encourage businesses to use zero emission or low emission technologies or enhancements to the South Coast AQMD's existing programs to reduce or eliminate barriers to implement state of the art technologies. The list below represents an "initial list" of potential concepts. It is expected that as South Coast AQMD staff and stakeholders further explore incentives approaches, additional concepts may be identified. South Coast AQMD staff is committed to further investigating the concepts listed below and others. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Incentive Funding: Incentive funding involves the creation of economic incentives to reduce the cost and encourage businesses to replace their existing high emitting equipment or their materials with equipment or materials that are zero or ~~near-zero~~low emitting. It includes mechanisms such as loans and grants. Funding for these programs could derive from mitigation fees, penalty or settlement fees, or federal or State grants and programs.

Permitting and Fee Incentives and Enhancements: Permitting and fee incentives and enhancements could include the expansion of the existing certification program and pre-approved permit program to include additional qualified categories. Incentives involving reduced permitting fee programs for advanced technologies which significantly reduce emissions, as well as other permitting enhancements identified as priority projects are also discussed and require less effort to permit or enforce in this incentive approach, however, would need to be evaluated and reviewed prior to program implementation.

NSR Incentives and Enhancements: The mechanism of credit offsets and NSR incentives includes expanding the number of exemptions under Rule 1304 – Exemptions, and expanding the use of the priority reserve under Rule 1309.1 – Priority Reserve, for businesses using or providing advanced clean technologies. In addition, this mechanism could include the adoption of a Clean Air Investment Fund and potential short-term leasing of offset credits.

CEQA Incentives: CEQA incentives will focus on mechanisms South Coast AQMD staff can provide in the CEQA process such as expedited review.

Branding Incentives: Branding incentives can recognize businesses or equipment for reaching a superior level of air quality excellence. Branding incentives can vary from recognition awards to specific labeling or certification.

Recordkeeping and Reporting Incentives: Recordkeeping and reporting incentives can reduce the recordkeeping and reporting requirements for specific zero and ~~near-zero~~low emission technologies.

Emission Reductions

Predicting VOC emission reductions from these voluntary activities is challenging. The availability and amount of incentives would directly affect the level of VOC emission reductions achieved. Emission benefits from incentives can be quantified based on program participation, technology/material penetration, and other assessment and inventory methods. Implementing additional incentive programs will include a means to quantify these benefits as they are developed. Updated emission reductions achieved from these activities will be incorporated into the subsequent SIP revisions as projects are implemented.

Rule Compliance and Test Methods

Not Applicable.

Cost Effectiveness

The decision regarding when to replace existing equipment can vary; some facilities may replace equipment or reformulate material when it is no longer operable or outdated, while other facilities may replace equipment or material well before it reaches that point. Regardless, equipment/material replacement and/or installation of pollution controls can represent a significant financial decision where the operator must assess for the capital cost to purchase new equipment, installation, operating and maintenance costs.

The South Coast AQMD has implemented several funding programs to help facilitate specific technologies and compliance with the South Coast AQMD rules. One such example involved the establishment of the Rule 1470 Risk Reduction Fund in May 2012. This fund was adopted by the South Coast AQMD Governing Board to set aside $2.5 million to offset the cost of purchasing diesel particulate filters for new diesel emergency standby engines as required under Rule 1470 – Requirements for Stationary Diesel-Fueled Internal Combustion and Other Compression Ignition Engines. Another program is the Dry Cleaner Financial Incentive Grant Program which was designed to assist local dry cleaners to switch to non-perchloroethylene dry cleaning systems to comply with Rule 1421 – Control of Perchloroethylene Emissions from Dry Cleaning Systems. Up to $20,000 was available for CO_2 machines and $10,000 for water-base system machines. For a limited time, $5,000 was available for hydrocarbon machines. Since 2008, the program has provided approximately $265,000 to local dry cleaners in order to upgrade their systems. In addition, there are several existing incentive programs which help promote higher efficiency and lower emitting technologies such as the: residential energy efficiency upgrades for Environmental Justice (EJ) areas that includes attic insulation, smart thermostats for the heating/air conditioning system, and higher efficiency light bulb replacements; electrification of residential appliances in EJ areas to replace existing natural gas fired appliances in multi-unit apartments with electric appliances, the Lawn Mower and Leaf Blower Exchange; Surplus Off-Road Opt-In for NOx (SOON) Program; Carl Moyer Memorial Air Quality Standards Attainment Program; Mobile Source Emission Reduction Credit (MSERC) Credit Programs; and Voucher Incentive Program. Additionally, in January 2018 the South Coast AQMD Governing Board approved the release of Request for Proposal (RFP) #P2018-06 to announce the availability of funds and solicit stationary and mobile source projects that would result in emission reductions of NOx, VOC, and PM, in accordance with the approved control strategy in the 2016 AQMP (e.g., FLX-02). The broad-based RFP was open to a wide variety of project types such as zero and near zero technologies, equipment replacement/repower/retrofit, infrastructure, energy efficiency improvement, and technology demonstration to achieve emission reductions with up to $61 million available from a combination of several South Coast AQMD Special Revenue Funds.

The cost-effectiveness of this measure cannot be determined, given the potential variety of programs and projects that will be developed. The cost-effectiveness for specific incentive programs can be determined as they are developed and implemented by the South Coast AQMD

Implementing Agency

The implementing agency will be the South Coast AQMD, in potential cooperation with other local governments, agencies, businesses, technology manufacturers and distributors, and community groups.

References

South Coast Air Quality Management District. (2016). 2016 AQMP White Paper – Industrial Facility Modernization. November 2015

BIO-01: ASSESSING EMISSIONS FROM URBAN VEGETATION [VOCs]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	URBAN VEGETATION			
CONTROL METHODS:	ASSESSING URBAN BVOC EMISSIONS AND IMPACTS ON OZONE AND PM; PROMOTING LOW BVOC EMITTING TREE SPECIES			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
VOC INVENTORY	TBD	TBD	TBD	TBD
VOC REDUCTION		TBD	TBD	TBD
VOC REMAINING		TBD	TBD	TBD
SUMMER PLANNING	2018	2031	2032	2037
VOC INVENTORY	TBD	TBD	TBD	TBD
VOC REDUCTION		TBD	TBD	TBD
VOC REMAINING		TBD	TBD	TBD
CONTROL COST:	TO BE DETERMINED			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

Description of Source Category

Trees emit biogenic volatile organic compounds (BVOCs), and some BVOCs (e.g., isoprene and monoterpenes) are important precursors of ozone and PM. However, there are large differences in both the amount and type of BVOCs emitted by tree species. There are over 800 distinct tree species within urban areas of the Basin, yet only 45 species represent about 80 percent of the total tree population. While studies have assessed the BVOC emission potential of about half of the tree species in the Basin, most studies reported qualitative measurements but have limitations in comprehensive measurements of all the BVOC species. Thus, uncertainties exist in the current BVOC inventory.

Basin total anthropogenic VOC (AVOC) emissions are 417 tons per day in 2018 summer planning emissions inventory, while Basin average BVOC emissions from May through September were estimated at 247 tons per day. However, BVOC emissions surged to over 500 tons per day on the hottest summer days in 2018. About 75 percent of BVOC emission in the Basin is isoprene, a highly reactive compound that has a higher ozone forming potential than many AVOCs. Between now and 2037, marginal declines in AVOC emissions are anticipated due to regulation. However, the trajectory of BVOC emissions is uncertain. Perturbations to BVOC emissions can result due to meteorological variability, climate change, or changes in the composition of the urban landscape. This measure is intended to enhance awareness of the significance of BVOCs in ozone and PM2.5 formation and improve the BVOC emissions inventory to assist future planning efforts.

Background

A recent study estimated tree species composition for 140 cities within the Basin based on municipal tree inventories (including about 1 million individual trees) and field plot data, representing both private and public lands (Guenther, 2020). The inventory includes over 800 tree species that are members of more than 300 different plant genera and 100 plant families. However, most of these trees are relatively rare and just 45 tree species and 20 plant genera account for about 80 percent of all trees. The contribution of individual species varies for different cities. For example, coast live oak contributes 5 to 10 percent of the total trees in many cities in Orange and Riverside counties but about 1 percent or less in Los Angeles and nearby cities. Carrotwood (Cupaniopsis anacardiodes) and Sweetgum (Liquidambar styraciflua) contributions range from 2 to 10 percent for specific cities with the higher values in Los Angeles County and in a few Orange County cities.

A 1982 vegetation inventory for part of the Basin (~84 of the 140 cities) found that the plant cover consisted of 67 percent shrubs, 10 percent herbaceous, and 23 percent trees including 78 trees species (Miller and Winer, 1984). The 1982 tree species composition is generally similar to the current tree inventory but there has been a substantial decrease in native California species, primarily Quercus (Oaks) and Pinus (Pines) species, and a decrease in Ulmus (Elms), Acer (Maple), and Eucalyptus species. The species replacing these trees are primarily exotics from subtropical and Mediterranean regions including Ficus, Cupaniopsis (Carrotwood), Platanus (Sycamore), and Ligustrum (Privet) species. In addition, there have been substantial increases of two southeastern US native species, Liquidambar styraciflua (American sweetgum) and Magnolia grandiflora (southern magnolia).

The tree species recommended by existing tree planting programs differ considerably from the current urban forest and an increase in these trees could lead to significant changes in overall South Coast tree species composition and the associated BVOC emission in future decades (Gu et al., 2021). The California Climate Investment (CCI) program supports urban tree planting and other projects to reduce greenhouse gas emissions from the State. A database of 18,261 CCI trees that were recently planted in the 140-city region was analyzed to investigate tree species composition trends. Only one (Fraxinus) of the top twelve recently planted tree genera was ranked in the top twelve genera of the current tree inventory. Most of the recently planted trees were either high BVOC emitters (e.g., Quercus ilex, Quercus agrifolia, Platanus species) or were trees for which emission factors are unknown or highly uncertain (e.g., Koelreuteria bipinnata, Cercis canadensis, Pistacia chinensis, Podocarpus gracilor, Hymenosporum flavum). Other tree planting organizations in Los Angeles (e.g., City Plants https://www.cityplants.org/our-story/) are also planting trees that differ substantially from the current inventory and are primarily species for which there are no reported BVOC emission factor measurements.

Regulatory History

Because trees are a natural emission source, there has not been extensive regulation in this area. In 2009, the South Coast AQMD launched a Local Government Match Program - Tree Partnership (Tree Partnership). The primary goal of the Tree Partnership was to assist cities and counties within the South Coast Air Basin (Basin) to provide additional tree planting within their communities, educational facilities or other public land areas controlled by the city or county. The program was funded with $1.5 million from interest earned in the Rule 1309.1 Mitigation Fund. The Governing Board awarded 20 contracts with 19 cities at its October 2, 2009 meeting, resulting in the planting of over 4,300 low-emitting trees.

Proposed Method of Control

The South Coast AQMD will further improve the biogenic emissions inventory for the Basin, improve understanding of the contribution of BVOCs to ozone and PM formation, and promote low VOC emitting species, when applicable. BVOC emission models assume that emission rates are the product of an emission factor and an emission activity factor, similar to the approach used for most anthropogenic emission models. Recent BVOC research has focused primarily on emission activity even though uncertainties in the emission factors are relatively high and may even dominate the total uncertainty in BVOC emission rate estimates (Arneth et al., 2011). The lack of reliable emission factor measurements for many of the most common tree species in the Basin is a critical concern. To address this, semi-qualitative emission factor measurements will be performed for many tree species in the Basin, including exotic species for which no emission factor data is available. Subsequently, high quality, comprehensive BVOC measurements will be performed for a subset of the tree species, focusing on those with the greatest emission potential.

Another source of uncertainty exists in the calculation of landscape weighted emission factors, which consider the fractional coverage of trees, shrubs, crops, and herbs. The fractional coverage of individual vegetation types is referred to as the growth form distribution. The default distribution employed in existing models relies on satellite data which provides approximately 1 km by 1 km resolution. However, a more accurate distribution will be necessary to enhance the emission estimation. Thus, the distribution will be further refined by using high resolution data (60 cm) from the National Agriculture Imagery Program to classify the individual growth forms in the Basin.

These data will be integrated into the South Coast AQMD's AQMP modeling tools to improve the accuracy of BVOC emission estimates by directly measuring emission factors of the dominant urban tree species and improving the growth form distribution. This is especially important because BVOC emissions have been implicated in the transition from VOC-limited ozone formation during winter to NOx-limited ozone formation during summer (Wu et al., 2021). Improving the BVOC emissions inventory is the first step toward understanding this complex dynamic and designing appropriate controls, which may include programs similar to the Tree Partnership. Such programs would provide outreach and funding to cities and counties for the planting of low emitting species on public lands. Trees could either be newly planted or replacing high emitting species, when applicable. BVOC emission potential would be assessed according to the results of an ongoing study as well as published literature (Benjamin and Winer, 1998). The exact nature of the program, timeline for implementation, and funding availability will be determined at the appropriate time. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Emission Reductions

To be determined.

Rule Compliance and Test Methods

Not applicable.

Cost Effectiveness

The cost-effectiveness of this measure cannot be determined, given the variety of programs and projects that may be developed. The cost-effectiveness for specific incentive programs can be determined as they are developed and implemented by the South Coast AQMD.

Implementing Agency

The South Coast AQMD is responsible for implementing this measure.

References

Arneth, A., G. et al. Global terrestrial isoprene emission models: sensitivity to variability in climate and vegetation. Atmospheric Chemistry and Physics, 11, 8037-8052, https://doi.org/10.5194/acp-11-8037-2011, 2011.

Benjamin, M.T., and Winer, A.M. Estimating the ozone-forming potential of urban trees and shrubs, Atmospheric Environment, 31, 53-68, https://doi.org/10.1016/S1352-2310(97)00176-3, 1998.

Gu, S., et al. Effects of Anthropogenic and Biogenic Volatile Organic Compounds on Los Angeles Air Quality. Environmental Science and Technology, 18, 12191-12201, https://doi.org/10.1021/acs.est.1c01481, 2021.

Guenther, A. South Coast Tree Inventory. In Project Report for South Coast Air Quality Management District; South Coast Air Quality Management District, 2020.

Miller, P. R., and Winer, A. M. Composition and dominance in Los Angeles Basin urban vegetation, Urban Ecology, 8, 29-54, https://doi.org/10.1016/0304-4009(84)90005-6, 1984.

Wu, S., et al. Direct Measurements of Ozone Response to Emissions Perturbations in California. Atmospheric Chemistry and Physics Discussions, https://doi.org/10.5194/acp-2021-708, 2021.

MCS-01: APPLICATION OF ALL FEASIBLE MEASURES [ALL POLLUTANTS]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	ALL SOURCE CATEGORIES			
CONTROL METHODS:	ALL AVAILABLE CONTROL METHODS			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
POLLUTANT INVENTORY	TBD	TBD	TBD	TBD
POLLUTANT REDUCTION		TBD	TBD	TBD
POLLUTANT REMAINING		TBD	TBD	TBD
SUMMER PLANNING	2018	2031	2032	2037
POLLUTANT INVENTORY	N/A	TBD	TBD	TBD
POLLUTANT REDUCTION		TBD	TBD	TBD
POLLUTANT REMAINING		TBD	TBD	TBD
CONTROL COST:	NOT DETERMINED*			
INCENTIVE COST:	N/A			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

* Emission reductions and cost-effectiveness will be determined after a source category and feasible controls are identified.

Description of Source Category

This control measure is to address the State law requirement for all feasible measures for ozone. Existing rules and regulations for pollutants including VOCs and NOx reflect current best available retrofit control technology (BARCT). However, BARCT continually evolves as new technology becomes available that is feasible and cost-effective. South Coast AQMD staff would continue to review actions taken by other air districts for applicability in our region. Through this proposed control measure, the South Coast AQMD would commit to consider the adoption and implementation of the new retrofit control technology standards, as well as new controls or limits on existing operations.

Background

This control measure serves as a placeholder for any future control measures that may become feasible, prior to subsequent State Implementation Plan (SIP) revisions, through technology advances and/or cost decreases. South Coast AQMD staff continually monitors evolving control technologies, price changes, and the actions of other air quality agencies to determine the feasibility of implementing additional controls to achieve emission reductions. For example, almost all processes (pulping machines, press and dryers to convert waste-paper (newspaper, cardboard, etc.) back into cardboard paper) in the pulp and recycled paper mills are sources of fugitive VOC emissions, yet currently there is no known feasible control potentially available for fugitive VOC emissions generated by these type of sources. Very high air flow of vent gases makes it impractical and not cost-effective to vent the exhaust gas to a control device. Similarly, breweries, wineries, distillers and other similar operations that store and process grains, ferment, age, store and package the spirits (beer, wine, whiskey, etc.,) and treat the wastewater on site generate VOC emissions. Known feasible methods of control are not cost-effective based on the current emissions inventory. However, in the future, industry growth and affordable cost-effective control could make these sources viable future control measures.

Regulatory History

The California Clean Air Act (CCAA) requires air districts to achieve and maintain State standards by the earliest practicable date and for "extreme" nonattainment areas, to include all feasible measures in the California Health and Safety Code (H&SC) §§ 40913, 40914, and 40920.5. The term "feasible" is defined in the California Code of Regulations, section 15364, as a measure "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors." CARB guidance states that this definition, found in the CEQA Guidelines, applies to the requirements under air pollution laws. The required use of BARCT for existing stationary sources is one of the specified feasible measures. H&SC §40440 (b)(1) requires the South Coast AQMD to adopt rules requiring best available retrofit control technology for existing sources. H&SC §40406 specifically defines BARCT as "…best available retrofit technology means an emission limitation that is based on the maximum degree of reduction achievable taking into account environmental, energy, and economic impacts by each class or category of source."

Existing rules and regulations on VOC and NOx reflect current BARCT. However, BARCT evolves as new control methods become available that are feasible and cost-effective. Through this control measure, the South Coast AQMD commits to consider the adoption and implementation of new retrofit control technology standards as technology develops.

Proposed Method of Control

South Coast AQMD staff will continue to review new emission limits or controls introduced through federal, State or local regulations to determine if South Coast AQMD regulations remain equivalent or more stringent than rules in other regions. If not, a rulemaking process will be initiated to perform a BARCT analysis with potential rule amendments if deemed feasible. In addition, the South Coast AQMD will consider adopting and implementing new retrofit technology control standards, based on research and development and other information, that are feasible and cost-effective. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Emission Reductions

Further emission reductions would be sought from the adoption of new rules or amendment of existing rules and regulations to reflect new BARCT standards that may become available in the future prior to subsequent AQMP revisions.

Rule Compliance and Test Methods

Compliance with this measure would be based on monitoring, recordkeeping, and reporting requirements that have been established in existing source specific rules and regulations. In addition, compliance would be verified through inspections and recordkeeping and reporting requirements.

Cost Effectiveness

Cost-effectiveness for this control measure cannot be determined because the future set of "all feasible" measures are not known. The South Coast AQMD will continue to analyze the potential cost impact associated with implementing this control measure, conduct research on new control technologies, and provide cost-effectiveness information during any future rule making processes.

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from stationary sources.

References

California Health and Safety Code Sections 40913, 40914, 40920.5, 40406, and 40440 (b)(1)

California Code of Regulations, Section 15364

MCS-02: WILDFIRE PREVENTION
[NOx, PM]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	N/A			
CONTROL METHODS:	INCENTIVE FUNDING			
EMISSIONS (TONS/DAY):	N/A			
ANNUAL AVERAGE	2018	2031	2032	2037
POLLUTANT INVENTORY	N/A	N/A	N/A	N/A
POLLUTANT REDUCTION		N/A	N/A	N/A
POLLUTANT REMAINING		N/A	N/A	N/A
SUMMER PLANNING (IF NOX/VOC)	2018	2031	2032	2037
POLLUTANT INVENTORY	N/A	N/A	N/A	N/A
POLLUTANT REDUCTION		N/A	N/A	N/A
POLLUTANT REMAINING		N/A	N/A	N/A
CONTROL COST:	$4,100 per ton of TSP prevented; TBD for NOx			
INCENTIVE COST:	$259,800			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

Description of Source Category

This proposed control measure will seek particulate matter emission reductions and property defensible space enhancements from fuel reduction efforts via hand-thinning, mechanical thinning, and the use of chipping equipment (chipping) to mitigate excess fuels at properties located in the residential urban-wild-interface (UWI) areas of the San Bernardino National Forest (SBNF).

Background

Wildfires are a natural part of healthy Southern California forest ecosystems. Frequent and low- to moderate-intensity natural wildfires allow for fire-adapted species to reproduce, remove dying or dead flora, and increase forest resiliency through maintaining a natural biomass density.

Beginning in the early 20th century, fire suppression became the standard approach to managing fire. Fueled by fire suppression initiatives from the U.S. Forest Service as a result of the Theodore Roosevelt administration, changes to the social perception of forests, and economic pressure for optimizing timberlands not for forest health but for timber density, the natural cycle of fire-induced forest clearing and rejuvenation was disrupted. Several areas, including Southern California, have experienced severe wildfires as a result of overgrown fuel sources that have accumulated over the last several decades. Combined with increasing urbanization and increased climate change, flagrant wildfires are becoming more destructive and frequent, with 9 of 10 of the largest, most destructive, and most deadly fires in California's history occurring within the last decade.

Since the last third of the 20th century, policies against controlled burns were lifted on public and private lands and prescribed fire began to reemerge as a tool to combat human-caused forest compositional changes. However, progress has been slow and many acres remain to be fully treated. A 2019 study "We're Not Doing Enough Prescribed Fire in the Western United States to Mitigate Wildfire Risk," written by University of Idaho fire scientist Crystal Kolden, concluded that although California intentionally burned around 90,000 acres in 2018, however, the ideal burn rate is 5-10 times that amount.

While effective, prescribed burns have a complex administrative process in order to be approved, including burn and smoke management plans requiring regulatory approval. Prescribed burns also have social and safety implications as they are inherently a stronger and more complex approach to fuel reduction than thinning mechanisms. Hand-thinning and mechanical-thinning are fuel reduction methods that can be used in addition to or in-place of prescribed burning to achieve the objective of reduced fuel loads. These methods are often chosen in UWI areas due to proximity to structures and human life.

Thinning methods are also often paired with either prescribed pile burns or with chipping. Prescribed pile burns are similar to prescribed burns (often called "broadcast burns") but are localized to individual piles of loaded fuel from thinning efforts. Chipping involves no burning but changes the physical composition of the fuel.

Fuel composition encompasses four different categories. *Ground fuels* are the lowest elevation fuel that do not generally contribute to wildfire intensity or spread and consist of below-surface materials such as organic soils, duff, decomposing litter, roots, buried logs, and portions of stumps that lie below the surface. *Surface fuels* are on or near the ground floor that are often the most hazardous fuels, which is especially true in drier forests that have been affected by fire suppression and hyper-focused timber harvesting. Surface fuels consist of leaf and needle litter, dead branch material, downed logs, bark, tree cones, short shrubs, grasses, and other herbaceous materials. *Ladder fuels* are the next vertical fuel layer and are the second-most dangerous fuel as they allow for vertical extension of lower-intensity ground and surface fires into the canopy of larger trees. Ladder fuels consist of small trees, large shrubs, and the understory layer of trees. *Crown fuels* are the highest vertical fuel layer and include the canopy of large trees and play a smaller role in overall fire hazard potential.

Pairing thinning with chipping, also known as mastication, reduces flammable material and changes the physical composition from voluminous and flammable surface, ladder, and occasionally canopy fuels, into dense and less flammable chips. Thinning efforts primarily target ladder fuels to both reduce continuity between surface and crown fuels as well as promote native species propagation in areas where natural fires have been suppressed. Chips are a class of organic mulch and may be spread on the site where the fuel is collected, spread on private or government properties, or delivered to county facilities for processing. There is currently a shortage of data on mulch spread on the site of fuel collection on long-term ecological impact, with some studies showing an increase in non-native herbaceous and shrub flora and a short-term increase in surface fire hazard.

This mulch provides a multitude of benefits including reduced water consumption for adjacent flora, enhanced soil temperature insulation, reduced invasive weed propagation, improved erosion and dust control, mitigation of soil compaction, and aesthetic improvements. If gathered in sufficient enough quantities, chip material may also serve as an input to biomass processing facilities for energy production.

Homes and structures can catch fire through a variety of mechanisms, including embers which can float away from a main fire, radiant heat which can indirectly ignite materials from a sightline to a flame if in close enough proximity, and direct flame contact. Home hardening is the process of selecting materials, installation techniques, landscaping, and spacing considerations to increase the resiliency of homes or structures against these ignition mechanisms.

The California Department of Forestry and Fire Protection (CalFire) currently specifies 4 zones for defensible space for structures. *Zone 0* requirements, put into law in 2020 by Assembly Bill 3074, extend 0-5 feet from a structure and allows for no combustible material. *Zone 1* extends to 30 feet and requires removal of highly combustible materials such as dead vegetation. *Zone 2* extends to 100 feet and requires optimized spacing and vegetative care, such as no overgrown grass and appropriate spacing between plants, shrubs, and trees. CalFire also recommends removing all tree branches at least 6 feet from the ground and maintaining a vertical spacing under trees equal to 3 times the height of the tallest nearby shrub.

The practice of thinning and use of chips as ground cover can facilitate defensible space modifications by removing excess surface and ladder fuels and enhance the resiliency of underlying soil through increased water retention, complementing home hardening efforts.

The Mountain Rim Fire Safe Council (the "Council"), encompassing 110 square miles and much of the San Bernardino UWI, has successfully demonstrated the effectiveness of chipping initiatives and has successfully received CalFire and Southern California Edison funding in the past for thinning and chipping treatment.

Regulatory History

There are no South Coast AQMD funding initiatives specifically addressing fuel reduction efforts in communities in the San Bernardino National Forest. Rule 444 currently applies to open burning activities, which includes prescribed fire burning, but does not include a fuel reduction provision or mechanism for private landowners to conduct prescribed burning on residential properties. Rule 444 currently only allows for prescribed burning on public lands or lands open to the public, such as scout and Christian camps, when conducted by fire management agencies only.

Proposed Method of Control

The proposed method of control is to coordinate with other agencies to provide funding for chipping operations for the remaining untreated area in the Council's UWI. This would be similar to the CalFire and

Southern California Edison grants the Council has received in the past. The Council has not been able to provide sufficient chipping operations to its constituency due to the overwhelming demand for the service that has already exhausted its most recent grant.

The Council has received a total of three grants for chipping operations, awarded in 2014, 2017, and 2018. Although the 2018 grant was intended to be a 4-year grant, the Council had a nearly 300 percent increase in enrollment in its constituency from the 2017 grant and the funds were exhausted 18 months early.

The Council has provided records detailing the volunteer match to the grant funds. With the chipping program in place, homeowners in the UWI are much more compliant and engaged with assisting with fuel load reduction by trimming and removing excess hazardous vegetation, such as dead trees and leaf litter, for chipping than without the program. Using the number of volunteer hours from these property owners for each grant and the California Volunteer Rate, the Council estimates a 440 percent volunteer match to grant funds.

The Council's 2017 and 2018 grants' funds were provided by the California Climate Investments Program, with a requirement to track the amount of fuel collected. The Council also tracked the 2014 amount of fuel collected. The total fuel collected was 1,682,215 cubic feet which is equivalent to approximately 20,187 green tons. The unit of measure, green tons, refers to the weight of material as it currently exists, moisture included, and bone-dry tons (BDT) refers to the dry-weight component of the green tonnage, without moisture.

The Council estimates that 25,000 properties still remain untreated, even after the three grants had been received and chipping was implemented.

Studies show that the combination of thinning and chipping costs approximately $500-$1,500 per acre treated. Over the course of the three grants, the Council has treated approximately 1,491 acres with grant funds of $284,242 and a volunteer match of $1,259,920, or a total of $1,544,162 expended for fuel reduction. This results in a cost-per-acre of $1,036. Based solely on grant funds, the cost-per-acre is $191/acre.

The 1,491 treated acres covered 2,281 properties, or an average of 0.65 acres per property. For the 25,000 remaining properties, a total of 38,246 acres remain to be treated assuming 0.65 acres per property. With the current grant-portion cost-per-acre of $191, this results in grant funds of $7,304,986. Given the extensive and ongoing nature of fuel reduction, it is advisable to stage the total number of treated acres over several years. This proposal recommends providing a portion of this total amount as funding for an initial pilot for one grant cycle to last 2 years. The increasing engagement of the chipping program in the subject area suggests that subsequent cycles have an increasing enrollment. The assumed number of participating properties is at least that of the highest enrollment in a previous year, which was 1,046 properties in 2020. Providing funding for 2 years results in a total of at least 2,092 properties or 1,360 acres. This results in pilot funding in the amount of $259,760. Upon conclusion of this pilot, a review shall be completed and a vote conducted on whether to continue providing funding for additional years based on treated area and overall success of the pilot grant.

While it is possible another CalFire grant may be received by the Mountain Rim Fire Safe Council, funds from the South Coast AQMD would allow any future CalFire grant funds to be targeted to any number of additional fire-related initiatives: fire hazard abatement assistance; hazardous dead tree removal, document shredding, elimination of interior fuels, the publication of "Living with Wildfire in the Inland Empire", house numbering, and fire prevention outreach and education.

Additional projects are conducted by the Council without any funding: Gold-Spotted Oak Borer Task Force (an invasive species), goats for fuel reduction; BioChar for woody debris disposal, pine needle collection and disposal (for use as biochar and/or use at ski resorts), home hardening compliance, demonstration of fire safe gardens/landscape sites (to showcase drought resistant, low water native species in various areas), and others such as a statewide chipping locator service currently in development. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Emission Reductions

While there are no direct emission reductions associated with this proposal, it provides a preventative mechanism that may reduce emissions in the future. A flagrant, uncontrolled wildfire is undesirable, and can lead to destruction of properties as well as multiple tons of pollutants, including toxic pollutants, depending on the size of the wildfire and what is burning. Fortunately, there has not been a major fire in the San Bernardino UWI area since 2018 and thus the mitigated impact in terms of wildfire severity cannot be measured. However, it is reasonable to assume that, should a wildfire break out, that the 1,360 acres' worth of fuel, if not collected, would be burned, which is a likely scenario given the collected fuel is primarily ladder fuels. Additionally, structures that have not had thinning and chipping treatment are at an increased risk of burning and emitting toxic contaminants from interior fuel burning such as benzene, methylene chloride, vinyl chloride monomer, naphthalene, asbestos, and arsenic. These contaminants were released into the town of Paradise's drinking water supplies as it burned during the 2018 Camp Fire.

The average cubic feet of collected fuel per acre over the last 3 grants is 1,130 cubic feet per acre. Applied to the pilot grant's 1,360 acres, this equates to a total of 1,536,800 cubic feet of fuel proposed to be collected.

Several studies have reviewed the emissions profile of burned fuel. These emissions vary extremely widely depending on a number of factors including type of fuel (plant, shrub, or tree), species of fuel, humidity, available oxygen, temperature, wind, moisture content, and other factors.

One such source is a calculator developed by the University of Washington and used by the U.S. Forest Service which estimates emissions from pile burning based on fuel type, volume of fuel pile, packing density (large trees have higher packing density), bone-dry mass (removing moisture), and percentage of mass consumed. Using a total of 1,536,800 cubic feet of fuel collected (assumed to be a conifer composition with 90 percent combustion efficiency) and revising the calculator's packing density from 20 percent to 75 percent, the total emissions are 4.24 tons (PM), 3.00 tons (PM_{10}), 2.62 tons ($PM_{2.5}$), 60.72 tons (CO), 1,862 tons (CO_2), 4.91 tons (CH_4), and 3.32 tons (non-methane hydrocarbons). This source determines foregone emissions from preventing wildfire of the collected fuel only.

Another source is the U.S. EPA's AP-42, CH 13.1: "Wildfires and Prescribed Burning," which gives various emission factors for several different regions of the country. Although California is its own region (Region 5), due to the majority of California's forest being outside of Southern California and the region of the Council being closer in climate to that of the Southwestern region (Region 3), Region 3's emission factors were chosen. Region 3's emission factors are also lower than that of Region 5, providing a more conservative estimate of an emissions profile from burning. These emission factors are given in kg/Hectare units and are shown as 191 (PM), 1,570 (CO_2), 269 (CH_4), and 45 (NOx). Converting the pilot acreage of 1,360 acres to hectares yields 550.37 hectares. Converting kilograms (kg) to tons yields a conversion factor of 0.0011 tons/kg. This yields the following: 115.6 tons (PM), 950.49 tons (CO_2), 162.85 tons (CH_4), and 27.24 tons (NOx). This source determines foregone emissions from preventing wildfire of the total land area in the pilot grant. It is reasonable to assume that if a given land area is not treated, that more fuel than just that amount collected will burn as well. The collected fuel will contain excess ladder fuels, which if not collected, may lead to canopy fires and total combustion of a given land area.

Rule Compliance and Test Methods

Due to the nature of this control measure, no rules or test methods are proposed.

Cost Effectiveness

The pilot funding amounts to a grant of $259,760 to treat 1,360 acres for fuel reduction in the San Bernardino UWI. Should these materials be prevented from burning in a wildfire, the PM emissions prevented amount to 9.86 tons - 115.6 tons. Total Suspended Particles (TSP) will be used to aggregate all PM emissions and is defined as all particulates with a diameter less than or equal to 100 microns. A median of value of 62.73 tons TSP is selected, as the most probable scenario is that all of the excess surface and ladder fuels and a portion of canopy fuels would be combusted in a wildfire. Using this median value, the cost-effectiveness is $259,760/62.73 tons = $4,141 per ton of TSP prevented.

Implementing Agency

The South Coast AQMD has the authority to provide grant funds to prevent emissions from excess fuel.

References

CalFire. (n.d.). *History*. Retrieved August 4, 2021, from https://www.fire.ca.gov/about-us/history/

CalFire. (n.d.). *Fuels Reduction Guide*. Retrieved August 4, 2021, from https://www.fire.ca.gov/media/4jqerfjh/fuels-reduction-guide-final-2021-interactive.pdf

CalFire. (n.d.). *Fire Probability for Carbon Accounting*. Retrieved August 4, 2021, from https://egis.fire.ca.gov/FireProbability/

CalFire. (n.d.). *Fire Hazard Severity Zones*. Retrieved August 4, 2021, from https://osfm.fire.ca.gov/divisions/community-wildfire-preparedness-and-mitigation/wildfire-prevention-engineering/fire-hazard-severity-zones/

CalFire. (n.d.). *Defensible Space*. Retrieved August 4, 2021, from https://www.fire.ca.gov/programs/communications/defensible-space-prc-4291/

California Fire Safe Council. (n.d.). *Annual Grant Reports*. Retrieved July 22, 2021, from https://cafiresafecouncil.org/grants-and-funding/grants-clearinghouse/annual-grant-reports/

Fire prevention: wildfire risk: defensible space: ember-resistant zones, Cal. Assemb. B. 3074, Chapter 259 (Cal. Stat. 2020).

Fitzgerald, S. (2013). *A Land Manager's Guide for Creating Fire-Resistant Forests* (M. Bennett, Ed.) [Review of *A Land Manager's Guide for Creating Fire-Resistant Forests*]. Oregon State University Extension Service. https://www.nwfirescience.org/sites/default/files/publications/A%20Land%20Managers%20Guide%20for%20Creating%20Fire-resistant%20Forests%20.pdf

Forest History Society. (n.d.). *U.S. Forest Service Fire Suppression*. Retrieved August 4, 2021, from https://foresthistory.org/research-explore/us-forest-service-history/policy-and-law/fire-u-s-forest-service/u-s-forest-service-fire-suppression/

Jakobs, J. (2020, September 15). *California Forests 80%-600% Denser Than 150 Years Ago, UC Researcher Says Biomass Is One of the Answers*. GV Wire. https://gvwire.com/2020/09/15/california-forests-80-600-denser-than-150-years-ago-uc-researcher-says-biomass-is-one-of-the-answers/

Kolden, C. A. (2019). We're Not Doing Enough Prescribed Fire in the Western United States to Mitigate Wildfire Risk. *Fire*, *2*(2), 30. doi:10.3390/fire2020030

Minnesota Department of Natural Resources. (n.d.). *The Benefits of Prescribed Burning on Private Lands*. Retrieved August 4, 2021, from https://files.dnr.state.mn.us/assistance/backyard/privatelandsprogram/benefits_prescribed_burning.pdf

Office of Air Quality Planning and Standards, Office of Air and Radiation (1995). AP-42 Fifth Edition: *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources*. U.S. Environmental Protection Agency.

Rogstad, A., DeGomez, T., Hayes, C., Schalau, J., & Kelly, J. (n.d.). *Comparing the Ignitability of Mulch Materials for a Firewise Landscape* [Review of *Comparing the Ignitability of Mulch Materials for a Firewise Landscape*]. The University of Arizona Cooperative Extension. Retrieved August 4, 2021, from https://www.firesafemarin.org/wp-content/uploads/2017/04/Comparing_the_ignitability_of_mulch_materials_for_a_firewise_landscape_az1440-2014.pdf

Schrader-Patton, C. C., & Underwood, E. C. (2021). New Biomass Estimates for Chaparral-Dominated Southern California Landscapes. *Remote Sensing*, *13*(8), 1581. https://doi.org/10.3390/rs13081581

South Coast Air Quality Management District. (2013). Rule 444 – Open Burning (Amended July 12, 2013). http://www.aqmd.gov/docs/default-source/rule-book/rule-iv/rule-444.pdf

Wright, C. S. (2015). Piled fuels biomass and emissions calculator. Retrieved July 27, 2021, from https://www.fs.usda.gov/pnw/tools/piled-fuels-biomass-and-emissions-calculator-tool

FLX-01: IMPROVED EDUCATION AND PUBLIC OUTREACH [ALL POLLUTANTS]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	RESIDENTIAL, COMMERCIAL, INDUSTRIAL, TRANSPORTATION, AND MISCELLANEOUS SOURCES			
CONTROL METHODS:	INCREASED AWARENESS, INCENTIVE PROGRAMS, AND TECHNICAL ASSISTANCE IN MAKING LOW OR ZERO EMITTING PURCHASES, IMPLEMENTING EFFICIENCY PROJECTS, AND CONSERVATION TECHNIQUES			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	**2018**	**2031**	**2032**	**2037**
POLLUTANT INVENTORY	N/A	N/A	N/A	N/A
POLLUTANT REDUCTION		N/A	N/A	N/A
POLLUTANT REMAINING		N/A	N/A	N/A
SUMMER PLANNING	**2018**	**2031**	**2032**	**2037**
POLLUTANT INVENTORY	N/A	N/A	N/A	N/A
POLLUTANT REDUCTION		N/A	N/A	N/A
POLLUTANT REMAINING		N/A	N/A	N/A
CONTROL COST:	N/A			
INCENTIVE COST:	N/A			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD AND OTHER PARTIES			

Description of Source Category

This proposed control measure seeks to provide education, outreach, and incentives for consumers to contribute to clean air efforts. Examples include consumer choices such as the use of energy efficient products, new lighting technology, "super-compliant" coatings, low VOC-emitting tree planting, transportation choices, and the use of lighter colored roofing and paving materials which reduce energy usage by lowering the ambient temperature. In addition, this proposed measure intends to increase the effectiveness of energy conservation programs through public education and awareness as to the environmental and economic benefits of conservation. Educational and incentive tools to be used include social comparison applications (comparing your personal environmental impacts with other individuals), social media, and public/private partnerships. Further improvement of outreach allows the public to alert staff of any environmental problems that need attention.

Background

Energy efficiency and conservation have been included in the South Coast AQMD's Air Quality Management Plans since 1991. The South Coast AQMD continues to implement incentive and education programs to help promote clean air product purchases, energy efficiency projects, and conservation techniques that provide criteria pollutant emissions benefits. The South Coast AQMD has since adopted policies such as the Air Quality Related Energy Policy, Climate Change Policy, and Green Policy that help further define the South Coast AQMD's efforts in these areas.

This measure seeks to increase awareness of the benefits of purchasing low or zero emitting products and promote further implementation of efficiency and conservation p~~ye~~rojects. When making purchases such as new cars, yard equipment, or household products, there are several factors consumers must consider, but emissions and health benefits are typically not among them. To help make emissions an important factor in purchasers' decision-making process, the South Coast AQMD has several existing outreach and education programs in place such as Clean Air Choices,[34] educational materials, conferences, and outreach to specific communities throughout the Basin. Providing additional outreach and education regarding clean air choices will help consumers consider the emission benefits of their purchases. In some instances, these purchases include efficiency gains that will decrease longer term operating costs, and thus provide a built-in financial incentive. Providing specific outreach and education on these potential cost savings will help increase penetration of such low emitting technologies and practices.

Furthermore, there are several existing incentive programs to help promote higher efficiency and lower emitting technologies such as the utility administered rebate programs for purchases of high efficiency appliances. Some of these existing programs are established for reasons other than emissions benefits. For instance, the electric utility rebate program was established to reduce electricity demand to help decrease the need for additional power generation plants. However, this program also provides emission benefits that might be implemented faster with further education and outreach by the South Coast AQMD. The Energy Savings Assistance program covers the equipment and installation costs of new energy-efficient appliances for income-qualified customer.[35] Income-qualified homeowners in disadvantaged communities may also qualify for a free solar system through the Energy for All Program.[36] The Residential Advanced Clean Energy program provides eligible customers with a household energy assessment and the installation of energy efficient technologies such as no-cost furnace and water heating optimization measures and incentives for upgrading to high efficiency furnaces, tankless water heaters,

[34] http://www.cleanairchoices.org/

[35] https://www.sce.com/residential/assistance/energy-saving-program

[36] https://www.gridsolar.org/scesolarcare/

and fireplace inserts.[37] Rebates are also available for upgrades to select Energy Star-certified high efficiency appliances.[38]

The outreach and education regarding these existing programs will include information on co-benefits such as emission reductions and cost savings to promote accelerated implementation of these existing programs. The South Coast AQMD will also offer additional incentive programs to complement existing programs or promote specific efficient low or zero emitting technologies. For instance, the South Coast AQMD's Lawn Mower and Leaf Blower Exchange program provides a good example of the significant impacts incentive programs can have. Since 2003, the South Coast AQMD has sponsored a lawn mower exchange program for residential lawn mowers which is now known as the Electric Lawn Mower Rebate Program. The program is designed to incentivize residential users with a rebate of up to $250 for the purchase of a new electric lawn mower when they turn in their old gas-powered lawn mowers to an approved scrapper. Since its inception, this program has replaced over 57,000 high polluting gasoline-powered lawn mowers with electric lawn mowers. Similarly, the total number of old, polluting leaf blowers that have been scrapped exceeds 10,000.[39] The South Coast AQMD has also launched the Commercial Electric Lawn and Garden Equipment Incentive and Exchange Program to provide promote transition to zero emission equipment for commercial electric leaf blowers, string and hedge trimmers, lawn mowers and chainsaws, resulting in additional emission reduction benefits in the commercial sector. In addition, in June 2018, the South Coast AQMD launched the Clean Air Furnace Rebate Program to incentivize early deployment of low emitting furnaces. In September 2020 this program was approved to be updated with additional funds and expanded to incentivize zero-emitting all-electric heat pumps.

The South Coast AQMD will also help to promote potential efficiency benefits for existing equipment and structures. There are several reasons why many efficiency projects are not undertaken. In many instances, tools, incentive programs, and loan programs for efficiency upgrades are not adequately described, advertised, or consolidated, which makes it challenging for consumers to gather necessary information. Certain projects require high initial capital costs, despite relatively fast payback periods, which serves as a barrier to implementation. In addition, technical barriers prevent many system operators, homeowners, and building maintenance crews from utilizing existing tools and implementing efficiency projects. South Coast AQMD staff will help develop technical outreach to residents and businesses to help implement projects that have emission benefits and short payback periods. South Coast AQMD staff may also examine ways to provide assistance through additional incentive programs and/or loan products to defray or amortize capital costs on certain efficiency projects.

Regulatory History

As this measure is not a regulatory item that will be implemented via rulemaking, there is no relevant regulatory history in this area. However, as mentioned above, the South Coast AQMD has developed and implemented a wide array of education, outreach, technical assistance, and incentive programs designed

[37] https://www.socalgas.com/save-money-and-energy/rebates-and-incentives/residential-direct-install-program

[38] https://www.socalgas.com/save-money-and-energy/rebates-and-incentives/natural-gas-appliance-rebates

[39] http://www.aqmd.gov/home/programs/community/community-detail?title=lawn-equipment.

to achieve emission reductions on a voluntary basis. A discretionary economic incentive program (EIP) could be established that provides funding for outreach and incentives to promote the use of efficient low or zero emitting technologies. In order to get emission reduction credit as part of the State Implementation Plan (SIP) submittal, guidelines would be required that demonstrate the emission reductions from the EIP are quantifiable, surplus, enforceable, and permanent.

Proposed Method of Control

This control measure is a voluntary program that provides education and outreach to consumers, business owners, and residents regarding the benefits of making clean air choices in purchases, conducting efficiency upgrades, installing clean energy sources, and approaches to conservation. These efforts will be complimented with helping implement currently available incentive programs and developing additional incentive programs. Lastly, South Coast AQMD staff may develop an EIP to offer technical and financial assistance to help implement efficiency measures and other low emission technologies.

Emission Reductions

Quantifying emission reductions from these activities is not possible at this time due to the voluntary nature of the control measure. Outreach and education components will have emission benefits that can perhaps be quantified later based on program evaluation, technology penetration, and other assessment and inventory methods. Implementing additional incentive programs will provide a means to quantify these benefits as they are developed. Emission reductions achieved from these activities will be incorporated into the subsequent SIP revisions once projects are implemented.

Rule Compliance and Test Methods

Not applicable.

Cost Effectiveness

The cost-effectiveness of this measure cannot be determined, given the variety of programs and projects that will be developed. South Coast AQMD staff will continually analyze costs associated for with education and outreach, and where possible quantify resulting emission reductions. The cost-effectiveness for specific incentive programs can be determined as they are developed and implemented by the South Coast AQMD.

Implementing Agency

The implementing agency will be the South Coast AQMD, in cooperation with other local governments, agencies, technology manufacturers and distributors, and utility service providers.

References

South Coast Air Quality Management District, Air Quality Related Energy Policy, September 2011.

South Coast Air Quality Management District, Climate Change Policy, September. 2008.

South Coast Air Quality Management District, Green Policy, October, 2009.

South Coast Air Quality Management District, Electric Lawn and Equipment. http://www.aqmd.gov/home/programs/community/community-detail?title=lawn-equipment.

National Academy of Sciences, Real Prospects for Energy Efficiency in the United States, 2010.

American Council for an Energy-Efficient Economy (ACEEE), Energy-Efficiency: The Slip Switch to a New Track Toward Compliance with Federal Air Regulations, January 2012, Report # E122.

McKinsey and Co., Unlocking Energy Efficiency in the U.S. Economy, July 2009.

California Energy Commission, 2019 California Energy Efficiency Action Plan, December 2019. https://www.energy.ca.gov/programs-and-topics/programs/energy-efficiency-existing-buildings

California Energy Commission, 2019 Building Energy Efficiency Standards for Residential and Nonresidential Buildings, December 2018. https://www.energy.ca.gov/publications/2008/2019-building-energy-efficiency-standards-residential-and-nonresidential

EGM-01: EMISSION GROWTH MANAGEMENT FROM NEW DEVELOPMENT AND REDEVELOPMENT

[ALL POLLUTANTS]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	NEW DEVELOPMENT AND REDEVELOPMENT PROJECTS			
CONTROL METHODS:	TO BE DEVELOPED THROUGH A PUBLIC PROCESS			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
POLLUTANT INVENTORY	TBD	TBD	TBD	TBD
POLLUTANT REDUCTION	TBD	TBD	TBD	TBD
POLLUTANT REMAINING	TBD	TBD	TBD	TBD
SUMMER PLANNING	2018	2031	2032	2037
POLLUTANT INVENTORY	TBD	TBD	TBD	TBD
POLLUTANT REDUCTION	TBD	TBD	TBD	TBD
POLLUTANT REMAINING	TBD	TBD	TBD	TBD
CONTROL COST:	TBD			
INCENTIVE COST:	TBD			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD/LOCAL OR REGIONAL AGENCIES			

Description of Source Category

The purpose of this control measure is to identify emission reduction opportunities and to mitigate and, where appropriate, reduce emissions from new development or redevelopment projects such as residential, commercial, and industrial projects that are otherwise not included in other Facility Based Mobile Source Measures (FBMSMs) identified in the 2022 Air Quality Management Plan (2022 AQMP). These projects are considered indirect sources. An indirect source is any facility, building, structure, or installation, or combination thereof, which generates or attracts mobile source activity. Through a public process with the Working Group, the measure is designed to identify control measures and a path forward to reducing emissions related to indirect sources required to meet and balance the needs of the Basin in demonstrating attainment of the federal standards with evolving land use development patterns, growing economy, and the needs of the Basin's increasing populations for clean air, public health, infrastructure, and jobs.

Background

The South Coast Air Basin (Basin) population is projected to increase 12 percent by 2031, resulting in new residential, commercial, and industrial development activities, according to the Southern California Association of Governments (SCAG). The majority of that growth will occur as infill to existing urbanized areas. By 2045, SCAG's 2020 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS) expects 51 percent of housing and 60 percent of jobs to be located in areas served by high quality transit. They are increased from the projected 46 percent of housing and 55 percent of jobs for 2040 in SCAG's 2016 RTP/SCS. As a result of the changing distribution and density of development, SCAG reports a decrease in vehicle miles traveled (VMT) per capita in the Basin between 2018 and 2037: daily per capita VMT is projected to decrease by 6 percent, from 23.23 million miles to 21.83 million miles.

A variety of existing and future programs, such as California's 2016, 2019, and the recently adopted 2022 Building Energy Efficiency Standards (i.e., Title 24) will contribute to emission reductions when compared to existing development activities. New development and redevelopment projects will also be constructed in compliance with Title 24 green building requirements that greatly reduce construction and operational emissions compared with existing development. However, additional numbers and length of passenger vehicles and trucks trips, landscape maintenance equipment, and construction emissions from new developments and redevelopments will contribute to regional and localized air pollution. EGM-01 seeks to reduce emissions primarily from project construction activities by enabling greater deployment of zero and ~~near-zero~~low NOx emission technologies for on-road and off-road mobile sources.

In recent years project developers and local jurisdictions have actively explored and implemented innovative policies that reduce emissions. One recent example includes the Net Zero Newhall Ranch development project located in the Santa Clarita Valley of Los Angeles County. The project is committed to reducing or mitigating the project's greenhouse gas emissions to zero. While net-zero greenhouse gas emission projects do not necessarily target Nitrogen Oxides (NOx) emission reductions they may provide quantifiable co-benefits of NOx and other criteria pollutant emissions. Another example includes Clean Construction policies used by Los Angeles County Metropolitan Transportation Authority (LA Metro), Los Angeles World Airport (LAX), and the Port of Los Angeles. These policies generally provide a step-down approach, where project developers must use Tier 4 final equipment, but are allowed to use lower tiered equipment if certain criteria are met (such as an inability to identify any manufacturers of a particular type of Tier 4 final equipment). While these policies reduce emissions for these specific projects, it is unclear if these are State Implementation Plan (SIP) creditable due to the complexity of demonstrating the U.S. EPA's integrity elements for SIP credit, which require the emission reductions to be surplus, permanent, enforceable and quantifiable. Finally, as part of the environmental review process under California Environmental Quality Act (CEQA) and/or National Environmental Policy Act (NEPA), some projects have chosen to contribute money to an air quality mitigation fund that would be used to incentivize the purchase and use of cleaner equipment to offset emissions.

A number of air districts in California have already adopted and are implementing indirect source rules, policies, and/or collection of mitigation fees to address emissions from new development and redevelopment projects. Common approaches include an emissions threshold test to determine the applicability of the rule, and mitigation fees, and/or demonstrations that feasible direct, on-site mitigation measures have been implemented. These examples by other air districts are provided for informational purposes only, and do not necessarily reflect a model of what an applicable rule that may be developed by the South Coast Air Quality Management District (South Coast AQMD) would entail. Given the uniqueness and severity of the air quality in the Basin in comparison to other regions in California and the United States, unique considerations will be given in developing enforceable mechanisms in order to meet federal air emissions standards.

In December 2005, the San Joaquin Valley Air Pollution Control District (SJVAPCD) adopted Rule 9510 – Indirect Source Review, which was approved by the U.S. EPA in May 2011. In December 2017, SJVAPCD amended Rule 9510. The purpose of the rule is to reduce emissions of NOx and PM10 from the construction of a development project that seeks to gain a final discretionary approval from a public agency (upon full build-out) with design features, on-site measures, and off-site measures. The rule also applies to transportation or transit development projects whose construction exhaust emissions will equal or exceed 2 tons per year of NOx or 2 tons per year of PM10. The rule requires applicants of new development projects to provide documents necessary to perform an emissions generation analysis. SJVAPCD calculates a required emission reduction amount based on total emissions and identifies credits for specific on-site emission reduction measures included in the project. Required reductions not achieved by voluntary on-site measures would be achieved off-site through a mitigation fee. Off-site reductions are subject to criteria including, but not limited to, being quantifiable and surplus. Such offsite reductions are analyzed annually to ensure their effectiveness.

Regulatory History

California Health and Safety Code (H&SC) Section 40716 states that "a district may adopt and implement regulations to reduce or mitigate emissions from indirect and areawide sources of air pollution". As an example, a 1993 California Attorney General opinion states that "a district's regulations may require the developer of an indirect source to submit the plans to the district for review and comment prior to the issuance of a permit for construction by a city or county. A district may also require the owner of an indirect source to adopt reasonable post-construction measures to mitigate particular indirect effects of the facility's operation [as a stationary source]. Such regulations could be enforced through an action for civil penalties…". (Cal. Attorney General Opinion 92-519.) While other types of indirect source measures could be developed, the same attorney general's opinion concluded that a district may not impose a permitting system upon indirect sources per se, given the primacy of local land use control. H&SC Section 40716 also states that "nothing in the section constitutes an infringement on the existing authority of counties and cities to plan or control land use, and nothing in the section provides or transfers new authority over such land use to a district" when an air district adopts and implement regulations to reduce or mitigate emissions from indirect and areawide sources of air pollution or encourage or require the use of measures that reduce the number or length of vehicle trips.

EGM-01 was first adopted as part of the mobile source control measure strategies within the 2016 AQMP. After the adoption, South Coast AQMD staff convened an EGM-01 working group consisting of affected stakeholders from local governments, the building industry, developers, realtors, other business representatives, environmental/community organizations, and other stakeholders and held four Working Group meetings from May 2017 to January 2018 to explore a framework and identify opportunities, innovative approaches, strategies, and actions to mitigate and potentially reduce emissions from new development or redevelopment projects. In March 2018, an initial concept for EGM-01 was developed and consisted of the pursuit of voluntary emission reduction strategies in addition to the development of an indirect source rule focused on reducing construction emissions from projects over a certain size or activity threshold using several compliance options. Potential options that staff proposed and presented to the South Coast AQMD's Governing Board included a new voluntary fleet certification program coupled with a facility/project requirement to utilize at least some certified clean fleets, a mitigation fee option, crediting options for activities like installation of charging/fueling infrastructure, or other emission reduction measures. In May 2018, the South Coast AQMD's Governing Board considered staff's proposal and directed staff to continue to work with the Working Group to develop rule concepts, timelines, and cost-benefits estimates.

Based on Governing Board direction, staff held three additional Working Group Meetings for the development of EGM-01 and surveyed the Working Group on investigative approaches to identify emission reduction costs. The Working Group identified that the fundamental step in proceeding with emission reduction strategies for New Development and Redevelopment Projects would require a cost-benefit analysis to investigate the costs of construction and assess the impacts of emission reduction strategies on these projects individually and at a larger scale regionally, specifically as it related to affordable housing projects. A Request for Proposal (RFP) to study the feasibility of emission reductions from construction and cost of emission reduction strategies on new development and redevelopment projects was drafted by staff with input from the Working Group. The RFP sought to profile the universe of off-road construction equipment available in the South Coast Air Basin and identify the incremental cost to upgrade existing off-road construction equipment to Tier 4 standards. The RFP was released for a 60-day period from September 2019 to November 2019. No proposals were received, and no contract was awarded.

Proposed Method of Control

The South Coast AQMD is not required to adopt an indirect source rule simply because another air district found it feasible. However, a demonstration of infeasibility may be required in light of the actions taken by other air districts if the South Coast AQMD does not pursue a regulatory approach in developing an indirect source rule for this facility sector.

South Coast AQMD staff will re-convene the Working Group to develop a proposed method of control for EGM-01. Discussions and review will include, but are not limited to, types of projects affected, including affordable housing projects; effects on real-estate prices and jobs; economic growth forecast and impacts; the latest Title 24 green building standards; and regionwide policy shifts toward infill development and active transportation with implications for trip generation, as documented in SCAG's 2020 RTP/SCS pursuant to SB 375. Promising emission reduction strategies are being pursued or implemented by new development or redevelopment projects under CEQA and/or NEPA. Through the Working Group, South Coast AQMD staff will continue to explore potential actions to encourage net-zero developments, use of zero emission technologies in developing new or redeveloping projects, and installation of charging and fueling infrastructure and develop concepts and innovative approaches that could include, but are not limited to, voluntary CEQA air quality mitigation programs. The South Coast AQMD will continue collaborating with local utilities, local governments, SCAG, and the state Energy and Public Utility Commissions and leverage their policies, programs, and resources to encourage acceleration of clean construction equipment and more rapid growth of alternative fuel and/or electric vehicle charging infrastructure in the South Coast AQMD's jurisdiction. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Emission Reductions

The amount of emission reductions that can be achieved from this measure will be determined dependent on the type and number of new development and redevelopment projects affected by the measure and the method of control to be implemented to reduce emissions for all pollutants. The reliance merely on VMT as an applicable metric will be avoided to the maximum extent possible due to the advances in fleet change and emission control technologies discussed earlier.

Rule Compliance and Test Methods

Compliance will be verified via South Coast AQMD outreach and field inspection. Approved emission quantification protocols by federal, State or local agencies will be used to track and report emission reductions for SIP purposes. If a protocol does not exist for a specific project, a protocol will be developed for the South Coast AQMD Governing Board's consideration for adoption.

Cost Effectiveness

The South Coast AQMD will continue to work with the Working Group through a public process to identify methods for evaluating cost-effectiveness for the measure based on the control methods to be implemented by new development and redevelopment projects that will be subject to the measure.

Implementing Agency

Implementing agencies would include counties, cities, or other local or regional agencies that implement new development or redevelopment projects. The South Coast AQMD may also be an implementing agency but may not "infringe upon the existing authority of counties and cities to plan or control land use" (California H&SC Section 40716).

References

Southern California Association of Governments. (2020). 2020 RTP/SCS. https://scag.ca.gov/sites/main/files/file-attachments/0903fconnectsocal-plan_0.pdf?1606001176.

California Energy Commission. (2021). The 2022 Building Energy Efficiency Standards. https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency.

Proposed Rule to Implement the Fine Particle National Ambient Air Quality Standards. 40 CFR Parts 51 and 52, Federal Register, Volume 70, No. 210, page 65984. November 1, 2005.

San Joaquin Valley Air Pollution Control South Coast AQMD. (2017). Rule 9510 Indirect Sour Review (ISR). https://www.valleyair.org/rules/currntrules/r9510-a.pdf.

San Joaquin Valley Air Pollution Control South Coast AQMD. (2015). PM2.5 Plan for the 1997 PM2.5 Federal Standard. http://www.valleyair.org/Air_Quality_Plans/PM25Plans2015.htm.

United States Environmental Protection Agency. Menu of Control Measures. http://www3.epa.gov/ttn/naaqs/pdfs/MenuOfControlMeasures.pdf.

Jones, D., Wu, R., Barros, C. and Peterson, J. (2013). Research Findings on the Use of Rubberized Warm-Mix Asphalt in California. http://ra-foundation.org/wp-content/uploads/2013/02/040-PAP_060.pdf.

South Coast Air Quality Management District. (2010). Rule 1110.2 – Emission Reductions from Gaseous and Liquid Fueled Engines (Amended July 9, 2010).

EGM-02: EMISSION REDUCTIONS FROM PROJECTS SUBJECT TO GENERAL CONFORMITY REQUIREMENTS [ALL POLLUTANTS]

CONTROL MEASURE SUMMARY

SOURCE CATEGORY: GENERAL CONFORMITY

CONTROL METHODS: MOBILE SOURCE EMISSION REDUCTION EFFORTS THROUGH OFFSETTING PROJECT EMISSIONS

EMISSIONS (TONS/DAY):

ANNUAL AVERAGE	2018	2031	2032	2037
VOC INVENTORY	TBD	TBD	TBD	TBD
VOC REDUCTION		TBD	TBD	TBD
VOC REMAINING		TBD	TBD	TBD
NOX INVENTORY	TBD	TBD	TBD	TBD
NOX REDUCTION		TBD	TBD	TBD
NOX REMAINING		TBD	TBD	TBD
CO INVENTORY	TBD	TBD	TBD	TBD
CO REDUCTION		TBD	TBD	TBD
CO REMAINING		TBD	TBD	TBD
SUMMER PLANNING	2018	2031	2032	2037
VOC INVENTORY	TBD	TBD	TBD	TBD
VOC REDUCTION		TBD	TBD	TBD
VOC REMAINING		TBD	TBD	TBD
NOX INVENTORY	TBD	TBD	TBD	TBD
NOX REDUCTION		TBD	TBD	TBD
NOX REMAINING		TBD	TBD	TBD
CO INVENTORY	TBD	TBD	TBD	TBD
CO REDUCTION		TBD	TBD	TBD
CO REMAINING		TBD	TBD	TBD

CONTROL COST: TO BE DETERMINED

IMPLEMENTING AGENCY: SOUTH COAST AQMD

Description of Source Category

Pursuant to Clean Air Act Section 176(c) (42 U.S.C. 7506) and the U.S. Environmental Protection Agency (U.S. EPA)'s implementing regulations (40 CFR Part 93, Subpart B and 40 CFR Part 51, Subpart W), general conformity is required for National Ambient Air Quality Standard (NAAQS) nonattainment and maintenance areas. The intent of general conformity is to prevent the air quality impacts of a proposed federal action, under Title 23 U.S.C., from causing or contributing to new violations of the air quality standards, exacerbating existing violations, or interfering with the purpose of the applicable implementation plan. Mobile sources are the primary contributors to emissions increases under general conformity since stationary sources are subject to New Source Review requirements, however, stationary sources can also play a role. Emission increases can be temporary, as in the case of construction and development projects, or long-term as in the case of increased operations at commercial airports.

Background

The U.S. EPA's General Conformity Rule establishes an applicability test for determining which Federal actions are subject to the conformity requirement for the nonattainment or maintenance areas. If a proposed action results in emission increases which are less than the de minimis thresholds for the relevant pollutants or precursors, no conformity determination needs to be made. If the emissions from a proposed action exceed the de minimis threshold for any given pollutant (or precursor) for which the area is designated as maintenance or in nonattainment, the Federal agency must make a positive conformity determination for that pollutant on the basis of one of the criteria listed in 40 CFR 93.158 before the project can proceed. The conformity determination must demonstrate that the emissions from the proposed project are accounted for in the most recently approved SIP. The South Coast Air Basin is designated as an "extreme" nonattainment area for ozone and as a "serious" nonattainment area for both 24-hour and annual PM2.5. The general conformity de minimis thresholds are 10 tons per year of Volatile Organic Compounds (VOC) and 10 tons per year of Nitrogen Oxides (NOx) for the "extreme" ozone nonattainment areas; and 70 tons per year of PM2.5 and the applicable precursors for the "serious" PM2.5 nonattainment areas. The de minimis threshold for Carbon Monoxide (CO) is 100 tons per year for all nonattainment and maintenance areas. The South Coast Air Basin attained the 1971 CO NAAQS and was redesignated as maintenance area as of May 11, 2007.

In order to streamline a conformity evaluation process, SIP set-aside accounts were established in the 2012 Air Quality Management Plan (AQMP). The set-aside account for general conformity has an initial balance of 1 ton~~s~~ per day of NOx and 0.2 tons per day of VOC for each year from 2013 to 2030. The general conformity account was re-evaluated in the 2016 AQMP based on expected growth and the number of projects that are planned to take place in the near future. The revised set-aside account to accommodate projects subject to general conformity included a balance of 2.0 tons per day of NOx and 0.5 tons per day of VOC each year from 2017 to 2030, and 0.5 tons per day of NOx and 0.2 ton per day of VOC in 2031. Emissions from general conformity projects are tracked by the South Coast AQMD tracking system and debited from the account on a first-come-first-serve basis. Any unused portion cannot be carried forward to the following year. For those projects that come in after the conformity budget is exhausted, the corresponding federal agency must go through the regular general conformity determination process to demonstrate that the increased emissions are accounted for in the SIP or would not interfere the State and the South Coast AQMD's effort to attain NAAQSs. Prior to the SIP set-aside account approach, general conformity was determined on a ~~case by case~~case-by-case basis, which was resource intensive and time consuming.

Regulatory History

The U.S. EPA promulgated its general conformity regulations (40 CFR Parts 51 and 93) in response to Clean Air Act amendments in 1990, which required that federal actions conform to applicable implementation plans. The regulation established the criteria and procedures governing the determination of conformity for all federal actions and took effect on January 31, 1994. In 2006, the U.S. EPA revised general conformity regulations to include de minimis thresholds for PM2.5 and its precursors. Subsequently, in 2010, the U.S. EPA further revised its regulations to streamline the conformity process. The revisions removed a requirement for the submission of General Conformity SIPs, allowed a federal agency to negotiate a facility-wide emission budget, incorporated the use of early emission reduction credits into the regulations, and enabled greater flexibility in mitigating emission increases.

On September 9, 1994, the South Coast AQMD adopted Rule 1901 regarding the applicable general conformity provisions (40 CFR Part 51). However, the rule has not been amended since and does not provide guidance on performing general conformity determinations. The set-aside account introduced in the 2012 and 2016 AQMPs streamlines the evaluation process compared to a case-by-case approach conducted prior to creation of the set-aside account.

Other Air Basins

Other air districts in the State require the offsetting of emissions when a positive conformity determination is made. San Joaquin Valley Air Pollution Control District (SJVAPCD) and Sacramento Metro AQMD frequently handle projects subject to general conformity requirements. The approaches adopted by the two districts are listed below. The San Joaquin Valley Air Pollution Control District (SJVAPCD) requires that emission increases be mitigated through a Voluntary Emission Reduction Agreement (VERA), an innovative California Environmental Quality Act (CEQA) mitigation measure that reduces air quality impacts from development projects. Developers provide pound-for-pound mitigation of their project emissions through a process that funds and implements emission reductions. SJVAPCD reinvests the mitigation fees, prioritizing communities located near the proposed project, through grants to businesses, residents, and municipalities to facilitate emission reductions. Examples include grants to schools to replace high emitting diesel buses, grants to businesses to purchase electric off-road equipment, or rebates to residents who acquire zero emission vehicles. VERA is a mature and successful process with 46 agreements and over 9,600 tons of emissions reduced as of February 2021. The Sacramento Metro AQMD also requires the offsetting of emissions increases associated with positive conformity determinations. Rule 205 - Community Bank and Priority Reserve allows the use of Emission Reduction Credits (ERCs) for general conformity purposes. Entities may either choose to purchase ERCs from others that have banked ERCs, or request an ERC loan from Sacramento Metro AQMD's Priority Reserve Bank or Community Bank. Loans are prioritized based on multiple criteria and approval requires that an Authority to Construct or a Permit to Operate has been issued and the applicant has paid the fees.

Proposed Method of Control

This measure seeks to achieve emission reductions by eliminating the SIP set-aside account for general conformity. Considering the rigorous emission reductions required for attainment of the 2015 8-hour ozone standard, no new emissions can be accommodated without appropriate mitigation or offset of the increased emissions. All projects that receive a positive conformity determination may be required to undergo a formal process to demonstrate that the emissions are accounted for in the SIP. The South Coast AQMD will consider establishing a new mechanism to offset emission increases, similar to VERA and Rule 205 at SJVAPCD and Sacramento Metro AQMD, respectively, through a rule making process, which will invite stakeholders and the public to participate.

Emission Reductions

Emission reductions would be sought in order to mitigate emission increases from general conformity projects that have exceeded the de minimis thresholds.

Rule Compliance

Compliance with the mitigation measures would be based on monitoring, recordkeeping, and reporting requirements that have been established in existing source-specific rules and regulations. In addition, compliance would be verified through inspections and other recordkeeping and reporting requirements.

Test Methods

Approved emission quantification protocols by federal, state, or local agencies will be used to track and report emission reductions for SIP purposes.

Cost Effectiveness

The cost-effectiveness of this measure will be based on the type and number of projects affected by the measure and the strategies identified through the public process.

Implementing Agency

The South Coast AQMD has authority to establish an emission budget, assess mitigation measures, and seek emission reductions through the use of mitigation fees.

References

San Joaquin Valley Air Pollution Control District. Voluntary Emission Reduction Agreement (VERA) with the Friant Water Authority.

http://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2021/February/presentations/08.pdf

Sacramento Metropolitan Air Quality Management District. Solution for Environment & Economic Development (SEED). http://www.airquality.org/businesses/permits-registration-programs/new-source-review-(nsr)/solution-for-environment-economic-development-(seed)

EGM-03: EMISSION REDUCTIONS FROM CLEAN CONSTRUCTION POLICY [ALL POLLUTANTS]

CONTROL MEASURES SUMMARY				
SOURCE CATEGORY:	CONSTRUCTION EQUIPMENT/VEHICLES AND ACTIVITIES			
CONTROL METHODS:	TO BE DEVELOPED			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
POLLUTANT INVENTORY	TBD	TBD	TBD	TBD
POLLUTANT REDUCTION	TBD	TBD	TBD	TBD
POLLUTANT REMAINING	TBD	TBD	TBD	TBD
SUMMER PLANNING	2018	2031	2032	2037
POLLUTANT INVENTORY	TBD	TBD	TBD	TBD
POLLUTANT REDUCTION	TBD	TBD	TBD	TBD
POLLUTANT REMAINING	TBD	TBD	TBD	TBD
CONTROL COST:	TBD			
INCENTIVE COST:	N/A			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD/LOCAL OR REGIONAL AGENCIES			

Description of Source Category

The purpose of this control measure is to identify potential approaches to mitigate and control emissions from construction activities in the South Coast Air Basin (Basin). This measure is to develop a Clean Construction Policy (CCP) with a set of recommended control measures and approaches that can be utilized for reference and voluntary implementation by local municipalities and public agencies.

Background

Indirect sources such as construction projects involve and attract mobile sources, both on- and off-road, that emit significant amounts of harmful air pollutants that can adversely affect air quality and public health. To mitigate and reduce emissions from these indirect sources, EGM-01: Emission Reductions from New Development and Redevelopment Projects, was first adopted as a control measure in the 2007 Air Quality Management Plan (AQMP) and subsequently included in the 2016 AQMP. EGM-01 is designed to reduce emissions related to new residential, commercial, industrial, and institutional development and redevelopment projects. While EGM-01 will be based on mandated measures and approaches, such as an indirect source rule, to address air emissions from the new development and redevelopment projects, the Clean Construction Policy to be developed under EGM-03 will be offered as a voluntary measure for municipalities and other public agencies to adopt fully or partially in their respective programs. If the CCP is adopted and widely applied by the large majority of municipalities and public agencies to mitigate and reduce emissions from construction activities in the Basin, EGM-03 will be implemented in lieu of EGM-01 where applicable and feasible.

The California Health and Safety Code (H&SC) Section 40716 states that “a District may adopt and implement regulations to reduce or mitigate emissions from indirect and areawide sources of air pollution.” The objective of the voluntary Clean Construction Policy is to encourage the implementation of the cleanest technology and equipment available as well as best management practices for construction activities, especially those located in or near environmental justice communities.

Regulatory History

To mitigate and reduce emissions from construction activities, a number of municipalities and agencies in California have adopted clean (or green) construction policies for their own projects and/or public projects within their jurisdiction.

In April 2007, the City and County of San Francisco adopted an Ordinance requiring public projects to reduce emissions at construction sites starting in 2009. In March 2015, the Ordinance was expanded to require construction sites to further reduce emissions in areas with high background levels of air pollutants. The Ordinance requires contractors of publicly funded construction projects (greater than 20 days in length) to significantly reduce emissions by implementing: (a) the use of cleaner diesel-fueled engines, (b) alternative sources of power (if available) instead of portable diesel engines, (c) the preparation of a Construction Emissions Minimization Plan, which includes best management practices, and (d) construction activities monitoring and reporting.

In July 2011, the Lost Angeles County Metropolitan Transportation Authority (Metro) adopted a Green Construction Policy (GCP) to reduce harmful diesel exhaust emissions from on-road vehicles, off-road equipment, and portable generators used for construction projects on their properties and at their rights-of-way. The GCP requires that off-road construction equipment must meet the Tier 4 engine standards, on-road vehicles to meet 2010 standards, and portable generators be BACT-compliant. In addition, the GCP requires the use of renewable diesel and 5-minute idling limit. It also requires contractors to consider, where feasible, emissions-reducing technology such as hybrid drives and specific fuel economy standards. To ensure compliance, Metro conducts periodic inspections of sites and construction equipment and also provides assistance to help contractors to meet the requirements.

Other authorities such as the Port of Los Angeles (POLA) and the Los Angeles World Airports (LAWA) have implemented similar policies and guidelines to reduce emissions related to construction activities. In 2008, the POLA Board of Harbor Commissioners adopted the Los Angeles Harbor Department Sustainable Construction Guidelines, and on August 4, 2017, LAWA published a Sustainable Design & Construction Requirements for new construction and major renovation projects owned by LAWA or its tenants.

Together, these policies require cleanest-tier diesel engines available, hybrid and electric off-road equipment (where feasible), and best management practices.

Proposed Method of Control

This measure seeks to mitigate and reduce emissions generated by construction activities in the Basin through the voluntary adoption and use of a CCP. Although this CCP will be developed in collaboration with local municipalities and agencies, construction industry, and other affected stakeholders, a set of draft guidelines for the proposed CCP is provided below with recommended control measures and best management practices based on clean construction policies and ordinances that are already adopted and currently implemented in California.

The proposed approach to the CCP guidelines would consist of a hierarchy that prioritizes direct, on-site emission reductions. These emission reductions should first come from zero emission off-road construction equipment and on-road haul and material delivery trucks. If zero emission off-road and on-road equipment is not available or feasible for implementation, then the next cleanest, commercially available off-road and on-road equipment should be utilized during construction activities.

The alternative to direct, on-site emission reductions would be to achieve regional emission reductions off-site and outside of the area of the project. This may be accomplished through the use of credits from non-new source review programs, although this approach would be the least favorable and should be utilized as a last resort option to achieve emission reductions from construction activities.

Examples of potential voluntary measures that could be utilized to reduce emissions from construction activities are discussed below.

All off-road construction equipment used during construction activities shall be zero emission. If it is not feasible to have all off-road construction equipment units be zero emission, then a step-down approach should be utilized to ensure that the majority of off-road construction equipment will be zero emission. Any diesel-powered off-road construction equipment greater than 50 horsepower shall meet the U.S. EPA Tier 4 Final off-road emission standards, at a minimum. Additionally, any emissions control device used by contractor(s) shall achieve emission reductions that are no less than what could be achieved by a Level 3 diesel emissions control strategy for a similarly sized engine as defined by CARB regulations. These requirements shall be included in applicable bid documents, purchase orders, and contracts.

A copy of each unit's certified tier specification, BACT documentation, and CARB or the South Coast AQMD operating permit shall be provided at the time of mobilization of each applicable unit of equipment.

All construction equipment must be tuned and maintained in compliance with the manufacturer's recommended maintenance schedule and specifications that optimize emissions without nullifying engine warranties. All maintenance records for each equipment and their construction contractor(s) should be made available for inspection and remain on-site for a period of at least two years from completion of construction.

All on-road construction equipment (e.g., haul and material delivery trucks), especially those greater than 14,000 lbs Gross Vehicle Weight Rating (GVWR), shall be zero emission. If it is not feasible to have all on-road construction equipment be zero emission, then a step-down approach should be utilized to ensure that the majority of on-road construction equipment will be zero emission. Any diesel-powered on road construction equipment is encouraged to, at minimum, have engines that meet the 2010 U.S. EPA engine standards, or 0.2 g/bhp-hr NOx and 0.01 g/bhp-hr PM.

Cleaner off and on-road construction equipment will become increasingly more feasible and commercially available as technology advances. If using zero emission technologies is not feasible at the start of construction activities, it could become feasible in a reasonable period of time for projects with extended or long-term construction schedules. These projects are encouraged to develop a process with performance standards to require and/or accelerate the deployment of the lowest emission technologies and the utilization of zero emission ~~(ZE)~~ or ~~near-zero~~low NOx emission ~~(NZE)~~ off- and on-road construction equipment. These standards may include:

- Developing a minimum amount of ~~ZE~~ zero emission or ~~NZE~~ low NOx off- and on-road construction equipment that must be used each year during construction to ensure adequate progress. Include this requirement in construction management plans and business development agreement(s).
- Establishing a contractor(s) selection policy that prefers contractor(s) who can supply and use ~~ZE~~ zero emission or ~~NZE~~ low NOx off- and on-road construction. Include this policy in the Request for Proposal, procurement documents, and purchase order(s) for selecting contractor(s), tenant(s), or operator(s).
- Establishing a policy to select and use vendors that use ~~ZE~~ zero emission or ~~NZE~~ low NOx on-road construction equipment. Include this policy in the vendor contracts and business agreements.
- Establishing a purchasing policy to purchase and receive materials from vendors that use ~~ZE~~ zero emission or ~~NZE~~ low NOx on-road construction equipment to deliver materials. Include this policy in the procurement documents and purchase orders with vendors.
- Developing a project-specific process and criteria for periodically assessing progress in implementing the use of ~~ZE~~ zero emission and ~~NZE~~ low NOx off- and on-road construction equipment during the duration of construction activities.
- Best management practices such as scheduling truck trips to avoid sensitive land use (e.g., homes and schools), limiting engine idling time, maintaining an equipment inventory, and reducing construction duration by 10 percent for projects located in environmental justice communities, and design considerations including appropriate points for staging areas, and maintaining a buffer zone between truck traffic and sensitive receptors.

Emission Reductions

Emission reductions are not estimated at this time. The amount of emission reductions that can be achieved from this measure will be based on the number and type of participating construction projects and the method of control to be implemented to reduce Volatile Organic Compounds (VOCs), Nitrogen Oxides (NOx), and fine Particulate Matter (PM2.5) emissions by each of those projects.

Cost Effectiveness

TBD

Implementing Agency

South Coast AQMD, Local Municipalities and Agencies

References

2022 AQMP Control Measures Workshop - South Coast AQMD's Mobile Source Measures and CARB's State SIP Strategy Measures. 2021. https://scaqmd.zoom.us/j/93576923378

California Air Resources Board. 2021. Construction & Earthmoving Equipment. https://ww2.arb.ca.gov/our-work/topics/construction-earthmoving-equipment

Guide to Off-Road Vehicle & Equipment Regulations. California Air Resources Board. https://ww2.arb.ca.gov/sites/default/files/offroadzone/pdfs/offroad_booklet.pdf

Los Angeles International Airport. 2017. Sustainable Design & Construction Requirements. https://www.lawa.org/-/media/lawa-web/tenants411/file/sustainable-design-construction-requirements.ashx

Low Carbon Fuel Standard. California Air Resources Board. https://ww2.arb.ca.gov/sites/default/files/2020-09/basics-notes.pdf

Los Angeles County Metropolitan Transportation Authority (LACMTA). 2011. LACMTA Green Construction Policy. http://boardarchives.metro.net/Items/2011/06_June/20110615EMACItem10.pdf

On-Road Heavy-Duty and Off-Road Compression Ignition Certification Programs: Useful Life Compliance and Durability Demonstration. California Air Resources Board. https://ww2.arb.ca.gov/road-heavy-duty-and-road-compression-ignition-certification-programsuseful-life-compliance-and

San Francisco Department of the Environment. 2015. San Francisco Clean Construction Ordinance – Implementation Guide for San Francisco Public Projects. https://www.sfdph.org/dph/files/EHSdocs/AirQuality/San_Francisco_Clean_Construction_Ordinance_2015.pdf

Truck and Bus Regulation Compliance Requirement Overview. California Air Resources Board. June 18, 2019. https://ww3.arb.ca.gov/msprog/onrdiesel/documents/fsregsum.pdf

U.S. EPA 2007/1010 Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements. http://www.meca.org/regulation/us-epa-20072010-heavyduty-engine-and-vehicle-standards-and-highway-diesel-fuel-sulfur-control-requirements

MOB-01: EMISSION REDUCTIONS AT COMMERCIAL MARINE PORTS [NOx, SOx, PM]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	PORTS AND PORT-RELATED SOURCES (I.E., OCEAN-GOING VESSELS, ON-ROAD HEAVY-DUTY TRUCKS, LOCOMOTIVES, HARBOR CRAFT, AND CARGO HANDLING EQUIPMENT)			
CONTROL METHODS:	INDIRECT SOURCE RULES, INCENTIVES			
EMISSIONS (TONS/DAY):*				
ANNUAL AVERAGE	**2018**	**2031**	**2032**	**2037**
NOx INVENTORY	36.99	32.82	32.94	29.70
NOx REDUCTION		TBD	TBD	TBD
NOx REMAINING		TBD	TBD	TBD
PM2.5 INVENTORY	0.71	0.75	0.76	0.76
PM2.5 REDUCTION		TBD	TBD	TBD
PM2.5 REMAINING		TBD	TBD	TBD
SOx INVENTORY	0.92	1.07	1.09	1.16
SOx REDUCTION		TBD	TBD	TBD
SOx REMAINING		TBD	TBD	TBD
CONTROL COST:	TO BE DETERMINED			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD, PORTS OF LOS ANGELES AND LONG BEACH			

*Estimated based on the ratio of the 2018 Ports emissions inventory to the 2018 baseline in the latest SIP emissions inventory for each port source category and by assuming the ratios stay constant. The projected emissions implicitly exclude OGV emissions outside of the Ports emission inventory domain but within the SIP emissions inventory domain (100 nautical miles from California shore).

Description of Source Category

The goal of this measure is to assist in achieving the committed emission reductions described in the State SIP (State Implementation Plan) Strategy related to on-road heavy-duty vehicles, off-road equipment, and federal and international sources that operate in and out of the Ports of Los Angeles and Long Beach (San Pedro Bay Ports or Ports). This measure is also a continuation of control measure MOB-01 from the 2016 Air Quality Management Plan (AQMP). It is not expected that this measure will achieve the full emission reductions associated with the committed measures from the State SIP Strategy. Instead, this measure seeks to reduce emissions from port-related sources through an indirect source rule, as well as incentive funding and/or other voluntary programs. To the extent that these actions are sustained over a long-term basis and the emission reduction levels are maintained, the emission reductions may be credited as surplus reductions (as defined by the U.S. Environmental Protection Agency, U.S. EPA) into the SIP. Affected sources could include some or all port-related sources (on-road heavy-duty trucks, cargo handling equipment, harbor craft, marine vessels, locomotives, and stationary equipment), to the extent that cost-effective and feasible strategies are available.

Background

Emissions and Progress. The Ports of Los Angeles (POLA) and Long Beach (POLB) are the largest in the nation in terms of container throughput, and the mobile sources travelling to and from the ports collectively make up the single largest fixed source of air pollution in Southern California. Emissions from port-related sources were reduced significantly between 2006 and 2012 through efforts by the Ports and a wide range of stakeholders. In large part, these emission reductions resulted from programs developed and implemented by the Ports in collaboration with port tenants, marine carriers, trucking interests and railroads. Regulatory agencies, including the U.S. EPA, California Air Resources Board (CARB), and the South Coast Air Quality Management District (South Coast AQMD), participated in these earlier collaborative efforts, and some measures adopted by the Ports have led the way for adoption of analogous regulatory requirements that are now applicable Statewide as well as at the Ports. These earlier port measures included the first version of the Clean Trucks Program and actions to deploy shore-power and low emission cargo handling equipment. The Ports have also established incentive programs, which have not subsequently been adopted as regulations. These include incentives for routing of vessels meeting the International Maritime Organization (IMO) Tier II and III Nitrogen Oxides (NOx) standards, and vessel speed reduction. In addition, the Ports are, in collaboration with the regulatory agencies, implementing a Technology Advancement Program to develop and deploy clean technologies of the future.

Recently, the Ports implemented an update to the Clean Trucks Program. The centerpiece of this new program is a charge to cargo owners of $10 per twenty-foot equivalent unit (TEU) of loaded cargo that is trucked to or from the Ports. Zero emission trucks are exempt from the $10/TEU rate. At POLB, low NOx trucks (those meeting CARB's 0.02 g/hp-hr standard) purchased before November 8, 2021 will be exempt from the $10/TEU rate through the end of 2034, while low NOx trucks entered into the drayage registry before the end of 2022, or purchased before July 31, 2022 and registered within a month after receipt will be exempt through the end of 2031. At POLA, the low NOx truck exemption only applies to low NOx trucks entered into the drayage registry by the end of 2022, and only lasts through the end of 2027. The fee rate collection started in April 2022, with the funding disbursement anticipated in the following year. This program is anticipated to annually raise up to $90 million, and funding will go primarily towards deploying zero emission trucks and funding zero emission infrastructure, with POLB having provided some early funding for low NOx trucks using the anticipated fee revenue.

The supply chain has been disrupted in recent years with the COVID-19 pandemic, and the Ports experienced significant congestion beginning from late 2020. At its peak, there were more than 100 container vessels in queue waiting for a berth, and emissions may have increased by more than 25 tons per day at its peak. A new voluntary program[40] was subsequently established by the Pacific Merchant Shipping Association, the Pacific Maritime Association, and the Marine Exchange to keep container vessels from anchoring within 150 miles from shore, resulting in lower emissions from vessels closer to shore.

Port-related sources such as marine vessels, locomotives, trucks, harbor craft and cargo handling equipment, continue to be among the largest sources of NOx in the region. Given the large magnitude of emissions from port-related sources, the substantial efforts described above play a critical part in the ability of the Basin to attain the national ozone and PM2.5 ambient air standards by federal deadlines. This measure provides assurance that emissions from the South Coast Air Basin (Basin)'s largest magnet of mobile sources will continue to support attainment of the federal 8-hour ozone and the 24-hour and annual PM2.5 standards. In addition, reductions in PM2.5 emissions will also reduce cancer risks from diesel particulate matter.

Clean Air Action Plan (CAAP). The emission control efforts described above largely began in 2006 when the Ports of Los Angeles and Long Beach, with the participation and cooperation of staff of the South Coast AQMD, CARB, and the U.S. EPA, adopted the San Pedro Bay Ports CAAP. The CAAP was amended in 2010 and 2017, updating many of the goals and implementation strategies to reduce air emissions and health risks associated with port operations while allowing port development to continue. In addition to addressing health risks and greenhouse gas emissions from port-related sources, the CAAP sought the reduction of criteria pollutant emissions to the levels that assure port-related sources decrease their "fair share" of regional emissions to enable the Basin to attain State and federal ambient air quality standards. The CAAP includes proposed strategies on port-related sources that are implemented through new leases or port-wide tariffs, Memoranda of Understanding (MOU), voluntary action, grants or incentive programs.

In addition to the CAAP, the Ports have completed annual inventories of port-related sources since 2005. These inventories have been completed in conjunction with a technical working group composed of the South Coast AQMD, CARB, and the U.S. EPA. Based on the latest inventories, emissions from port-related sources are continuing to decrease from 2005 emission levels, albeit at slower levels in recent years compared to early year.[41] Although the ports met their 59 percent NOx reduction goal from the 2010 CAAP by 2020, this goal did not include emission reductions needed from the "black box" described in the 2007 AQMP—which also contained defined (non-"black box") measures that served as the basis for the 2010 CAAP emission reduction goals. In addition, the 2017 CAAP did not update the NOx emission reduction goal, and additional NOx emission reductions are still needed to attain federal air quality standards. As an example, the Ports' implementation of their 2017 CAAP is expected to result in about 2 to 3 tons per day of NOx reductions by 2031, yet their 'fair share' as described in the 2016 AQMP about 19 tons per day.[42]

[40] Pacific Maritime Management Services (PacMMS). Online at: https://mxsocal.org/.

[41] The congestion at the ports during 2021 are expected to show an increase in emissions from previous years, however the Ports' emission inventory for 2021 has not been released yet.

[42] Determined by the percent reductions deemed necessary in the 2016 AQMP for each mobile source related to port operations, with the percent reductions applied to projected port-specific emissions based on the Ports' emissions inventory figures.

While many of the emission reduction targets in the CAAP result from implementation of federal and State regulations (either adopted prior to or after the CAAP), some are contingent upon the Ports taking and maintaining actions which are not required by air quality regulations. These actions include the Expanded Vessel Speed Reduction Incentive Program, lower-emission switching locomotives, and incentives for lower emission marine vessels.

Regulatory History

Port emission sources are regulated at the international, federal, and local level. There are also some anticipated regulations that CARB and IMO are proposing that would affect Port sources. The key regulations affecting Port sources are listed below.

The CAAP sets out the emission control programs and plans that will help mitigate air quality impacts from port-related sources. The CAAP relies on a combination of regulatory requirements and voluntary control strategies that go beyond the U.S. EPA or CARB requirements, or are implemented earlier than the requirements of applicable regulatory rules. The regulations that the CAAP relies on include international, federal and State requirements controlling port-related sources such as marine vessels, harbor craft, cargo handling equipment, locomotives, and trucks. Key regulatory and other actions taken to date are as follows:

International Maritime Organization (IMO) Emissions and Fuel Standards. The IMO MARPOL Annex VI, which came into force in May 2005, set new international NOx emission limits on Category 3 (>30 liters per cylinder displacement) marine engines installed on new vessels retroactive to the year 2000. In October 2008, the IMO adopted an amendment which placed a limit on marine fuel sulfur content of 0.1 percent by 2015 for specific areas known as Emission Control Areas (ECA). The North American ECA extends 200 nautical miles from the U.S. Coast. The Basin off-coast waters are included in the ECA and ships calling at the Ports have to meet this new fuel standard or use SOx scrubber as an alternative compliance method. In addition, the 2008 IMO amendment required new ships with their keel laid after January 1, 2016 that enter the North American and U.S. Caribbean ECA to meet a Tier III NOx emission standard which is 80 percent lower than the Tier I emission standard. However, only about 2 percent of vessels calling at the Ports met these standards in 2020.

IMO GHG Strategy. In October 2018 IMO approved an initial strategy to address GHG emissions from ships. This strategy includes targets to reduce carbon dioxide (CO2) emissions from international shipping (per unit of transport work) on average by 40 percent by 2030 and pursuing efforts towards 70 percent reduction by 2050, compared to 2008 levels. Total GHG emissions from international shipping should also decline by at least 50 percent by 2050 compared to 2008 levels. This strategy may be further refined in 2023, and new IMO standards are expected to ultimately be developed to implement this strategy. This level of reduction is anticipated to require new low or zero carbon fuels; however, the effect on NOx from this fuel switch may vary widely depending on which fuels are used and what controls are added to ship engines.

U.S. EPA Marine Vessel Regulations. In 2010, the U.S. EPA adopted standards that apply to Category 3 (C3) engines installed on U.S. vessels and to marine diesel fuels produced and distributed in the United States. That rule added two new tiers of engine standards for C3 engines consistent with the

IMO standards described above. It also includes a regulatory program to implement IMO MARPOL Annex VI in the United States, including engine and fuel sulfur limits, and extends the ECA engine and fuel requirements to U.S. internal waters (i.e., rivers, lakes, etc.). The Department of State is the head of the U.S. delegation to the IMO; however, the U.S. EPA is also a participating member of the delegation. In that capacity the U.S. EPA has provided input to the fuel sulfur and NOx emission standards adopted by IMO and also works within international organizations to establish global engine and fuel standards.

CARB Marine Fuel Rule. Beginning in 2009, CARB began implementing the State's fuel sulfur regulation, applicable to both domestic and foreign flagged vessels, in waters out to 24 nm of the California baseline (i.e., Regulated California Waters or RCW). The rule initially limited sulfur content in marine gas oil (MGO) to 1.5 percent sulfur by weight and in marine diesel fuel (MDO) to 0.5 percent sulfur by weight. Beginning on January 1, 2012, all OGVs when operating in the RCW must switch to either type of distillate grade fuel with at maximum 0.1 percent sulfur content in weight, and unlike the IMO sulfur oxides (SOx) ECA requirements, the use of SOx scrubber is not permitted as an alternative compliance method.

CARB At-Berth Regulation. In 2020 CARB amended its At-Berth regulation that requires ships to reduce emissions while they are docked at a berth. This emission reduction is achieved either by plugging a ship into the land-based electrical grid (shore power), or by capturing emissions and sending them to control equipment. The amended regulation requires all container, reefer, and cruise vessel visits to reduce emissions at berth by 2023, and roro (roll-on, roll-off) and tanker vessels by 2025.

U.S. EPA Emission Standards for Locomotives. To reduce emissions from switch and line-haul locomotives, the U.S. EPA in 2008 established a series of increasingly stricter emission standards for new or remanufactured locomotive engines. The emission standards are implemented by "Tier" with Tier 0 as the least stringent and Tier 4 being the most stringent. The U.S. EPA also established remanufacture standards for both line haul and switch engines. For Tiers 0, 1, and 2, the remanufacture standards are more stringent than the new manufacture standards for those engines for some pollutants. As of 2020, only 5.9 percent of locomotive activities operated by Union Pacific (UP) within the South Coast Air Basin was with Tier 4 locomotives, and the corresponding figure was 7.5 percent by Burlington Northern Santa Fe Corp (BNSF). In contrast, about 78 percent of locomotive activities operated by UP was with Tier 2 or older locomotives, and the corresponding figure was 66 percent by BNSF.

CARB Proposed Locomotive Regulation. CARB is proposing a new regulation that would affect locomotives operating throughout the state, including at the Ports. This proposal includes a requirement for railroads to establish a spending account in 2024 and to pay into the account on an annual basis depending on the tier of locomotive used in the state. Lower tiers would pay more into the account than higher tiers. Funds from this account could be used to purchase Tier 4 and cleaner locomotives through 2030, and zero emission locomotives thereafter, or for the development of zero emission locomotive technologies including the supporting infrastructure. The proposal also would prohibit locomotives older than 23 years from operating in the state starting in 2030, and require new locomotives to be zero emissions if they are built after 2030 for switch, industrial, and passenger, and

2035 for line haul. Finally, the proposal adopts the U.S. EPA's existing idling limits into state law. The proposed regulation tentatively is scheduled to be considered by the CARB Board in fall 2022.

U.S. EPA and CARB Emission Standards for New Trucks. To reduce emissions from on-road, heavy-duty diesel trucks, the U.S. EPA established a series of cleaner emission standards for new engines, starting in 1988. The U.S. EPA promulgated the final and cleanest standards with the 2004 Heavy-Duty Highway Rule. Starting with model year 2010, all new heavy-duty trucks have to meet the final emission standards specified in the rule.

U.S. EPA Proposed Rule on New Heavy-Duty Vehicles. In March 2022 U.S. EPA released a proposed regulation to reduce NOx emissions from heavy-duty vehicles. The proposal would require control equipment on trucks to last longer, and to control emissions better in low load duty cycles (such as drayage activity). The two options proposed would 1) lower the 2010 emission standard by 83 percent in 2027 and 90 percent in 2031, or 2) lower the 2010 emission standard by 75 percent in 2027.

CARB In-use Fleet Rules. Between 2005 and 2010, CARB adopted several rules that reduce emissions at the Ports by requiring accelerated modernization of equipment by replacing or repowering old equipment with new equipment. These rules include: In-Use Truck and Bus Rule, In-use Off-road Equipment Rule, Cargo Handling Rule, Drayage Truck Rule, Commercial Harbor Craft Rule, and the At-Berth Auxiliary Engine (Shore power) Rule.

MOUs. In 1998, CARB entered into an MOU with Class 1 railroads UP and BNSF which established a fleet average emissions limit for locomotives operating in the Basin. The intended effect of this MOU was to accelerate introduction of Tier 2 or cleaner locomotives (achieving an approximate 57 percent level of NOx control) in this region. In June 2005, CARB entered into a second MOU with the same two railroads that is intended to reduce health risks near railyards and identify actions to achieve a projected 20 percent reduction in DPM emissions. Finally, several years ago, the ports, shipping interests, and regulatory agencies entered into a MOU seeking voluntary reductions in vessel speed to reduce NOx emissions.

Proposed Method of Control

This measure seeks to reduce emissions related to on-road heavy-duty vehicles, off-road equipment, harbor craft, locomotives, and ocean going vessels that operate in and out of the San Pedro Bay Ports. This measure will include development of an Indirect Source Rule (ISR) applicable to sources at the San Pedro Bay Ports, as well as pursuit of incentive funding or other voluntary measures that can also achieve and/or facilitate emission reductions. Depending upon how the ISR is ultimately structured, it may also require some level of federal approval before it can be fully implemented. To the extent possible, the ISR will be structured so as to allow incentive funding to be used to deploy cleaner technologies. Emission reductions may also be achieved if new regulations are developed and implemented at the federal or international level.

The proposed ISR for marine ports will continue to be developed through a public process that includes a working group, meetings with individual stakeholders, facility tours, community forums, and reports to the South Coast AQMD Governing Board Mobile Source Committee. The ISR is anticipated to be brought to the Governing Board for its consideration in 2023. Incentive programs and/or other voluntary programs will use their own public process specific to each program. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Emission Reductions

Potential emission reductions will be determined as the ISR is developed and as programs are implemented. Emission reductions from any ISR or other program applicable to marine ports might not be creditable into the SIP at time of adoption. If so, the emission reductions that do occur will ultimately be SIP-creditable at a later date (e.g., through retrospective analysis after rule implementation), or quantified through other measures (e.g., incentive programs) or inventory analysis, so long as they are quantifiable, permanent, surplus, enforceable, and real.

Rule Compliance

Compliance with this control measure will depend on the type of control strategy implemented. Compliance will be verified through actual emissions reported, and enforced through submittal and review of records, reports, and emission inventories. Enforcement provisions will be discussed as part of the public process to develop enforceable mechanisms to ensure that the emission reductions remain permanent. If other enforceable mechanisms are established outside of the South Coast AQMD public process, or the State or federal government implement regulatory actions, that achieve equivalent emission reductions, compliance will be enforced through the provisions of those actions.

Test Methods

Approved emission quantification protocols by federal, State or local agencies will be used to track and report emission reductions for SIP purposes.

Cost Effectiveness

The cost-effectiveness of this measure will be based on the strategies identified through the public process.

Implementing Agency

There are many potential implementing agencies for this measure. The ISR would be implemented by the South Coast AQMD. Voluntary programs (e.g, vessel speed reduction) may be implemented by the Ports of Long Beach and Los Angeles. Incentive programs may be implemented either by the agency issuing the funding (e.g., California Energy Commission, Federal Maritime Administration, etc.) or co-implemented by the Ports of Long Beach and Los Angeles if they receive the funding. Regulations adopted at the federal or international level would be implemented by the applicable federal agency. For example, the Emission Control Area under the IMO's MARPOL Annex VI is enforced by both the U.S. Coast Guard and the U.S. EPA.

References

CARB (2022). 2022 State Strategy for the State Implementation Plan, January 2022

IMO (2018). Adoption of the Initial IMO Strategy on Reduction of GHG Emissions from Ships and Existing IMO Activity Related to Reducing GHG Emissions in the Shipping Sector, April 2018

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

South Coast AQMD (2007). Air Quality Management Plan, Appendix IV-A, June 2007

South Coast AQMD (2012). Air Quality Management Plan, Appendix IV-A, December 2012

South Coast AQMD (2017). Air Quality Management Plan, Appendix ~~Iv~~IV-A, March 2017

MOB-02A: EMISSION REDUCTIONS AT NEW RAIL YARDS AND INTERMODAL FACILITIES [NOx, PM]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	NEW RAIL YARDS AND INTERMODAL FACILITIES			
CONTROL METHODS:	DEPLOYMENT OF CLEANER TECHNOLOGIES			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
NOx INVENTORY	TBD	TBD	TBD	TBD
NOx REDUCTION	TBD	TBD	TBD	TBD
NOx REMAINING	TBD	TBD	TBD	TBD
SUMMER PLANNING	2018	2031	2032	2037
NOx INVENTORY	TBD	TBD	TBD	TBD
NOx REDUCTION	TBD	TBD	TBD	TBD
NOx REMAINING	TBD	TBD	TBD	TBD
CONTROL COST:	TO BE DETERMINED			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

Description of Source Category

Two new intermodal facilities are proposed to be built in the South Coast Air Basin (Basin). There are a variety of emission sources related to railyard and intermodal facility operations including line-haul locomotives, switchers, on-road heavy-duty trucks, cargo-handling equipment, transportation refrigeration units (TRUs), and maintenance shops. This measure seeks to reduce NOx and particular matter emissions related to on-road heavy-duty vehicles, offroad equipment, and locomotives at new rail yards and intermodal facilities. Through the public process, the South Coast Air Quality Management District (South Coast AQMD) will assess and identify potential actions that could result in further emission reductions at new rail yards and intermodal facilities.

Background

Due to projected economic and population growth, it is anticipated that freight and passenger locomotive activities will increase and the new intermodal railyards could potentially facilitate this projected growth, thereby resulting in increased Nitrogen Oxides (NOx) and Particulate Matter (PM) emissions. In addition, many environmental justice communities are located adjacent to the currently proposed sites of these new intermodal rail yards. Due to high rail and vehicle traffic already existing in the area, nearby communities could be potentially subject to further elevated levels of Nitrogen Dioxide (NO2) and diesel particulate emissions due to the new intermodal facilities.

Regulatory History

U.S. EPA Emission Standards for Locomotives

To reduce emissions from switch and line-haul locomotives, the U.S. EPA in 2008 established a series of increasingly strict emission standards for new or remanufactured locomotive engines. The emission standards are implemented by “Tier” with Tier 0 as the least stringent and Tier 4 being the most stringent. The U.S. EPA also established remanufacture standards for both line-haul and switch engines. For Tiers 0, 1, and 2, the remanufacture standards are more stringent than the new manufacture standards for those engines for some pollutants.

In 1998, the railroads and California Air Resources Board (CARB) entered into an Memorandum of Understanding (MOU) to accelerate the introduction of Tier 2 locomotives into the Basin. The MOU includes provisions for a fleet average in the Basin, equivalent to the U.S. EPA's Tier 2 locomotive standard by 2010. The MOU addressed NOx emissions from locomotives. Under the MOU, NOx levels from locomotives are reduced by 57 percent. However, little progress in emission reductions occurred in the most recent decade. As of 2020, only 5.9 percent of locomotive activities operated by Union Pacific (UP) within the South Coast Air Basin was with the cleanest Tier 4 locomotives, and the corresponding figure was 7.5 percent by Burlington Northern Santa Fe Corp (BNSF). In contrast, about 78 percent of locomotive activities operated by UP was with Tier 2 or older locomotives, and the corresponding figure was 66 percent by BNSF.

On June 30, 2005, UP and BNSF entered into a Statewide Rail Yard Agreement to Reduce Diesel PM at California Rail Yards with the CARB. The railroads committed to implementing certain actions from rail operations throughout the State. In addition, the railroads prepared equipment inventories and conducted dispersion modeling for diesel PM at a number of rail yards.

U.S. EPA and CARB Emission Standards for On-Road Heavy-Duty Engines and Trucks

To reduce emissions from on-road, heavy-duty diesel trucks, the U.S. EPA established a series of cleaner emission standards for new engines, starting in 1988. The U.S. EPA promulgated the final and cleanest standards with the 2007 Heavy-Duty Highway Rule. Starting with model year 2010, all new heavy-duty trucks have to meet the final emission standards specified in the rule.

In December 2007, CARB adopted regulation that applies to heavy-duty diesel trucks operating at California ports and intermodal rail yards. This regulation eventually required that all drayage trucks meet 2007 on-road emission standards by 2014.

CARB Cargo Handling Equipment Regulation

On December 8, 2005, CARB approved the Regulation for Mobile Cargo-Handling Equipment (CHE) at Ports and Intermodal Rail Yards (Title 13, CCR, Section 2479), which is designed to use Best Available Control Technology (BACT) to reduce diesel PM and NOx emissions from mobile cargo-handling equipment at ports and intermodal rail yards. The regulation became effective December 31, 2006. Since January 1, 2007, the regulation imposes emission performance standards on new and in-use terminal equipment that vary by equipment type.

<u>South Coast AQMD Regulation XXXV – Railroads and Railroad Operations</u>

The South Coast AQMD adopted Regulation XXXV – Railroads and Railroad Operations, which consists of three rules that address emissions from locomotives and rail yards. Rule 3501 – Recordkeeping for Locomotive Idling, requires recordkeeping of idling events in order to identify opportunities for reducing idling emissions and to assist in quantifying idling emissions. Rule 3502 – Minimization of Emissions from Locomotive Idling, requires railroads to minimize unnecessary locomotive idling. Rule 3503 – Emissions Inventory and Health Risk Assessment for Railyards, requires operators of railroads and rail yards to develop emissions inventories, prepare health risk assessments and notify the public of health risks. A federal District Court decision prevents these rules from being implemented until they become federally enforceable through inclusion in the SIP. Rules 3501 and 3502 have been submitted to the U.S. EPA for inclusion into the State implementation plan (SIP). However, the U.S. EPA has not made a decision on the approval of the rules.

Proposed Method of Control

In July 2021, the South Coast AQMD began the rule development process for Proposed Rule 2306 – Indirect Source Rule for New Intermodal Facilities. The proposed rule seeks to address NOx and particulate matter emissions from new intermodal facilities including the proposed Colton Intermodal Facility and the proposed Southern California International Gateway. PR 2306 rule concepts would seek to implement the cleanest locomotives, switchers, on-road heavy-duty trucks, cargo-handling equipment, transportation refrigeration units available, including the necessary infrastructure to support zero and low NOx emission technologies, with the implementation going above and beyond existing and proposed state and federal regulations.. In addition to rule development, this measure will also pursue incentive funding or other voluntary measures that can also achieve and/or facilitate emission reductions. Depending upon how the ISR is ultimately structured, it may also require some level of federal approval before it can be fully implemented. To the extent possible, the ISR will be structured so as to allow incentive funding to be used to deploy cleaner technologies. Emission reductions may also be achieved if new regulations are developed and implemented at the federal or international level.

The proposed ISR for ~~marine ports~~<u>new intermodal facilities</u> will continue to be developed through a public process that includes a working group, meetings with individual stakeholders, site tours, community forums, and reports to the South Coast AQMD Governing Board Mobile Source Committee. The ISR is anticipated to be brought to the Governing Board for its consideration in ~~2022~~<u>2023</u>. Incentive programs and/or other voluntary programs will use their own public process specific to each program.<u> During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.</u>

Emission Reductions

Potential emission reductions will be determined as the ISR is developed and as programs are implemented. Emission reductions from any ISR or other program applicable to new intermodal facilities might not be creditable into the SIP at time of adoption. If so, the emission reductions that do occur will ultimately be SIP-creditable at a later date (e.g., through retrospective analysis after rule implementation), or quantified through other measures (e.g., incentive programs) or inventory analysis, so long as they are quantifiable, permanent, surplus, enforceable, and real.

Rule Compliance

Compliance with this control measure will depend on the type of control strategy implemented. Compliance will be verified through actual emissions reported, and enforced through submittal and review of records, reports, and emission inventories. Enforcement provisions will be discussed as part of the public process to develop enforceable mechanisms to ensure that the emission reductions remain permanent. If other enforceable mechanisms are established outside of the South Coast AQMD public process, or the State or federal government implement regulatory actions, that achieve equivalent emission reductions, compliance will be enforced through the provisions of those actions.

Test Methods

Approved emission quantification protocols by federal, State or local agencies will be used to track and report emission reductions for SIP purposes.

Cost Effectiveness

The cost-effectiveness of this measure will be based on the strategies identified through the public process.

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from indirect sources, including new intermodal facilities.

References

South Coast AQMD (2006). Regulation 35 – Railroads and Railroad Operations (2006) SCAQMD (2015).

U.S. EPA (2008). Control of Emissions of Air Pollution from Locomotive Engines and Marine Compression-Ignition Engines Less Than 30 Liters per Cylinder; Republication, June 30, 2008 (73FR37096).

MOB-02B: EMISSION REDUCTIONS AT EXISTING RAIL YARDS AND INTERMODAL FACILITIES [NOx, PM]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	EXISTING RAIL YARDS AND INTERMODAL FACILITIES			
CONTROL METHODS:	DEPLOYMENT OF CLEANER TECHNOLOGIES			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	**2018**	**2031**	**2032**	**2037**
NOx INVENTORY	15.10	17.78	17.74	15.50
NOx REDUCTION	TBD	TBD	TBD	TBD
NOx REMAINING	TBD	TBD	TBD	TBD
SUMMER PLANNING	**2018**	**2031**	**2032**	**2037**
NOx INVENTORY	15.10	17.78	17.75	15.50
NOx REDUCTION	TBD	TBD	TBD	TBD
NOx REMAINING	TBD	TBD	TBD	TBD
CONTROL COST:	TO BE DETERMINED			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

Description of Source Category

There are 15 freight rail yards and intermodal facilities (of which nine are considered major rail yards) located within the jurisdiction of the South Coast Air Quality Management District (South Coast AQMD). In addition, the South California Regional Rail Authority (SCRRA or Metrolink) and Amtrak provide commuter rail transportation in the South Coast AQMD. SCRRA maintains their passenger locomotives at two locations in the Basin. There are a variety of emission sources related to railyard and intermodal facility operations including locomotives, switchers, on-road heavy-duty trucks, cargo-handling equipment, transportation refrigeration units (TRUs), and maintenance shops. This measure seeks to reduce NOx and particular matter emissions related to at the operation of existing rail yards and intermodal facilities. Through the public process, the South Coast AQMD will assess and identify potential actions that could result in further emission reductions at existing rail yards and intermodal facilities.

Background

Railyard and intermodal facility operations generate significant levels of Nitrogen Oxides (NOx) and particulate matter (PM) emissions that contribute to the region's challenges to attain federal National Air Ambient Air Quality Standard (NAAQS). There are nine major freight rail yards and intermodal facilities and two commuter rail maintenance facilities within the South Coast AQMD jurisdiction. Moreover, environmental justice communities are located adjacent to many of these existing rail yards and facilities. Due to high rail and vehicle traffic in the area, nearby communities are subject to high levels of Nitrogen Dioxide (NO2) and diesel particulate emissions. During periods of routine locomotive maintenance, there have been concerns raised regarding excessive emissions from idling locomotives or during periods of routine locomotive maintenance.

Regulatory History

U.S. EPA Emission Standards for Locomotives

To reduce emissions from switch and line-haul locomotives, the U.S. Environmental Protection Agency (U.S. EPA) in 2008 established a series of increasingly strict emission standards for new or remanufactured locomotive engines. The emission standards are implemented by "Tier" with Tier 0 as the least stringent and Tier 4 being the most stringent. The U.S. EPA also established remanufacture standards for both line-haul and switch engines. For Tiers 0, 1, and 2, the remanufacture standards are more stringent than the new manufacture standards for those engines for some pollutants.

In 1998, the railroads and California Air Resources Board (CARB) entered into an Memorandum of Understanding (MOU) to accelerate the introduction of Tier 2 locomotives into the Basin. The MOU includes provisions for a fleet average in the Basin, equivalent to the U.S. EPA's Tier 2 locomotive standard by 2010. The MOU addressed NOx emissions from locomotives. Under the MOU, NOx levels from locomotives are reduced by 57 percent. However, little progress in emission reductions occurred in the most recent decade. As of 2020, only 5.9 percent of locomotive activities operated by Union Pacific (UP) within the South Coast Air Basin was with the cleanest Tier 4 locomotives, and the corresponding figure was 7.5 percent by Burlington Northern Santa Fe Corp (BNSF). In contrast, about 78 percent of locomotive activities operated by UP was with Tier 2 or older locomotives, and the corresponding figure was 66 percent by BNSF.

On June 30, 2005, UP and BNSF entered into a Statewide Rail Yard Agreement to Reduce Diesel PM at California Rail Yards with the CARB. The railroads committed to implementing certain actions from rail operations throughout the State. In addition, the railroads prepared equipment inventories and conducted dispersion modeling for diesel PM at a number of rail yards.

U.S. EPA and CARB Emission Standards for On-Road Heavy-Duty Engines and Trucks

To reduce emissions from on-road, heavy-duty diesel trucks, the U.S. EPA established a series of cleaner emission standards for new engines, starting in 1988. The U.S. EPA promulgated the final and cleanest standards with the 2007 Heavy-Duty Highway Rule. Starting with model year 2010, all new heavy-duty trucks have to meet the final emission standards specified in the rule.

In December 2007, CARB adopted regulation that applies to heavy-duty diesel trucks operating at California ports and intermodal rail yards. This regulation eventually required that all drayage trucks meet 2007 on-road emission standards by 2014.

CARB Cargo Handling Equipment Regulation

On December 8, 2005, CARB approved the Regulation for Mobile Cargo-Handling Equipment (CHE) at Ports and Intermodal Rail Yards (Title 13, CCR, Section 2479), which is designed to use Best Available Control Technology (BACT) to reduce diesel PM and NOx emissions from mobile cargo-handling equipment at ports and intermodal rail yards. The regulation became effective December 31, 2006. Since January 1, 2007, the regulation imposes emission performance standards on new and in-use terminal equipment that vary by equipment type.

South Coast AQMD Regulation XXXV – Railroads and Railroad Operations

The South Coast AQMD adopted Regulation XXXV – Railroads and Railroad Operations, which consists of three rules that address emissions from locomotives and rail yards. Rule 3501 – Recordkeeping for Locomotive Idling, requires recordkeeping of idling events in order to identify opportunities for reducing idling emissions and to assist in quantifying idling emissions. Rule 3502 – Minimization of Emissions from Locomotive Idling, requires railroads to minimize unnecessary locomotive idling. Rule 3503 – Emissions Inventory and Health Risk Assessment for Railyards, requires operators of railroads and rail yards to develop emissions inventories, prepare health risk assessments and notify the public of health risks. A federal District Court decision prevents these rules from being implemented until they become federally enforceable through inclusion in the SIP. Rules 3501 and 3502 have been submitted to the U.S. EPA for inclusion into the State Implementation Plan (SIP). However, the U.S. EPA has not made a decision on the approval of the rules.

Proposed Method of Control

This measure seeks to reduce emissions related to on-road heavy-duty vehicles, off-road equipment including cargo handling equipment and transportation refrigeration units, and both line-haul and switcher locomotives, that operate in and out of the existing railyards and intermodal facilities. This measure will include development of an Indirect Source Rule (ISR) applicable to railyard sources, as well as pursuit of incentive funding or other voluntary measures that can also achieve and/or facilitate emission reductions. Depending upon how the ISR is ultimately structured, it may also require some level of federal approval before it can be fully implemented. To the extent possible, the ISR will be structured so as to allow incentive funding to be used to deploy cleaner technologies. Emission reductions may also be achieved if new regulations are developed and implemented at the federal or international level.

The proposed ISR for existing railyards and intermodal facilities will continue to be developed through a public process that includes a working group, meetings with individual stakeholders, facility tours, community forums, and reports to the South Coast AQMD Governing Board Mobile Source Committee. The ISR is anticipated to be brought to the Governing Board for its consideration in 2023-2024. Incentive programs and/or other voluntary programs will use their own public process specific to each program. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Emission Reductions

Potential emission reductions will be determined as the ISR is developed and as programs are implemented. Emission reductions from any ISR or other program applicable to existing railyards and intermodal facilities might not be creditable into the SIP at time of adoption. If so, the emission reductions that do occur will ultimately be SIP-creditable at a later date (e.g., through retrospective analysis after rule implementation), or quantified through other measures (e.g., incentive programs) or inventory analysis, so long as they are quantifiable, permanent, surplus, enforceable, and real.

Rule Compliance

Compliance with this control measure will depend on the type of control strategy implemented. Compliance will be verified through actual emissions reported, and enforced through submittal and review of records, reports, and emission inventories. Enforcement provisions will be discussed as part of the public process to develop enforceable mechanisms to ensure that the emission reductions remain permanent. If other enforceable mechanisms are established outside of the South Coast AQMD public process, or the State or federal government implement regulatory actions, that achieve equivalent emission reductions, compliance will be enforced through the provisions of those actions.

Test Methods

Approved emission quantification protocols by federal, State or local agencies will be used to track and report emission reductions for SIP purposes.

Cost Effectiveness

The cost-effectiveness of this measure will be based on the strategies identified through the public process.

Implementing Agency

The South Coast AQMD has the authority to regulate emissions from indirect sources, including existing railyards and intermodal facilities.

References

South Coast AQMD (2006). Regulation 35 – Railroads and Railroad Operations (2006) SCAQMD (2015).

U.S. EPA (2008). Control of Emissions of Air Pollution from Locomotive Engines and Marine Compression-Ignition Engines Less Than 30 Liters per Cylinder; Republication, June 30, 2008 (73FR37096).

MOB-03: EMISSION REDUCTIONS AT WAREHOUSE DISTRIBUTION CENTERS [NOx]

CONTROL MEASURE SUMMARY[43]

SOURCE CATEGORY:	MOBILE SOURCES (ON-ROAD VEHICLES, OFF-ROAD VEHICLES)
CONTROL METHODS:	Indirect Source Regulation, Market Incentives, Voluntary Curtailments
EMISSIONS (TONS/DAY):	

ANNUAL AVERAGE	2018	2031	2032	2037
NOx INVENTORY	42	20	TBD	TBD
NOx REDUCTION	-	~3	TBD	TBD
NOx REMAINING	-	17	TBD	TBD

CONTROL COST:	$12.6 MILLION – $979 MILLION (DEPENDENT ON THE MENU-BASED STRATEGY)
INCENTIVE COST:	INCENTIVES ARE NOT DIRECTLY RELATED
IMPLEMENTING AGENCY:	SOUTH COAST AQMD

Description of Source Category

Mobile Sources: (Includes Cargo Handling Equipment)
On-Road Vehicles; and
Off-Road Vehicles.

Background

A large portion of the Nitrogen Oxides (NOx) emission inventory in the South Coast Air Basin (Basin) comes from the goods movement industry. More than half of the emissions from that sector result from mobile source diesel trucks. Regulation of mobile sources is under the purview of the U.S. Environmental Protection Agency (U.S. EPA) and California Air Resources Board (CARB), but the South Coast Air Quality Management District (South Coast AQMD) has indirect source authority to be able to regulate the warehouses that attract mobile source diesel trucks and are a point source of emissions in local disadvantaged communities.

[43] http://www.aqmd.gov/docs/default-source/Agendas/Governing-Board/2021/2021-May7-027.pdf?sfvrsn=10.

There is a definite air quality need to reduce NOx emissions related to goods movement and warehousing industry to:

Assist in meeting attainment goals;
Assist related regulations in gaining emission reductions;
Assist in the shortfall incentive funds;
Increase the use of zero emission vehicles;
Assist in state actions on cleaner technology; and
Reduce pollution burden in local communities.

Regulatory History

Truck and Bus Regulation;
Advanced Clean Trucks (ACT) Regulation;
Low NOx Omnibus; and
Heavy-Duty Inspection and Maintenance Program.

Proposed Method of Control

Rule 2305 requires annual compliance by applicable warehouse operators to implement emission reducing strategies based on the volume of truck traffic to each individual warehouse. Based on the volume of truck traffic each warehouse operator would earn/acquire points through a variety of flexible options. The Warehouse Actions and Investments to Reduce Emissions (WAIRE) Program is a menu-based point system that would award WAIRE Points for completing items of a prescribed menu. Warehouse operators can propose a site-specific strategy evaluated similar to the actions/investments on the WAIRE Menu, and upon approval could earn the warehouse operator WAIRE Points. There is a mitigation fee option, where the funds paid to the mitigation fee program would fund incentives for cleaner technologies back in the communities of the warehouse operator that paid the mitigation fee. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Emission Reductions

The WAIRE Program is a menu-based points system that allows warehouse operators the flexibility to implement a variety of clean technology actions off the prescribed WAIRE Menu, proposing other emission reducing actions, or paying a mitigation fee become incentives for the installation of zero emission ~~(ZE)~~ infrastructure or turning over an older diesel truck into a~~n~~ ~~near-zero~~low NOx emission ~~(NZE)~~ or ~~ZE~~ zero emission replacement. Actions on the WAIRE Menu promote transportation electrification and fleet turnover to ~~near-zero~~low NOx emissions trucks. Most the actions result in NOx and diesel particulate matter (DPM) reductions from truck activity or offsetting reliance on electricity from local natural gas-fired power plants reducing NOx emissions or reducing exposure at the local communities sited near warehouses. For the truck usage analysis of emission reductions, a retrospective analysis will be conducted based on the surplus reductions observed in the EMFAC model.

TABLE MOB-03-A
Estimated Baseline Truck Emission (tons per day) Associated with Rule 2305 Warehouses Required to Earn WAIRE Points

	2019		2023		2031	
	NOx	Diesel PM	NOx	Diesel PM	NOx	Diesel PM
EMFAC 2017 Baseline	41.67	0.67	20.19	0.14	20.18	0.14
Reductions from CARB ACT, Low NOx Omnibus and Heavy-Duty I/M Regulations	0	0	-0.005	< -0.01	-3.37	-0.03
Total	***41.67***	***0.67***	***20.19***	***0.14***	***16.81***	***0.12***

Rule Compliance and Test Methods

Rule 2305 has several reporting requirements to ascertain responsible entities, establish baseline operation numbers, and tracking annual progress. Warehouse operators that are required to earn WAIRE Points must annually submit an Annual WAIRE Report (AWR) which would then be reviewed and/or audited through both a desktop and field audit to determine compliance with reporting requirements and WAIRE Program requirements.[44]

Cost Effectiveness

The total costs of implementing Rule 2305 ranges from $12.6 million to $979 million depending on the WAIRE Menu actions/investments implemented by the warehouse operator, and in some scenarios actually results in an overall savings. Potential economic impacts have been thoroughly analyzed in the socioeconomic impact assessment. These analyses concluded that the public health benefits of the rule are expected to outweigh the potential costs by a ratio of about 3:1, for most compliance scenarios that were analyzed. Further, the cost-effectiveness of Rule 2305 was found to be similar to the cost-effectiveness of several mobile source regulations adopted by CARB in recent years.

Implementing Agency

The South Coast AQMD has the indirect source authority to implement Rule 2305 which complements the mobile source emission standards and regulations that U.S. EPA and CARB can enact.

References

South Coast AQMD May 7, 2021 Governing Board Package. http://www.aqmd.gov/docs/default-source/Agendas/Governing-Board/2021/2021-May7-027.pdf?sfvrsn=10

[44] http://www.aqmd.gov/docs/default-source/Agendas/Governing-Board/2021/2021-May7-027.pdf?sfvrsn=10.

MOB-04: EMISSION REDUCTIONS AT COMMERCIAL AIRPORTS [ALL POLLUTANTS]

CONTROL MEASURE SUMMARY

SOURCE CATEGORY: COMMERCIAL AIRPORTS

CONTROL METHODS: MOBILE SOURCE EMISSION REDUCTION EFFORTS INCLUDING DEPLOYMENT OF CLEANER TECHNOLOGIES, INCREASED EFFICIENCIES, OR FURTHER AIR QUALITY IMPROVEMENT PROJECT OPTION

EMISSIONS (TONS/DAY):

ANNUAL AVERAGE	2018	2031	2032	2037
VOC INVENTORY	TBD	TBD	TBD	TBD
VOC REDUCTION		TBD	TBD	TBD
VOC REMAINING		TBD	TBD	TBD
NOx INVENTORY	TBD	TBD	TBD	TBD
NOx REDUCTION		TBD	TBD	TBD
NOx REMAINING		TBD	TBD	TBD
CO INVENTORY	TBD	TBD	TBD	TBD
CO REDUCTION		TBD	TBD	TBD
CO REMAINING		TBD	TBD	TBD
SUMMER PLANNING	**2018**	**2031**	**2032**	**2037**
VOC INVENTORY	TBD	TBD	TBD	TBD
VOC REDUCTION		TBD	TBD	TBD
VOC REMAINING		TBD	TBD	TBD
NOx INVENTORY	TBD	TBD	TBD	TBD
NOx REDUCTION		TBD	TBD	TBD
NOx REMAINING		TBD	TBD	TBD
CO INVENTORY	TBD	TBD	TBD	TBD
CO REDUCTION		TBD	TBD	TBD
CO REMAINING		TBD	TBD	TBD

CONTROL COST: TO BE DETERMINED

IMPLEMENTING AGENCY: SOUTH COAST AQMD

Description of Source Category

There are five major commercial airports located in the South Coast Air Basin (Basin): Los Angeles International Airport (LAX), John Wayne Orange County Airport (SNA), Hollywood Burbank Airport (BUR), Ontario International Airport (ONT), and Long Beach Airport (LGB). Due to projected increases in airline passenger transportation and expansion of operations at commercial airports, emissions from airport operations may increase unless the increased emissions are mitigated. For this reason, the Facility-Based Mobile Source Measure (FBMSM) for Commercial Airports, which controls non-aircraft mobile sources at commercial airports, was adopted by the South Coast Air Quality Management District (South Coast AQMD) on December 6, 2019. The measure consists of Memoranda of Understanding (MOUs) between the South Coast AQMD and the aforementioned airports and the South Coast AQMD's enforceable commitment to achieve 0.52 and 0.37 ton per day NOx reductions in 2023 and 2031, respectively. Each airport developed their own Air Quality Improvement Plans/Measures during the development of the FBMSM for Commercial Airports and used them as the basis for the Memorandum of Understandings (MOUs). The FBMSM for Commercial Airports was intended to assist with the implementation of the "Further Deployment of Clean Technologies" measures for mobile sources in the 2016 State SIP Strategy.[45] MOB-04 seeks to identify additional feasible measures to achieve emission reductions to assist with attainment of the 2015 ozone 70 ppb National Ambient Air Quality Standard (NAAQS).

Background

There are a variety of emission sources related to commercial airport operations. In addition to aircraft, ground support equipment (GSE) such as baggage handling equipment, food service trucks, fuel trucks, and aircraft tugs contribute to airport emissions. Emissions associated with passenger transportation to and from the airport, delivery of goods and fuel for aircraft transport, and stationary equipment also contribute.

Historically, airport authorities have mitigated airport-related emissions and airport ground support equipment and on-road vehicles are regulated by California Air Resources Board (CARB). However, aircraft emissions are primarily regulated by the federal government or by the International Civil Aviation Organization (ICAO). ICAO establishes new aircraft engine emission standards internationally, while the U.S. Environmental Protection Agency (U.S. EPA) establishes aircraft emission standards nationally.

Regulatory History

Emission standards for Aircraft

In 1973, the U.S. EPA published emissions 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

[45] 2016 State SIP Strategy. https://ww2.arb.ca.gov/resources/documents/2016-state-strategy-state-implementation-plan-federal-ozone-and-pm25-standards

in commercial aircraft. These standards (CAEP/2) included new CO, HC, and NOx emissions 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 percent for newly-certified commercial aircraft engines.

On June 1, 2012, the U.S. EPA Administrator signed a final rule to 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 require that all new engines meet the ICAO CAEP/6 standards. The CAEP/6 standards represent approximately a 12 percent emission reduction from the ICAO Tier 4 levels. The second set of standards, Tier 8, took effect in 2014 and represent approximately a 15 percent reduction from Tier 6 levels.

South Coast AQMD's Fleet Rules

South Coast AQMD's fleet rules apply to several vehicle categories operating at airports. Rule 1191, Clean On-Road Light- and Medium-Duty Public Fleet Vehicles, applies to all state and local government agencies located in the South Coast AQMD's jurisdiction, including state, regional, county, and city government departments and agencies, and any special districts such as water, air, sanitation, transit, and school districts, with 15 or more non-exempt light-duty vehicles. This regulation requires that these entities acquire low emission gasoline or alternative fuel vehicles when procuring new vehicles. Rule 1196, Clean On-Road Heavy-Duty Public Fleet Vehicles, is a similar regulation that applies to on-road heavy-duty vehicles with a gross vehicle weight of at least 14,000 pounds. It requires all applicable government agencies and special districts with fleets of 15 or more vehicles (including commercial airports), to acquire a gasoline, dual-fuel or alternative fueled engine or vehicle when purchasing or leasing a new vehicle. Airports and operators must also comply with Rule 1194, Commercial Airport Ground Access, which requires all public and private fleets providing passenger transportation services out of commercial airports to acquire low emission or alternative-fueled vehicles. This rule applies to passenger cars, light-duty trucks, and medium- and heavy-duty transit vehicle fleets of 15 or more vehicles. Passenger shuttle buses and taxi cabs under a contract or exclusive franchise serving airports must comply with this rule as well.

CARB GSE MOU

In 2002, CARB executed an MOU for GSE with commercial airlines and cargo operators in the Basin. GSE is utilized for various functions at airports such as refueling aircraft, transporting cargo and luggage, and providing maintenance. The 2002 MOU has the following objectives for airlines to meet; meeting a 2.65 g/bhp-hr hydrocarbon plus NOx emission rate performance target, converting at least 30 percent of the aggregate GSE fleet to electric, acquiring at least 45 percent of new GSE purchases be electric, and reducing diesel GSE emissions by installing particle filters. The date to achieve these objectives was December 31, 2010. However, the MOU was terminated in 2006 because CARB's statewide regulations addressed many aspects of the GSE MOU.

CARB In-Use Off-Road Diesel-Fueled Fleets Regulation

CARB requires emission reductions from existing off-road diesel-fueled vehicles through its statewide In-Use Off-Road Diesel-Fueled Fleets Regulation. The regulation applies to all off-road diesel vehicles with engines greater than 25 horsepower including diesel-powered GSE and other diesel off-road equipment and vehicles operated at airports. The regulation imposes limits on idling, restricts the addition of older vehicles to fleets, and requires fleet owners to retire, replace or repower older engines to achieve progressively lower fleet average emission rates, or comply with the Best Available Control Technology (BACT) requirements. This rule requires mandatory reporting of applicable equipment to CARB through the Diesel Off-road On-line Reporting System (DOORS).[46]

CARB On-Road Heavy-Duty Diesel Vehicles (In-Use) Regulation

CARB's regulation requires emission controls and replacements for existing diesel trucks and buses through its statewide On-Road Heavy-Duty Diesel Vehicles (In-Use) Regulation, commonly referred to as the Truck and Bus Regulation. Heavy-duty vehicles with a gross vehicle weight greater than 14,000 pounds are required to be retrofitted with diesel particulate filters based on truck model years and according to specified schedules. In addition, replacement of older heavy-duty vehicles is mandated based on a tiered schedule that began in 2015. By 2023, nearly all trucks and buses will be required to have model year 2010 engines or newer.

CARB Heavy-Duty Omnibus Regulation

CARB's Heavy-Duty Omnibus Regulation represents a comprehensive update to the California emission standards and other emission-related requirements for heavy-duty engines and vehicles. This regulation requires vehicles with a gross vehicle weight greater than 10,000 pounds to achieve more stringent NOx emission standards beginning with model year 2024 engines. The regulation also modifies the test cycle used to determine compliance with the standards to better represent real-world emissions. Finally, the regulation ensures that emission controls are sufficiently durable to control emissions over the vehicle's useful life by lengthening the criteria pollutant emissions warranty beginning with model year 2027 engines.

CARB Advanced Clean Trucks

The purpose of CARB's Advanced Clean Trucks Regulation is to accelerate the widespread adoption of zero emission vehicles (ZEVs) in the medium- and heavy-duty truck sector and reduce the amount of harmful emissions generated from on-road mobile sources. This is accomplished through a zero emission sales requirement for manufacturers of vehicles with a gross vehicle weight greater than 8,500 pounds. The sales requirement takes effect in 2024 and reaches its most stringent level in 2030. The regulation also includes a reporting requirement for large entities regarding their use of trucks and buses.

CARB Heavy-Duty Inspection and Maintenance Regulation

CARB's Heavy-Duty Inspection and Maintenance regulation ensures that emissions control systems on heavy-duty vehicles driven in California are operating as designed and are repaired in a timely manner if

[46] Available at https://ssl.arb.ca.gov/ssldoors/doors_reporting/doors_login.html

they malfunction. Affected vehicles are required to undergo inspections every six months beginning in 2023. Depending on vehicle capability, owners are required to submit On-Board Diagnostic data or submit results from a smoke opacity test. The opacity test would also include a visual inspection of the emissions control system to ensure the components are installed according to the manufacturer's specifications. Finally, the regulation calls for expanding a roadside emissions monitoring network and increasing field inspections.

CARB Large Spark-Ignition (LSI) Engine Fleet Requirements Regulation

CARB's LSI regulation applies to off-road LSI engine forklifts, sweepers/scrubbers, industrial tow tractors, and airport ground support equipment operated within the State of California. Additionally, it applies only to vehicles with engines of at least 25 horsepower and 1.0 liter displacement that are part of fleets of four vehicles or more. The regulation requires that applicable fleets achieve specific fleet average emission levels (FAELs) for hydrocarbons and NOx. These standards became more stringent over time until reaching the lowest regulated FAEL in 2013. The regulation also mandates reporting of applicable equipment to CARB through DOORS.

CARB Zero Emission Airport Shuttle Regulation

CARB's Zero Emission Airport Shuttle Regulation, adopted by the CARB Governing Board in June 2019, promotes the use of zero emission ground transportation to and from airports in California. The regulation requires that at least 33 percent, 66 percent, and 100 percent of airport shuttle fleets be zero emission vehicles by December 31, 2027, 2031 and 2035, respectively. It also requires fleet owners to report fleet information annually starting in 2022 and to have zero emission certificates for 2026 and later model year vehicles.

Airport MOUs

The FBMSM for Commercial Airports, which is based on the airports' implementation of MOU measures, seeks to reduce emissions from non-aircraft airport sources including ground support equipment (GSE), airport shuttle buses, and heavy-duty trucks. The MOU measures establish performance targets for 2023 and 2031 for these sources. All airport MOUs include a GSE measure, with three airports also including measures for shuttle buses and/or heavy-duty trucks. In addition to the MOU measures, each airport is implementing Air Quality Improvement Plans/Measures (AQIPs/AQIM), which will lead to further reductions. The AQIPs/AQIM cover sources including construction, light-duty fleets, and passenger transportation.

Proposed Method of Control

The South Coast AQMD will continue working with the airports to facilitate implementation of the MOU measures to meet the targets in 2023 and 2031. The airports are required to submit progress reports on implementing their respective MOU measures by June 1st every year. The first annual progress report was submitted to the U.S. EPA on November 2, 2021. The progress was discussed at the Airport MOU Working Group, which is comprised of stakeholders from, but not limited to, the airline industry, airport authorities, local governments, and community representatives. Working group meetings will be continued to monitor the airports' progress until 2032 when the current MOUs expire.

Through working group meetings, this measure seeks to estimate emission reductions through 2037. After 2032, it is anticipated that the airports will continue to implement their AQIPs/AQIM to further promote clean air and reduce emissions from their operation. Thus, emission reductions are expected to continue after the MOUs expire. The Airport MOU Working Group will be consulted regarding the optimal strategy to quantify these reductions and credit them into the SIP, if applicable. The working group will also be consulted to identify additional feasible measures to achieve further emission reductions for 2037, which may include continued implementation of other actions the airports are already taking to reduce emissions or new and enhanced policies and programs. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Emission Reductions

The amount of additional emission reductions that can be achieved by this measure needs to be determined depending on the number of actions or strategies identified by the Airport MOU Working Group and other FBMSM Working Groups, if needed. Quantified emission reductions that are real, surplus, permanent, and enforceable will be reflected in future emissions inventories as part of the rate-of-progress reporting requirements or in baseline emissions inventories as part of future AQMP/SIP development as long as the U.S. EPA approves the reductions into SIP.

Rule Compliance

Compliance with the MOUs will be verified in accordance with the process identified in the MOUs. The MOUs require that each airport submit detailed progress reports, emissions inventories, and calculations by June 1st each year followed by the South Coast AQMD's report to the U.S. EPA by November 1st. Compliance after 2032 would be strictly voluntary unless the term of the MOUs is extended through 2037.

Test Methods

Approved emission quantification protocols by federal, state, or local agencies will be used to track and report emission reductions for SIP purposes.

Cost Effectiveness

The cost-effectiveness of the measure will be based on the strategies identified through the Airport MOU Working Group.

Implementing Agency

The South Coast AQMD will work with affected parties, the public, and other stakeholders to identify potential actions to help meet the emission reductions associated with the State SIP Strategy "Further Deployment of Clean Technologies" measures for all sources included in airport's operation, which included, but not limited to, on-road vehicles, off-road mobile, and stationary sources.

References

South Coast Air Quality Management District. Facility Based Mobile Source Measure for Commercial Airports (Adopted December 6, 2019).

MOB-05: ACCELERATED RETIREMENT OF OLDER LIGHT-DUTY AND MEDIUM-DUTY VEHICLES
[VOCs, 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:	INCENTIVE PROGRAM FOR VOLUNTARY EARLY RETIREMENT OF OLDER LIGHT- AND MEDIUM-DUTY VEHICLES
EMISSIONS (TONS/DAY):	

ANNUAL AVERAGE	2018	2031	2032	2037
VOC INVENTORY	62.92	29.73	28.54	23.64
VOC REDUCTION		TBD	TBD	TBD
VOC REMAINING		TBD	TBD	TBD
NOx INVENTORY	58.29	17.20	16.52	14.49
NOx REDUCTION		0.19	0.22~~3~~	0.12~~6~~
NOx REMAINING		17.01~~2~~	16.3~~2~~	14.37~~42~~
CO INVENTORY	610.24	283.98	278.12	257.35
CO REDUCTION		TBD	TBD	TBD
CO REMAINING		TBD	TBD	TBD
SUMMER PLANNING	2018	2031	2032	2037
VOC INVENTORY	65.26	31.02	29.79	24.64
VOC REDUCTION		TBD	TBD	TBD
VOC REMAINING		TBD	TBD	TBD
NOx INVENTORY	52.14	15.54	14.93	13.12
NOx REDUCTION		0.18~~7~~	0.20~~1~~	0.11~~4~~
NOx REMAINING		15.36~~7~~	14.73~~5~~	13.01~~7~~
CO INVENTORY	641.96	292.73	286.56	264.68
CO REDUCTION		TBD	TBD	TBD
CO REMAINING		TBD	TBD	TBD

CONTROL COST:	MODIFIED LCF METHOD: $334,300/TON OF NOx REDUCED ESTIMATED PUBLIC FUNDING – UP TO $16,000,000/YEAR
INCENTIVE COST:	UP TO $9,500 PER VEHICLE RETIRED. ADDITIONAL FUNDING UP TO $2,000 FOR ELECTRIC VEHICLE CHARGING EQUIPMENT.
IMPLEMENTING AGENCY:	SOUTH COAST AQMD

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 with up to 8,500 lbs. gross vehicle weight rating (GVWR). These vehicles include passenger cars, sports utility vehicles, vans, and light-duty pick-up trucks.

Background

Significant strides have been made in reducing emissions from motor vehicles through California Air Resources Board (CARB)'s mobile source regulations. As a result, a "new" vehicle today is approximately 99 percent less polluting compared to a vehicle manufactured a couple of decades ago. However, given that on-road light- and medium-duty vehicles still account for over 15 percent of NOx emissions from all sources in the South Coast Air Basin (Basin), requiring the use of advanced technologies such as battery electric, fuel cell, and plug-in hybrid electric vehicle technologies that are capable of zero emission transportation is essential if clean air standards are to be realized, especially for in-use vehicles.

Motor vehicle emissions progressively increase as vehicles age and accumulate mileage. There are many causes for these emissions increases, but they 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 to ensure that vehicles stay clean as they age, but room for improvements in such programs exist. In addition, based on the Bureau of Automotive Repair (BAR) High Emitter profile, certain model year vehicles are considered inherently high emitters despite passing Smog Check. Accelerating the retirement of these high emitters would achieve significant reductions in emissions.

Regulatory History

In January 2012, CARB adopted the Advanced Clean Cars (ACC) Program, including Low-Vehicle Emission (LEV) III criteria pollutant emission standards, LEV III GHG standards, and Zero Emission Vehicle (ZEV) regulation amendments through 2025 model year. CARB is currently in the process of developing the ACC II Program to establish the next set of LEV and ZEV requirements for vehicle model years after 2025, with a target hearing date in June 2022.

On September 23, 2004, the California 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 South Coast AQMD implemented, under the AB 923 program, the High Emitters Repair Or Scrap (HEROS) pilot program to identify and retire high emitting on-road vehicles.

In addition, based on cost-effectiveness guidelines, model year 1992 and older vehicles were 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 about $30 million annually statewide for the EFMP. The EFMP augments the State's existing voluntary accelerated vehicle retirement program, referred to as the Consumer Assistance Program (CAP) which is administered by the Bureau of Automotive Repair. 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.

In 2014, the State Legislature passed two bills (SB 459 – Pavley and AB 1365 – De Leon) that placed an emphasis on increasing the efficacy of the EFMP and encouraged opportunities for low and moderate-income residents to purchase cleaner, more fuel-efficient combustion vehicles and advanced technology vehicles such as all-battery electric and plug-in hybrid electric vehicles. CARB amended the EFMP Regulation in 2014 to reflect these legislative directives. The EFMP now provides up to $4,500 to eligible low- and moderate-income residents for the replacement of older vehicles with newer or new vehicles. Under separate actions, CARB allocated Clean Car 4 All (CC4A, formerly EFMP Plus-Up) funding under the California Climate Investments to augment the EFMP for eligible low- and moderate-income residents living in disadvantaged communities (DAC) for the purchase or lease of cleaner, more fuel-efficient combustion vehicles and advanced technology vehicles. Eligible residents may receive additional funding assistance of up to $5,000 from CC4A. The South Coast AQMD has been implementing the EFMP and CC4A under the Replace Your Ride Program (RYR) since July 2015 with qualified applicants receiving up to $9,500 to replace their existing cars with newer, cleaner vehicles or other clean modes of transportation (e.g., transit passes or car-sharing). Since its inception, the RYR has replaced approximately 8,300 vehicles, having achieved approximately 24 tons per year and 4.7 tons per year of Nitrogen Oxides (NOx) and Volatile Organic Compounds (VOC) emission reductions, respectively. Based on the current projection, approximately $16 million will be appropriated annually by the Legislature for the implementation of the Replace Your Ride Program.

Proposed Methods of Control

This action is to retire 1,500 to 2,000 light- and medium-duty vehicles per year through the Replace Your Ride Program. The proposed incentives would be up to $9,500 which includes additional $5,000 for residents in a DAC zip code. For plug-in hybrid and battery electric vehicles, an additional incentive of up to $2,000 is also provided for the installation of electric vehicle charging equipment under this program.

Emission Reductions

The Calculator for Spending Incentives (CSI), which is an internally developed model to identify most cost-effective projects, is used to calculate emission reductions, as shown in the table below.

TABLE MOB-05-A

Projected NOx and PM Emission Reductions from the Replace Your Ride Program

Calendar Year	No. of Vehicles	NOx Reduction (tons/day)	PM Reduction (tons/day)
2031	4,061	0.19	0.001~~TBD~~
2032	5,022	0.22~~3~~	0.001~~TBD~~
2037	5,440	0.12~~6~~	0.001~~TBD~~

Cost Effectiveness

Since the EFMP guidelines are developed based on funding appropriated by the State Legislature with the desire to provide sufficient funding for low- and moderate-income residents to access newer, cleaner, and more fuel-efficient combustion vehicles and advanced technology vehicles, no cost-effectiveness threshold has been established. Based on the current and projected funding levels, the overall cost-effectiveness for this measure is estimated to be $334,300 per ton of NOx reduced using the Modified Levelized Cash Flow method.

Implementing Agency

The implementing agencies would be the South Coast AQMD under guidelines set forth by CARB for the EFMP and CC4A. Funding would be available from CARB with the South Coast AQMD's administration of the replacement voucher provisions of the EFMP regulation.

References

CARB (2015). AB118 Enhanced Fleet Modernization Program Regulation. April 2015. https://ww2.arb.ca.gov/sites/default/files/2021-03/finalregulationorder2014-S2.pdf

CARB (2021). EFMP Retire and Replace Program Statistics. June 2021. https://ww2.arb.ca.gov/sites/default/files/2021-09/EFMP%20Website%20Statistics%20Tables%20Cumulative%202021_Q2%2009-21-21.pdf

MOB-06: ACCELERATED RETIREMENT OF OLDER ON-ROAD HEAVY-DUTY VEHICLES [NOx, PM]

CONTROL MEASURE SUMMARY

SOURCE CATEGORY:	ON-ROAD HEAVY-DUTY VEHICLES (GREATER THAN 8,500 LBS GVWR)
CONTROL METHODS:	ACCELERATED REPLACEMENT OF EXISTING HEAVY-DUTY VEHICLES WITH ZERO OR LOW NOX EMISSION VEHICLES
EMISSIONS (TONS/DAY):	

ANNUAL AVERAGE	2018	2031	2032	2037
NOx INVENTORY	100.04	26.24	25.02	20.64
NOx REDUCTION		TBD	TBD	TBD
NOx REMAINING		TBD	TBD	TBD
PM2.5 INVENTORY	2.87	1.45	1.45	1.46
PM2.5 REDUCTION		TBD	TBD	TBD
PM2.5 REMAINING		TBD	TBD	TBD

SUMMER PLANNING	2018	2031	2032	2037
NOx INVENTORY	94.92	25.00	23.84	19.67
NOx REDUCTION		TBD	TBD	TBD
NOx REMAINING		TBD	TBD	TBD

CONTROL COST:	TBD
INCENTIVE COST:	TBD
IMPLEMENTING AGENCY:	SOUTH COAST AQMD

Description of Source Category

The intent of this control measure is to seek additional emission reductions from existing heavy-duty vehicles with gross vehicle weight rating (GVWR) greater than 8,500 lbs through an accelerated vehicle replacement program with zero or low NOx emission vehicles.

Background

Emissions from heavy-duty diesel mobile sources continue to represent a significant portion of the emissions inventory in the Basin, adversely affecting regional air quality and public health. The two primary pollutants resulting from the diesel fuel combustion are particulate matter (PM) and Nitrogen Oxides (NOx). Diesel PM contains over 40 known cancer-causing substances and California identified diesel PM as a toxic air contaminant based on its potential to cause cancer in 1998. In August 2021, the South Coast Air Quality Management District (South Coast AQMD) released a report titled, "MATES V Multiple Air Toxic Exposure Study." This report, the fifth in a series of such studies beginning in 1987, concluded that around 50 percent of the cancer risk associated with breathing ambient air can be attributed to diesel PM 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 the attainment of ozone and PM ambient air quality standards, as well as mitigating its toxic air quality impact.

Regulatory History

The regulation of emissions from heavy-duty diesel emission sources is the primary responsibility of California Air Resources Board (CARB) and the U.S. Environmental Protection Agency (U.S. EPA). In California, vehicles with the gross vehicle rating (GVWR) above 8,500 lbs and up to 14,000 lbs are classified as light heavy-duty vehicles; vehicles with GVWR between 14,001 to 33,000 lbs are classified as medium heavy-duty vehicles; and vehicles over 33,000 lbs are classified as heavy heavy-duty vehicles. US and California regulations do not require that medium heavy-duty and heavy heavy-duty diesel vehicles be chassis certified, instead engine certifications are required. Light heavy-duty vehicles may be certified using the heavy-duty engine or light-duty chassis certification procedures, depending on the application.

Emission standards for new diesel engines powering heavy-duty vehicles were first established for the 1974 model-year and have gradually increased in stringency over time. Current standards in effect are established by CARB and the U.S. EPA for 2010 and subsequent model-years, which includes a 0.2 g/bhp-hr NOx emission standard (usually called "2010 engine" standard).

In December 2008, CARB adopted the Truck and Bus Regulation which applies to a significant number of heavy-duty vehicles with the gross vehicle weight rating of 14,001 lbs and greater. The Regulation requires replacement of existing vehicles with 2010 engine standard-compliant vehicles based on a compliance schedule which starts from January 1, 2015. By January 1, 2023, all trucks and buses must have 2010 standard compliant engines with few exceptions.

In 2013, CARB adopted a set of Optional Low NOx Emission Standards for on-road heavy-duty engines that are applicable from 2015. Under the program, manufacturers could certify their engines to three optional NOx emission standards: 0.10, 0.05 or 0.02 g/bhp·hr. The optional NOx standards were developed to pave the way for mandatory standards by encouraging manufacturers to develop and certify low NOx engines and incentivizing the purchase of certified low NOx engines.

In June 2020, CARB adopted the Advanced Clean Truck (ACT) Regulation that accelerates a large-scale transition of heavy-duty vehicles from Class 2b to Class 8 (above 8,500 lbs) to zero emission technology. The regulation has two components: a manufacturer sales requirement and a reporting requirement. Manufacturers who certify Class 2b-8 chassis or complete vehicles with combustion engines would be required to sell zero emission trucks as an increasing percentage of their annual California sales from 2024. By 2035, zero emission truck/chassis sales would need to be 55 percent of Class 2b–3 truck sales, 75 percent of class 4–8 straight truck sales, and 40 percent of truck tractor sales. Large employers including retailers, manufacturers, brokers and others are required to report information about shipments and shuttle services. Fleet owners, with 50 or more trucks, are also required to report about their existing fleet operations.

In August 2020, CARB approved the Low NOx Heavy-Duty Vehicle and Engine Omnibus Regulation that requires a further 90 percent reduction of NOx emissions from heavy-duty on-road engines, to be phased-in over 2024-2031, and introduces a number of other requirements such as a new Low Load Cycle (LLC) and extended emission durability periods. The Omnibus regulation supersedes the Optional Low NOx Standards. The mandatory low NOx standards apply to diesel and Otto cycle engines with a GVWR greater than 10,000 lbs. The Omnibus standards are implemented in two main stages: (1) MY 2024-2026 at 0.050 g/bhp·hr over the Federal Test Procedure (FTP) and the Ramped Modal Cycle (RMC), and 0.200 g/bhp·hr over the Low Load Cycle (LLC); (2) MY 2027 and later at 0.020 g/bhp·hr over the FTP and the RMC test cycles, and 0.050 g/bhp·hr over the LLC test cycle.

On December 9, 2021, CARB Board approved the proposal for the Heavy-Duty Inspection and Maintenance Regulation (HD I/M). This new regulation requires owners of non-gasoline heavy-duty vehicles with gross vehicle weight ratings over 14,000 pounds to periodically demonstrate that their vehicles' emission control systems are properly functioning in order to legally operate within the state. This regulation is designed to achieve criteria emission reductions by ensuring that malfunctioning emissions control systems are timely repaired. This regulation would replace the CARB’s existing heavy-duty vehicle inspection programs. To enhance CARB’s ability to enforce the HD I/M Regulation, CARB will deploy roadside vehicle emission monitoring and an automated license plate recognition camera network throughout California to identify potentially non-complaint vehicles. All non-gasoline heavy-duty vehicles operating in California would be required to have a valid HD I/M compliance certificate to operate legally in the state, and the HD I/M program compliance would be tied to DMV vehicle registration for in-state vehicles. The HD I/M Regulation would begin in 2023 with requirements implemented in three phases: Phase 1: Initial Compliance Certification begins January 1, 2023; Phase 2: Enforcement of Compliance Certification begins no earlier than July 1, 2023; Phase 3: Full implementation begins no earlier than January 1, 2024. The HD I/M Regulation is expected to provide the largest benefits in regions with the most heavy-duty truck traffic. Thus, it would reduce adverse health impacts and improve air quality, especially in disadvantaged communities disproportionally impacted by truck emissions.

CARB is also developing an Advanced Clean Fleets (ACF) regulation with the goal of achieving a full transition to zero emission truck and bus fleets by 2045 everywhere feasible in California and significantly earlier transition for certain market segments such as last mile delivery and drayage applications. The regulation would apply to owner-operators and other fleets performing drayage operations, public agencies, federal governments, and high-priority fleets that own, operate or direct vehicles with a GVWR greater than 8,500 lbs. High priority fleets include any entity with $50 million or more in gross annual revenue, or any broker or fleet owners that in combination owns, operates, or dispatches 50 or more vehicles. High priority and federal fleets will be required to meet zero emission vehicle (ZEV) targets as a percentage of total fleet starting in 2025 with higher ZEV fleet percentages required in subsequent milestone dates, which would vary depending on vehicle types. Public fleets would be required to purchase ZEVs when they make new purchases starting 2024 (50 percent ZEVs starting 2024, and 100 percent ZEVs starting 2027). As for drayage trucks, starting January 2024, only zero emission drayage trucks would be eligible to be added to the CARB drayage truck registry. By 2035, all drayage trucks would be required to be zero emission. The ACF regulation would also set requirements for all new heavy-duty vehicle sales to be ZEVs starting 2040. The proposed regulation is expected to be submitted to CARB Board for adoption in late 2022.

On August 5, 2021, the U.S. EPA announced the Clean Trucks Plan to reduce greenhouse gas (GHG) and criteria pollutants emissions from heavy-duty trucks through a series of rulemakings over the next three years. The first rulemaking, to be finalized in 2022, will apply to heavy-duty vehicles starting in model year 2027. This action will set new standards for criteria pollutants for the entire sector as well as targeted updates to the current GHG emissions standards. A second rule would set more stringent GHG emission standards for new heavy-duty vehicles sold as soon as model year 2030 and beyond. Taken together, these new multi-pollutant standards will improve public health in our communities and set the U.S. on a course to achieve ambitious levels of GHG emission reductions from commercial highway transportation over the long term.

In 2000 and 2001, the South Coast AQMD adopted a series of Clean Fleet Vehicle Rules which require public fleets and certain private fleets under contract or exclusive franchise to a public agency, to purchase alternative fuel powered vehicles at the time the fleet is expanding or replacing existing vehicles in its fleet. Rules 1186.1, 1192, 1193, 1194, 1195, and 1196 affect street sweepers, transit buses, waste collection vehicles, heavy-duty vehicles operating at commercial airports, school buses and heavy-duty vehicles operated by public entities, respectively. The Clean Fleet Vehicle Rules have been successfully implemented since their adoption with a significant number of alternative fuel vehicles now in service in a majority of public fleets and certain private fleets under exclusive franchise to a public entity such as refuse collection fleets and private school bus providers.

Proposed Methods of Control

Trade Up Program for On-Road Heavy-Duty Vehicles is a new pilot program designed to achieve enforceable emission reductions by replacing old, high-polluting vehicles with a new, low~~-~~ NOx CNG powered vehicles through a three-way exchange process. Under this pilot program, qualified participants can trade in their MY 2014 or newer heavy-duty diesel truck to a South Coast AQMD-approved dealership and receive an incentive toward the purchase of a new ~~near-zero~~low NOx emission (0.02 g NOx) natural gas-powered truck. The dealer then sells the trade-in diesel truck at a discounted price, to an owner or fleet with a MY 2009 or older truck that will be scrapped by an approved dismantler to ensure permanent and enforceable reductions. The objective of this pilot program is to accelerate the turnover of 2009 and older heavy-duty diesel trucks while also increasing the deployment of ~~near-zero~~low NOx natural gas-powered heavy-duty trucks and maximizing emission reductions. If proven successful, this program can be further expanded to include other alternative-fuel vehicles including battery electric and fuel cell trucks. In addition, MY 2010 and newer vehicles can be also considered for scrapping after January 1, 2023 when only 2010 and newer engine-equipped vehicles are allowed to operate in California in compliance with the Truck and Bus Regulation.

Emission Reductions

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

Cost Effectiveness

The cost-effectiveness of the proposed action is not estimated at this time. Cost-effectiveness limits in the Carl Moyer Guidelines might be referenced. For trucks with engines that have zero emission mile capability, greater funding incentives may be needed in the near-term.

Implementing Agency

South Coast AQMD

References

South Coast AQMD (2021). MATES V Multiple Air Toxic Exposure Study. http://www.aqmd.gov/home/air-quality/air-quality-studies/health-studies/mates-v

DieselNet. Heavy-Duty Onroad Engines Emission Standards. https://dieselnet.com/standards/us/hd.php

CARB. On-Road Heavy-Duty Certification Program. https://ww2.arb.ca.gov/our-work/programs/road-heavy-duty-certification-program/about

CARB (2019). Truck and Bus Regulation Compliance Requirement Overview. https://ww2.arb.ca.gov/our-work/programs/truck-bus-regulation/truck-and-bus-regulation-fact-sheets

CARB (2020). Advanced Clean Trucks Fact Sheet. https://ww2.arb.ca.gov/resources/fact-sheets/advanced-clean-trucks-fact-sheet

CARB (2020). Low NOx Heavy-Duty Omnibus Regulation Fact Sheet. https://ww2.arb.ca.gov/sites/default/files/classic/msprog/hdlownox/files/HD_NOx_Omnibus_Fact_Sheet.pdf

CARB (2021). Facts about the Proposed Heavy-Duty Inspection and Maintenance Regulation. https://ww2.arb.ca.gov/sites/default/files/2021-10/HD%20IM%20FactSheet-final.pdf

CARB (2021). Advanced Clean Fleets Fact Sheet. https://ww2.arb.ca.gov/resources/fact-sheets/advanced-clean-fleets-fact-sheet

CARB (2021). State Strategy for the State Implementation Plan: Draft Measures. https://ww2.arb.ca.gov/sites/default/files/2021-10/2022_SSS_Draft_Measures.pdf

U.S. EPA (2021). Clean Trucks Plan. https://www.epa.gov/regulations-emissions-vehicles-and-engines/clean-trucks-plan

MOB-07: ON-ROAD MOBILE SOURCE EMISSION REDUCTION CREDIT GENERATION PROGRAM [NOx, PM]

SOURCE CATEGORY: ON-ROAD HEAVY-DUTY VEHICLES (14,001 LBS AND GREATER GVWR)

CONTROL METHODS: ACCELERATED DEPLOYMENT OF LOW NOX AND ZERO EMISSION VEHICLES

EMISSIONS (TONS/DAY):

ANNUAL AVERAGE	2018	2031	2032	2037
NOx INVENTORY	86.68	23.60	22.66	19.23
NOx REDUCTION	TBD	TBD	TBD	TBD
NOx REMAINING	TBD	TBD	TBD	TBD
PM2.5 INVENTORY	2.48	1.17	1.17	1.19
PM2.5 REDUCTION	TBD	TBD	TBD	TBD
PM2.5 REMAINING	TBD	TBD	TBD	TBD
SUMMER PLANNING	**2018**	**2031**	**2032**	**2037**
NOx INVENTORY	82.34	22.49	21.60	18.32
NOx REDUCTION	TBD	TBD	TBD	TBD
NOx REMAINING	TBD	TBD	TBD	TBD

CONTROL COST: TBD

INCENTIVE COST: TBD

IMPLEMENTING AGENCY: SOUTH COAST AQMD

Description of Source Category

This measure seeks to develop mechanisms to incentivize the early deployment of zero and ~~near-zero~~low NOx emission heavy-duty trucks through the generation of mobile source emission reduction credits (MSERCs) which could be used as an alternative means of compliance with the South Coast Air Quality Management District (South Coast AQMD) regulations, where applicable. These MSERCs will be used only by entities affected by the 2022 Air Quality Management Plan (AQMP) control measures MOB-01 through MOB-04, EGM-01, and EGM-03; and cannot be used to offset emissions from stationary sources.

Background

MSERC generation programs have been developed and implemented by the South Coast AQMD to provide an incentive for the early deployment of cleaner, advanced technologies that are not otherwise required to comply with existing air regulations. Generation of such credits may be considered surplus and have been used to comply with other South Coast AQMD regulations. The South Coast AQMD continues to work with affected stakeholders on the development and update of MSERC generation rules and the U.S. EPA to define an approach that can be approved into the SIP. This proposed measure provides a forum to advance such discussions with interested stakeholders and the U.S. EPA.

Regulatory History

In September 1995, the South Coast AQMD adopted Rule 1612 – Credits for Clean On-Road Vehicles, which provides a quantification protocol for entities to generate MSERCs that could be used for compliance with other South Coast AQMD rules. Rule 1612 establishes a mechanism for the quantification of emission benefits as a result of implementation of projects that deployed on-road vehicles meeting optional NOx emission standards or are not otherwise required by a regulation or other enforceable mechanism. Mobile source emission reductions associated with said projects are converted to credits that could be used by the project proponent or sold to other entities to meet other South Coast AQMD rules as allowed by those regulations.

In March 2001, the South Coast AQMD adopted Rule 1612.1 – Mobile Source Credit Generation Pilot Program, which sets forth credit generating mechanisms for mobile sources to generate MSERCs through the voluntary replacement of specific categories of diesel-fueled heavy-duty vehicles or yard hostlers with clean technologies. Although the South Coast AQMD Rule 1612 permits the use of MSERCs for compliance with other South Coast AQMD regulations, the NOx MSERCs generated under this pilot program can only be used for compliance with the South Coast AQMD's RECLAIM program. Rule 1612.1, which was approved by the U.S. EPA in 2002, provides local air quality benefits to community members who live in and around areas where participating vehicles operate. These benefits include reductions in NOx, diesel particulate matter (DPM), carbon monoxide (CO), and toxic air contaminant emissions associated with the use of heavy-duty diesel engines. Regional air quality benefits would accrue from: 1) the rule provision that automatically retires 9 percent of MSERCs generated for the benefit of the environment, 2) the non-credited emission reductions other than NOx, and 3) the accelerated and increased replacement of heavy-duty diesel vehicles with alternative clean fuel vehicles.

Proposed Method of Control

This measure seeks to amend Rule 1612.1 and/or 1612 to provide greater flexibility, such as expanding the eligibility of vehicle types and projects as well as providing more flexibility in the application and use of MSERCs, for accelerated deployment of zero and ~~near-zero~~low NOx emission heavy-duty vehicles in the Basin and Coachella Valley. The focus of the amendment will be to encourage the deployment of commercially available zero and ~~near-zero~~low NOx emission heavy-duty vehicles that do not receive or cannot receive public funding assistance. MSERCs must be real, surplus, quantifiable, permanent, and enforceable as defined by the U.S. EPA. As such, any project considered for generation of emission reduction credits must go beyond regulatory requirements such as the provisions of the Truck and Bus Regulation, mandatory engine exhaust emission standards, or other relevant regulations.

For the purpose of this measure, a ~~near-zero~~low NOx emission engine is one that meets the CARB optional low NOx standard of 0.02 g/bhp-hr. For 2027 and subsequent model year engines, the optional standard will be lowered to 0.01 g/bhp-hr. Zero emission trucks include, but are not limited to, commercially available battery-electric trucks, hydrogen 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 discussions of potential enforceable mechanisms will be through a public process. Through this process, South Coast AQMD staff will establish a working group, hold a series of working group meetings, along with public workshops. The purpose of the public process is to allow South Coast AQMD staff to work with a variety of stakeholders, potentially affected industries, other agencies, and environmental and community groups to solicit input and comments. It is envisioned that through the public process, there will be discussions on the types of voluntary actions that could lead to additional emission reductions. To the extent that such actions can be quantified and are determined to be surplus (i.e., the emission reduction benefits are not the result of a regulation), the emission reductions will be recognized into the SIP.

Emission Reductions

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

Cost Effectiveness

TBD

Implementing Agency

South Coast AQMD

References

California Legislative Information (2017). Assembly Bill 617 – Nonvehicular air pollution: criteria air pollutants and toxic air contaminants. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB617

California Air Resource Board (2020). Advanced Clean Trucks Regulation. https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2019/act2019/fro2.pdf

South Coast Air Quality Management District (2019). South Coast AQMD Rule 1612 – Clean On-Road Vehicles (Amended March 1, 2019). http://www.aqmd.gov/docs/default-source/rule-book/reg-xvi/rule-1612.pdf?sfvrsn=11

South Coast Air Quality Management District (2001). South Coast AQMD Rule 1612.1 – Mobile Source Credit Generation Pilot Program (Adopted March 16, 2001). https://www.aqmd.gov/docs/default-source/rule-book/reg-xvi/rule-1612-1.pdf?sfvrsn=4

United States Environmental Protection Agency. Menu of Control Measures. EPA (2002). Revisions to the California State Implementation Plan, South Coast Air Quality Management District. https://www.epa.gov/sips-ca/epa-approved-south-coast-air-South Coast AQMD-regulations-california-sip

South Coast Air Quality Management District (2021). RECLAIM Transition. http://www.aqmd.gov/home/rules-compliance/reclaim-transition.

MOB-08: SMALL OFF-ROAD ENGINE EQUIPMENT EXCHANGE PROGRAM [VOCs, NOx, CO]

SOURCE CATEGORY: SMALL OFF-ROAD ENGINES (SORE) AND LARGER DIESEL-POWERED LAWN AND GARDEN EQUIPMENT

CONTROL METHODS: EXCHANGE EXISTING IN-USE SORE FOR ELECTRICAL EQUIPMENT, OR NEW LOW-EMITTING ENGINES

EMISSIONS (TONS/DAY):

ANNUAL AVERAGE	2018	2031	2032	2037
VOC INVENTORY	40.66	20.27	18.65	12.81
VOC REDUCTION	TBD	TBD	TBD	TBD
VOC REMAINING	TBD	TBD	TBD	TBD
NOx INVENTORY	3.36	2.68	2.52	2.01
NOx REDUCTION	TBD	TBD	TBD	TBD
NOx REMAINING	TBD	TBD	TBD	TBD
CO INVENTORY	477.48	353.13	324.48	224.27
CO REDUCTION	TBD	TBD	TBD	TBD
CO REMAINING	TBD	TBD	TBD	TBD

SUMMER PLANNING	2018	2031	2032	2037
VOC INVENTORY	48.18	23.94	22.05	15.10
VOC REDUCTION	TBD	TBD	TBD	TBD
VOC REMAINING	TBD	TBD	TBD	TBD
NOx INVENTORY	3.58	2.86	2.69	2.16
NOx REDUCTION	TBD	TBD	TBD	TBD
NOx REMAINING	TBD	TBD	TBD	TBD

CONTROL COST: TBD

INCENTIVE COST: TBD

IMPLEMENTING AGENCY: SOUTH COAST AQMD

Description of Source Category

The purpose of this control measure is to promote the accelerated turn-over of in-use small off-road engines and other engines, such as those used in larger diesel-powered lawn and garden equipment, through expanded voluntary exchange programs.

Background

Small off-road engines (SORE) are spark-ignition engines rated at or below 25 horsepower (19 kilowatts) that are primarily used for lawn, garden, and other outdoor power equipment including trimmers, leaf blowers, lawn mowers, lawn tractors, as well as other commercial/industrial equipment. The SORE category does not include compression ignition engines or recreational vehicles. Although a small sector of the lawn and garden equipment operates on diesel such as riding lawn mowers, stump grinders, and other commercial turf equipment, most of the candidate equipment that are eligible for exchange programs under this measure are gasoline-powered.

Over half of the 15.4 million SORE population in California (61 percent) falls in the Residential Lawn and Garden equipment category, followed by Other Equipment types such as portable generators and pressure washers (20 percent), Federally Regulated Construction and Farming (11 percent), and Commercial Lawn and Garden equipment (8 percent). Although commercial lawn and garden equipment accounts for only 8 percent of the total SORE population, it is responsible for approximately 20 percent of smog-forming emissions from SORE during the summer in CA.

Since 2003, the South Coast AQMD has sponsored a lawn mower exchange program for residential lawn mowers which is now known as the Electric Lawn Mower Rebate Program. The program is designed to incentivize residential users with a rebate of up to $250 for the purchase of a new electric lawn mower when they turn in their old gas-powered lawn mowers to an approved scrapper. Since its inception, this program has replaced over 57,000 high polluting gasoline-powered lawn mowers with electric lawn mowers.

In addition to the Electric Lawn Mower Rebate Program, the South Coast Air Quality Management District (South Coast AQMD) has also sponsored a commercial leaf blower buyback program which provided $200 as an incentive to buy back an old two-stroke leaf blower. The payment was then applied toward the purchase of a new four-stroke gasoline-powered unit which are less polluting than the two-stroke units. Expanding the program to include other commercial lawn and garden equipment, the South Coast AQMD launched the Commercial Electric Lawn and Garden Equipment Incentive and Exchange Program (Commercial L&G Equipment Program) in 2018, which aims to accelerate the replacement of old gasoline- or diesel-powered commercial lawn and garden equipment with zero emission, battery electric technology. This program provides a point-of-sale discount of up to 75 percent off the purchase price of a variety of new electric equipment including lawn mowers (ride-on, stand-on and walk-behind mowers), handheld trimmers, chainsaws, and pruners in addition to backpack and handheld leaf blowers. In exchange, participants are required to turn in their old commercial-grade equipment to an approved dismantler for scrapping. Eligible participants include commercial gardeners and landscapers, local governments, school districts and colleges, and non-profit organizations. Since its inception in 2018, the

Commercial L&G Equipment Program has funded over 5,800 commercial lawn and garden equipment replacements with zero emission alternatives.

Regulatory History

In 1990, California Air Resources Board (CARB) became the first regulatory agency to adopt exhaust emissions standards for SORE engines. In 2003, CARB developed the first set of evaporative emissions standards for this category. As a result of the CARB regulations, SORE equipment today is 40-80 percent cleaner than they were when the program began. However, due to population growth SORE emissions has already surpassed passenger car emissions in the South Coast Air Basin (Basin) and they are expected to double the passenger car emissions by 2031.

On September 23, 2020, California adopted Executive Order N-79-20 to require the phasing out of gasoline-powered vehicles and equipment and transition to zero emission alternatives. Specifically, the order sets a goal to transition off-road vehicles and equipment operations to 100 percent zero emission by 2035, where feasible. As a strategy to meet this goal, the CARB Board approved amendments to the SORE Regulation on December 9, 2021, requiring most newly manufactured SORE equipment to be zero emissions starting in 2024. However, these new requirements do not apply to in-use sources, which presents a need for programs and/or regulations to reduce emissions from existing SORE engines.

Proposed Method of Control

In order to increase the penetration of new low-emission and zero emission equipment, this measure seeks to expand the existing exchange programs such as Electric Lawn Mower Rebate Program and Commercial Lawn and Garden Equipment Exchange Program by increasing the number of outreach and exchange events and available funding.. In addition, the South Coast AQMD has recently started a new battery rebate program for commercial lawn and garden equipment that were previously funded by the Commercial Lawn and Garden Exchange Program. The battery rebate program will fund up to 75 percent of the rechargeable battery cost with a maximum limit of three batteries per equipment. The South Coast AQMD will continue to seek additional funding opportunities and resources to expand the scope and types of equipment and engines that can be funded by these programs.

Emission Reductions

Emissions reductions are not estimated as they will depend on the number and types of engines/equipment participating in the existing and future programs to be developed under this measure.

Cost Effectiveness

The cost-effectiveness will also depend on the types of engines and/or equipment participating in the exchange programs.

Implementing Agency

South Coast AQMD

References

California Air Resources Board. (2021). Small Engine Fact Sheet – Small Off-Road Engines in California. October 14, 2021. https://ww2.arb.ca.gov/sites/default/files/2021-12/2021%20SORE%20Fact%20Sheet.pdf.

California Air Resources Board. (2021). CARB Approves Updated Regulations Requiring Most New Small Off-Road Engines Be Zero Emission By 2024. December 9, 2021. https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2021/sore21/isor.pdf

South Coast AQMD. (2021). Electric Lawn and Equipment. http://www.aqmd.gov/home/programs/community/community-detail?title=lawn-equipment.

State of California. (2021). Executive Order N-79-20. http://www.aqmd.gov/home/programs/community/community-detail?title=lawn-equipment.

MOB-09: FURTHER EMISSION REDUCTIONS FROM PASSENGER LOCOMOTIVES [NOx, PM]

CONTROL MEASURES 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	2018	2031	2032	2037
NOx INVENTORY	0.96	0.81	0.81	0.53
NOx REDUCTION	TBD	TBD	TBD	TBD
NOx REMAINING	TBD	TBD	TBD	TBD
PM2.5 INVENTORY	0.02	0.01	0.01	0.01
PM2.5 REDUCTION	TBD	TBD	TBD	TBD
PM2.5 REMAINING	TBD	TBD	TBD	TBD
SUMMER PLANNING	2018	2031	2032	2037
NOx INVENTORY	0.96	0.81	0.81	0.53
NOx REDUCTION	TBD	TBD	TBD	TBD
NOx REMAINING	TBD	TBD	TBD	TBD
CONTROL COST:	TBD			
INCENTIVE COST:	TBD			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

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. If new locomotive engine emission standards beyond the current Tier 4 standards are established, this measure will seek the procurement of cleaner locomotives as the older locomotives are replaced or remanufactured.

Background

Diesel-electric locomotives have a large diesel engine (main traction engine) for generating electric power, which in turn drives electric traction motors in each axle to propel the locomotive. Typically, passenger locomotives have engines with about 3,800 horsepower and these locomotives remain in commercial service for 25 to 40 years.

California's locomotive emission inventory is consisted of four categories: line-haul, switcher, short line, and passenger; with passenger contributing approximately 6 percent of the total statewide locomotive Nitrogen Oxides (NOx) emissions (CARB 2016 Technology Assessment: Freight Locomotives). Generally powered by medium speed diesel engines, passenger locomotives are designed for lighter load and higher speed compared to other categories. Unlike other categories, passenger locomotives typically have a main propulsion engine and onboard hotel power (a generator of about 600 horsepower) that provides electricity via cable for lights, air conditioning, and other comfort-related features to the connected passenger railcars.

Two passenger railroads, Metrolink and Amtrak, operate rail lines in the South Coast Air Basin (Basin) as well as the surrounding counties. Metrolink operates 62 stations across the South Coast's four-county region as well as Ventura, moving approximately 12 million passengers annually over a 538 track-mile network. Amtrak operates approximately 70 intercity trains and 100 commuter trains per day in California. Its contract commuter services include the Metrolink commuter service, which serves a five-county area in the Los Angeles Basin, with seven lines, 55 stations, and 40,000 weekday passengers.

Both Amtrak and Metrolink operate commuter rail services for the Southern California Regional Rail Authority. Southern California Regional Rail Authority adopted a locomotive replacement plan for Metrolink which includes the procurement of Tier 4 locomotive engines. Specifically, the plan directed the replacement of Metrolink's fleet of Tier 0 to Tier 2 locomotive engines with Tier 4 locomotives in a 5-year span. Since 2013, the South Coast AQMD's Governing Board has awarded a total of $110.8 million through the Carl Moyer Program over multiple funding cycles to fund the replacement of Metrolink's Tier 0 & Tier 2 locomotives with Tier 4 locomotives. Metrolink took delivery of its first Tier 4 locomotives in 2016 and has since replaced a total of 40 passenger locomotives with Tier 4 engines.

Regulatory History

Under the Clean Air Act, only the U.S. Environmental Protection Agency (U.S. EPA) has authority to establish emissions standards for new locomotives. By regulation, "new" locomotives include both newly manufactured as well as remanufactured or rebuilt locomotives. In 1998, and again in 2008, the U.S. EPA promulgated regulations for the control of emissions from locomotives. 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 standard (Tier 4) is required beginning in 2015 with emission levels 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. The U.S. EPA locomotive emission standards apply to 1973 and newer locomotives upon engine rebuild and new 2002 and later locomotives.

Proposed Method of Control

Through this measure, the South Coast AQMD will continue to not only promote earlier replacement or upgrade of existing passenger trains with Tier 4 locomotives, but also support the development and adoption of zero or ~~near-zero~~low NOx emission technologies. Amtrak’s fleet that travels in the South Coast Air Basin is almost exclusively Tier 0 locomotives. Although there is no requirement for Amtrak to purchase new locomotives that meet the current Tier 4 emission standards, Amtrak has plans to upgrade them to cleaner locomotives including Tier 4. Also, Metrolink currently operates 15 Tier 2 locomotives as standby units when Tier 4 locomotives are down due to maintenance and repairs. The South Coast AQMD will continue to work with both railroads to upgrade Tier 0 to Tier 2 locomotives with Tier 4 and cleaner engines. Tier 4 locomotives are 65 percent to 85 percent cleaner compared to Tier 2 and Tier 0, respectively, and have higher horsepower to pull more passenger cars per locomotive

In addition, the South Coast AQMD is continuing to work collaboratively with other stakeholders to explore the feasibility of zero and ~~near-zero~~low NOx emission locomotive technologies such as battery electric or fuel cell engine-driven systems. For example, the South Coast AQMD has been actively participating in the development and demonstration of zero emission battery-operated switcher locomotives in CARB-funded projects in the San Pedro Bay Ports since 2018.

There are other development and demonstration projects in the South Coast Air Basin. The San Bernardino County Transportation Authority is currently leading the way in the development of zero emission rail technology with a plan to debut the first of its kind battery and hydrogen-powered passenger train servicing San Bernardino and Redlands. -Named ZEMU (zero emission multiple unit), the locomotive will be powered by a hybrid hydrogen fuel cell/battery technology to propel the train.

Emission Reductions

Emission reductions are not estimated for this control measure as it will depend on the actual type and number of locomotives participating in the program. For reference, the replacement of Metrolink’s 40 Tier 0 and Tier 2 locomotives with Tier 4 locomotives has resulted in the reductions of 495 tons per year of NOx, 33.9 tons per year of Reactive Organic Gases (ROG), and 13.8 tons per year of particulate matter (PM).

Cost Effectiveness

According to the previous estimates by Metrolink staff, replacing Tier 0 passenger locomotives with Tier 4 locomotives would cost approximately \$6.2 million per locomotive, and repowering Tier 2 locomotives would cost approximately \$2.4 million each. These estimates would likely increase in future projects and the cost would be even greater for zero and ~~near-zero~~low NOx emission locomotives. The exact cost-effectiveness will depend on the number and types of locomotives participating in the program.

Implementing Agency

South Coast AQMD

References

California Air Resources Board. (2017). The Carl Moyer Program Guidelines – 2017 Revisions. https://ww2.arb.ca.gov/sites/default/files/classic/msprog/moyer/guidelines/2017/2017_cmpgl.pdf.

California Air Resources Board. (2016). Technology Assessment: Freight Locomotives. https://ww2.arb.ca.gov/sites/default/files/2020-06/final_rail_tech_assessment_11282016%20-%20ADA%2020200117.pdf.

Metrolink. (2021). Metrolink Central Maintenance Facility Community Update: Locomotive Fleet Modernization Study Update. https://d2kbkoa27fdvtw.cloudfront.net/metrolink/270f597291c927654419dba66f2a51e40.pdf.

Metrolink. (2021). Metrolink Central Maintenance Facility Update: Virtual Community Meeting Recap. https://metrolinktrains.com/globalassets/community/cmf/cmf-monthly-update-june-2021-1.pdf.

Amtrak. (2019). Amtrak Fact Sheet Fiscal Year 2019. State of California. https://www.amtrak.com/content/dam/projects/dotcom/english/public/documents/corporate/nationalfactsheets/Amtrak-Company-Profile-FY2020-041921.pdf.

Amtrak. (2020). FY 2020 Company Profile. https://www.amtrak.com/content/dam/projects/dotcom/english/public/documents/corporate/nationalfactsheets/Amtrak-Company-Profile-FY2020-041921.pdf.

San Bernardino County Transportation Authority. (2021). Zero-Emission Rail Technology. https://www.gosbcta.com/wp-content/uploads/2019/09/ZEMU-technology-fact-sheet-021921.pdf.

MOB-10: OFF-ROAD MOBILE SOURCE EMISSION REDUCTION CREDIT GENERATION PROGRAM
[NOx, PM]

CONTROL MEASURSE SUMMARY

SOURCE CATEGORY:	OFF-ROAD DIESEL-FUELED CONSTRUCTION, INDUSTRIAL EQUIPMENT, AIRPORT GROUND SUPPORT EQUIPMENT, AND DRILLING EQUIPMENT
CONTROL METHODS:	ACCELERATED DEPLOYMENT OF TIER 4 EQUIPMENT AND ~~NEAR-ZERO~~LOW NOX AND ZERO EMISSION EQUIPMENT WHERE APPLICABLE
EMISSIONS (TONS/DAY):	TBD

ANNUAL AVERAGE	2018	2031	2032	2037
NOX INVENTORY	37.38	10.66	10.07	8.16
NOX REDUCTION	TBD	TBD	TBD	TBD
NOX REMAINING	TBD	TBD	TBD	TBD
PM2.5 INVENTORY	1.64	0.75	0.73	0.64
PM2.5 REDUCTION	TBD	TBD	TBD	TBD
PM2.5 REMAINING	TBD	TBD	TBD	TBD
SUMMER PLANNING	**2018**	**2031**	**2032**	**2037**
NOX INVENTORY	41.92	11.81	11.14	8.94
NOX REDUCTION	TBD	TBD	TBD	TBD
NOX REMAINING	TBD	TBD	TBD	TBD

CONTROL COST:	TBD
INCENTIVE COST:	TBD
IMPLEMENTING AGENCY:	SOUTH COAST AQMD

Description of Source Category

This measure seeks to develop mechanisms to incentivize the early deployment of Tier 4, zero, and ~~near-zero~~low NOx off-road mobile combustion equipment, where applicable, through the generation of mobile source emission reduction credits (MSERCs). -These MSERCs will be used only by entities affected by the 2022 Air Quality Management Plan (AQMP) control measures MOB-01 through MOB-04, EGM-01, and

EGM-03; and cannot be used to offset emissions from stationary sources. -Furthermore, these MSERCs will be discounted to provide additional emission reductions to help meet air quality standards.

Background

Based on preliminary inventories, off-road equipment (construction, industrial, etc.) is projected to account for approximately 16 percent of the total basin-wide Nitrogen oxide (NOx) emissions in 2037. These off-road equipment categories are also a significant source of diesel Particulate Matter (PM) emissions which is a toxic air contaminant with over 40 known cancer-causing substances. Accelerated deployment of Tier 4 and cleaner technologies to reduce both NOx and diesel PM emissions from off-road equipment will be critical in achieving our air quality goals and also to protect public health.

Mobile source emission reduction credit generation programs developed by the South Coast Air Quality Management District (South Coast AQMD) provide an incentive to deploy cleaner, advanced technologies that are not otherwise required to comply with existing regulations. -Generation of such credits may be considered surplus and have been used to comply with other South Coast AQMD regulations. -The South Coast AQMD continues to work with affected stakeholders on the development of MSERC generation rules and the U.S. Environmental Protection Agency (U.S. EPA) to define an approach that can be approved into the SIP. –This proposed measure provides a forum to continue such discussions with interested stakeholders and the U.S. EPA.

Regulatory History

In September 1995, the South Coast AQMD adopted Rule 1620 – Credits for Clean Off-Road Mobile Equipment, which provides a protocol for entities to generate mobile source emission reduction credits that could be used for compliance with other South Coast AQMD rules. –Rule 1620 established a mechanism for the quantification of emission benefits as a result of implementation of projects that deployed cleaner off-road mobile equipment meeting the cleanest NOx emission standards (currently Tier 4) or were not otherwise required by a regulation or other enforceable mechanism. –Mobile source emission reductions associated with said projects are converted to credits that could be used by the project proponent or sold to other entities to meet other South Coast AQMD rules as allowed by those regulations.

In May 1996, the South Coast AQMD adopted an emission reductions credit generation rule for lawn and garden equipment. -Rule 1623 – Credits for Clean Lawn and Garden Equipment – focused on projects that replaced older gasoline powered lawn and garden equipment with new zero emission models. -Similar to Rule 1620, emission reduction credits generated under Rule 1623 can be used for compliance with other South Coast AQMD rules if allowed by those rules.

Proposed Method of Control

This measure seeks to amend Rule 1620 to provide greater flexibility for entities to initiate projects to accelerate the deployment of zero and ~~near-zero~~low NOx emission off-road mobile equipment in the South Coast Air Basin (Basin) and Coachella Valley. -The focus of the amendment will be to encourage the deployment of commercially available zero and ~~near-zero~~low NOx emission off-road mobile equipment that do not receive or cannot receive public funding assistance. -Mobile source emission reduction credits must be real, surplus, quantifiable, permanent, and enforceable as defined by the U.S. EPA. -As such, any project considered for generation of emission reduction credits must go beyond regulatory requirements.

For the purposes of this measure, a ~~near-zero~~low NOx emission engine is one that is certified to be at least 90 percent cleaner than the current Tier 4 off-road emission standard (for the horsepower specification of the off-road engine), or meets the lowest optional NOx emission standard (for on-road heavy-duty engines if the on-road engine is used in an off-road application). -If Tier 5 standard is adopted in the future, ~~near-zero~~low NOx would be based 90 percent cleaner than the Tier 5 standard. Zero emission mobile equipment include, but are not limited to, commercially available battery-electric or fuel cell powered equipment.

The discussions of potential enforceable mechanisms will be through a public process. –Through this process, South Coast AQMD staff will establish a working group, hold a series of working group meetings, along with public workshops. -The purpose of the public process is to allow South Coast AQMD staff to work with a variety of stakeholders, potentially affected industries, other agencies, and environmental and community groups to solicit input and comments. -It is envisioned that through the public process, there will be discussions on the types of voluntary actions that could lead to additional emission reductions. -To the extent that such actions can be quantified and are determined to be surplus (i.e., the emission reduction benefits are not the result of a regulation), the emission reductions will be recognized into the SIP.

Emission Reduction

Emission reductions are not estimated at this time and will depend on the actual type and number of off-road vehicles/equipment participating in the program.

Cost Effectiveness

TBD

Implementing Agency

South Coast AQMD

References

California Air Resources Board. (2021). Zero-Emission Off-Road Strategies. https://ww2.arb.ca.gov/sites/default/files/2020-11/ZEV_EO_Off-Road_Fact_Sheet_111820.pdf.

South Coast AQMD. (2019). Rule 1620 – Credits for Clean Off-Road Mobile Equipment (Amended March 1, 2019). http://www.aqmd.gov/docs/default-source/rule-book/reg-xvi/rule-1620.pdf.

South Coast AQMD. (2019). Rule 1623 – Credits for Clean Lawn and Garden Equipment (Amended March 1, 2019). http://www.aqmd.gov/docs/default-source/rule-book/reg-xvi/rule-1623.pdf.

MOB-11: EMISSION REDUCTIONS FROM INCENTIVE PROGRAMS [NOx, PM]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	ON-ROAD AND OFF-ROAD MOBILE SOURCE VEHICLES AND EQUIPMENT			
CONTROL METHODS:	IMPLEMENTATION OF INCENTIVE PROGRAMS			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
NOx INVENTORY	164.65	62.22	60.20	51.07
NOx REDUCTION		7.59	7.15	6.74
NOx REMAINING		54.63	53.05	44.33
PM2.5 INVENTORY	5.33	2.98	2.95	2.79
PM2.5 REDUCTION		0.23	0.23	0.21
PM2.5 REMAINING		2.75	2.72	2.58
SUMMER PLANNING	2018	2031	2032	2037
NOx INVENTORY	163.92	61.95	59.90	50.71
NOx REDUCTION		7.55	7.11	6.69
NOx REMAINING		54.40	52.79	44.02
CONTROL COST:	MODIFIED LCF METHOD: $87,000/TON OF NOx REDUCED ~~APPROXIMATELY $200 MILLION PER YEAR~~			
INCENTIVE COST:	VARIES DEPENDING ON INCENTIVE PROGRAMS			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

Description of Source Category

This control measure seeks to apply the administrative mechanism, as proposed in the 2016 Air Quality Management Plan (AQMP), to quantify and take credit for the emission reductions achieved through the implementation of incentive programs administered by the South Coast Air Quality Management District (South Coast AQMD) for State Implementation Plan (SIP) purposes. The incentive program-funded source category includes, but is not limited to, all on-road vehicles with a Gross Vehicle Weight Rating (GVWR) over 8,500 lbs (excluding motor homes), commercial harbor craft, locomotives, and off-road equipment from the sectors of port operations, rail operations, agricultural, industrial, construction, airport ground support, and oil drilling.

Background

The South Coast AQMD has a long history of successful implementation of incentive programs that help fund the accelerated deployment of cleaner engines and aftertreatment technologies in on-road heavy-duty vehicles and off-road mobile equipment which results in early and surplus emission reductions. Such accelerated deployment also provides a signal for technology providers, engine and automobile manufacturers, and academic researchers to develop and commercialize the cleanest combustion engines possible and further the efforts to commercialize zero emission technologies into a wider market. -Some of the major incentive programs that are administered by the South Coast AQMD are discussed below:

Carl Moyer Memorial Air Quality Standards Attainment Program

The Carl Moyer Memorial Air Quality Standards Attainment Program (Moyer Program) is a grant program that funds the incremental cost of cleaner-than-required engines, equipment, and other sources of air pollution. The Moyer Program was placed into State law in 1998 and the first set of Moyer Program Guidelines was adopted by California Air Resources Board (CARB) in 1999. The California Legislature has since periodically modified the Moyer Program to address evolving needs and to reflect advancing technologies as well as regulatory changes. For example, in 2004, Assembly Bill (AB) 923 and Senate Bill (SB) 1107 provided increased and continued funding while significantly expanding the Moyer Program to include light-duty vehicles and agricultural sources. Projects with Volatile Organic Compounds (VOCs) and Particulate Matter (PM) reductions were also included in 2004. This change allowed the Program to more comprehensively address air pollution challenges, including the air toxic risks from diesel engines. In 2013, AB 8 further extended funding from the AB 923 tire fees through 2023 and reauthorized the Moyer Program. Most recently, SB 513 has provided new opportunities for the Moyer Program to advance zero and ~~near-zero~~low NOx emission technologies by substantially increasing cost-effectiveness limits and also including infrastructure projects for funding. It also allowed Moyer Program to leverage co-funding from other incentive programs without penalizing cost-effectiveness.

The Moyer Program helps to fund a variety of vehicles and equipment. Typical project types include replacement of old vehicles and equipment, engine repowers, and installation of retrofit devices. Moyer funds also provide funding for installation of fueling/charging infrastructure for funded sources. Emission reduction technologies must be certified or verified by CARB and projects selected for funding must meet cost-effectiveness limits and achieve at least 15 percent reduction in Nitrogen Oxides (NOx). In addition, projects reducing PM and/or VOC emissions are also eligible for funding provided they are cost-effective. For SIP purposes, emission reductions funded through the Moyer Program must be permanent, surplus, quantifiable and enforceable.

The Moyer Program has been successful in reducing smog-forming and toxic emissions cost-effectively by providing incentives to obtain early or extra emission reductions, especially from emission sources in minority and low-income communities and areas disproportionately impacted by air pollution. Since 1998, the South Coast AQMD has awarded $530 million through the Moyer Program and has funded close to 8,000 vehicles and equipment with approximately 8,600 tons per year of accumulated NOx and 250 tons per year of accumulated PM reductions.

Proposition 1B: Goods Movement Emission Reduction Program

In 2006, California voters approved a bond measure called Proposition 1B. Proposition 1B authorized the Legislature to appropriate $1 billion in bond funding to the CARB to quickly reduce air pollution emissions and health risks from freight movement along California's priority trade corridors. The State Fiscal Year (FY) 2007-08 budget included implementing legislation, via SB 88, that created the Goods Movement Emission Reduction Program. AB 201 included a minor clarification. These bills are codified in the Health and Safety Code, sections 39625 et seq. SB 88 required CARB to adopt Guidelines to ensure the Program achieve the statutory objectives.

The implementing statutes directed CARB to maximize the emission reduction benefits and achieve the earliest possible health risk reduction in communities heavily impacted by goods movement. This program supplements regulatory actions and other incentives to cut diesel emissions. By statute, the program can only fund emission reductions "not otherwise required by law or regulation." Key pollutants targeted by the program include diesel PM and NOx that contribute to the formation of both PM2.5 and ozone. The projects funded under the program also provide co-benefits by reducing greenhouse gases and black carbon emissions that contribute to climate change.

Since 2009, the South Coast AQMD has awarded $486 million through Proposition 1B and funded over 7,500 projects including heavy-duty vehicles and equipment in the sectors of shore power, locomotives, cargo handling, and transport refrigeration units (TRUs), with approximately 7,650 tons per year of accumulated NOx and 230 tons per year of accumulated PM reductions.

Lower-Emission School Bus Program

The Lower-Emission School Bus Program is a grant program that provides funding for replacing old, high-emitting public school buses with new buses, and also for installing retrofit control devices on in-use diesel buses to reduce toxic particulate matter emissions.

The primary goal of the Lower-Emission School Bus Program is to reduce school children's exposure to both cancer-causing and smog-forming pollution. The program does not impose any regulatory requirements on schools and their participation in the program is voluntary.

Historically, the program has been administered by CARB and implemented by local air districts. Most recently, the San Joaquin Valley Air Pollution Control District (SJVAPCD) served as the statewide administrator for the Lower-Emission School Bus Program on behalf of CARB, prioritizing funding for schools in the small and medium air districts.

Since 2001, the South Coast AQMD has awarded $325 million in total through the program, and replaced/retrofitted over 5,200 school buses with approximately 860 tons per year of accumulated NOx and 60 tons per year of accumulated PM reductions achieved.

Volkswagen Environmental Mitigation Trust for California

On October 25, 2016 and May 17, 2017, the United States District Court for the Northern District of California approved Partial Consent Decrees (Consent Decrees) as part of the settlement agreements with

Volkswagen (VW) for their use of illegal defeat devices in certain 2.0-liter and 3.0-liter diesel vehicles. The Consent Decree requires VW pay $2.7 billion, $423 million of which for the State of California, into an Environmental Mitigation Trust to fund projects to reduce NOx emissions caused by the subject vehicles.

The CARB has been designated as lead agency to act on the State's behalf in implementing California's allocation of the VW Environmental Mitigation Trust. As required by the Consent Decree, CARB developed a Beneficiary Mitigation Plan (Plan) through an extensive public process. The Plan describes eligible mitigation actions that can be funded from the State's allocation of the Trust. SB 92, passed in June 2017, directs CARB to strive to ensure that 35 percent of the California's allocation benefit low-income or disadvantaged communities that are disproportionately impacted by air pollution. The approved Plan exceeds that target; at least 50 percent of the total funding is expected to benefit low-income or disadvantaged communities.

The Plan allocates $360 million of California's Trust to statewide funding opportunities in five project categories that are focused mostly on "scrap and replace" projects for the heavy-duty sector, including on-road freight trucks, transit and shuttle buses, school buses, forklifts and port cargo handling equipment, commercial marine vessels, and freight switcher locomotives. The three largest air districts in the State: Bay Area Air Quality Management District, San Joaquin Valley Air Pollution Control District, and South Coast Air Quality Management District serve as statewide administrators for the program. South Coast AQMD administers the Combustion Freight and Marine Projects, and Zero Emission Class 8 Freight and Port Drayage Trucks Projects.

Community Air Protection Program

In 2017, Governor Brown signed AB 617 (C. Garcia, Chapter 136, Statutes of 2017) to develop a new "community-focused" strategy to reduce emissions of criteria pollutants and toxic air contaminants (TAC) in communities that are affected by a high cumulative exposure burden. AB 617 directed CARB, in conjunction with local air districts to establish the Community Air Protection Program (CAPP). AB 617 also calls for CARB and air districts to actively engage with members of heavily impacted communities, follow their guidance, and address local sources of concern. AB 617 includes a variety of strategies to address air quality issues in impacted communities, including community-level monitoring, uniform emission reporting across the State, stronger regulation of pollution sources, and incentives for both mobile and stationary sources.

To support the AB 617 effort, the California Legislature has appropriated incentive funding to support early actions to address localized air pollution in the most impacted communities. Budget bills passed in 2017, 2018, 2019 and 2020 have provided funds, "to support local air districts' implementation of Chapter 136 of the Statutes of 2017" [AB 134 (2017), SB 856 (2018), AB 74 (2019), SB 74 (2020)]. The funding has enabled actions such as: establishing steering committees, developing and implementing emission reduction programs including staffing, outreach, strategies, and enforcement, as well as deploying air monitoring, reporting emissions, and implementing new requirements regarding best available retrofit control technologies.

The Legislature directed that air districts spend the funds appropriated in AB 134 on mobile source projects pursuant to the Carl Moyer Program and the Proposition 1B Program. The Legislature expanded the scope of the CAPP incentives appropriated in SB 856 to include additional project types. The project types called for in SB 856 include:

Mobile source projects. Eligibility continues through either the Moyer Program or the Proposition 1B Program, with a focus on zero emission equipment;
Zero emission charging infrastructure projects. Eligibility continues with a focus on medium- and heavy-duty vehicle infrastructure;
Stationary source projects. New eligibility for the replacement of equipment at locations of stationary sources of air pollution not subject to the Cap-and-Trade Program, which will result in direct reductions of TACs or criteria air pollutants; and
Community-identified projects. New eligibility for programs developed by an air district consistent with the actions identified in the applicable Community Emissions Reduction Program pursuant to AB 617, provided there is community input through a public process.

The CAPP program is now underway and South Coast AQMD staff are working in local communities to reduce air pollution in these most impacted communities. For the first three years of the CAPP program, the South Coast AQMD has awarded $194 million in total for mobile source projects through the Moyer Program and also allocated $48 million for stationary and/or community-identified projects.

Other incentive programs administered by the South Coast AQMD include:

Air Quality Improvement Program (AQIP) funds clean vehicle and equipment projects, research of biofuels production and air quality impacts of alternative fuels, and workforce training, etc. Each year, the Legislature appropriates funding to CARB for these incentives to reduce emissions and support advanced technology demonstrations and deployments;

On-Road Voucher Incentive Program (VIP) provides vouchers for truck replacements. The voucher amount ranges from $10,000 to $60,000 depending on factors such as miles traveled per year, weight class of the old vehicle, emission standards of the replacement vehicle, and whether the replacement vehicle is new or used. Funding also depends on the future compliance date to replace or retrofit the vehicle. The VIP program is funded with the Carl Moyer funds at local air district discretion. This program is limited to owners/operators with fleets of 10 or fewer vehicles that have been operating at least 75 percent (mileage-based) in California during the previous twenty-four (24) months; and

Funding Agricultural Replacement Measures for Emission Reductions Program (FARMER) provides funding for agricultural harvesting equipment, heavy-duty trucks, agricultural pump engines, tractors, and other equipment used in agricultural operations. The FARMER Program is supported in part by California Climate Investments, a statewide program that puts billions of Cap-and-Trade dollars to work. This program prioritizes funding to disadvantaged communities.

Proposed Method of Control

The proposed measure is based on the implementation of incentive programs administered by the South Coast AQMD. -The measure proposes to take credit for the emission reductions achieved through past and future projects that are funded by these programs for SIP purposes. -Examples of projects include heavy-duty vehicle/equipment replacements, installation of retrofit units, and engine repowers. –The emission reductions are provided in two parts. The first part of the measure is the actual emission reductions associated with current projects that will have remaining useful life in 2031 and 2037. The second part of this measure is based on potential reductions that are projected from the implementation of future projects under these incentive programs. These reductions are estimated based on the projected level of funding for the programs and average emission reductions from existing projects, discounted by control factors for future years. For on-road vehicle sectors (HD trucks and school buses), the Calculator for Spending Incentives (CSI), which is an internally developed model to identify at a screening level the most cost-effective projects, is used to calculate NOx emission reductions.

Emission Reductions

Emissions reductions from existing projects with remaining project life and future projects are reflected in the control measure summary tables below. Emissions reductions in 2031 and 2032 associated with projects awarded to-date are provided in Table MOB-11-A and Table MOB-11-B, respectively. Existing projects do not generate emission reductions in 2037 based on their remaining project life. Projected emission reductions from the future projects in 2031, 2032 and 2037 are listed in Table MOB-11-C, Table MOB-11-D and Table MOB-11-E, respectively.

TABLE MOB-11-A

NOx and PM Emission Reductions in 2031 Associated with Existing Project Awards*

Project Sector	Project Type	Funding Source	No. of Units	NOx (tons/day)	PM (tons/day)
Marine	Repower	CM	135	0.22~~51~~	0.00~~2~~
Locomotives	Replacement	CM	15	0.15~~19~~	0.01
TOTAL			150	0.37~~69~~	0.01~~3~~

TABLE MOB-11-B

NOx and PM Emission Reductions in 2032 Associated with Existing Project Awards*

Project Sector	Project Type	Funding Source	No. of Units	NOx (tons/day)	PM (tons/day)
Marine	Repower	CM	115	0.17~~43~~	0.00~~2~~
Locomotives	Replacement	CM	15	0.08~~19~~	0.00~~1~~
TOTAL			130	0.25~~62~~	0.01~~2~~

TABLE MOB-11-C

Projected NOx and PM Emission Reductions in 2031 Associated with Future Funding*

Project Sector	Project Type	Funding Source	No. of Units	NOx (tons/day)	PM (tons/day)
On-Road HD Trucks	Replacement	CM, Prop1B, CAPP, VIP, VW, AQIP	5,703~~9,253~~	1.09~~1.82~~	0.01
School Buses	Replacement	LESBP, VW	1,393~~2,787~~	0.34~~0.62~~	0.00
Agriculture	Replacement	FARMER, CAPP	112~~349~~	0.09~~0.77~~	0.02~~0.05~~
Construction	Repower	CM, CAPP, AQIP	668~~746~~	1.82~~2.69~~	0.06~~0.02~~
Construction	Replacement	CM, CAPP, AQIP	365~~564~~	0.95~~1.77~~	0.02
Other Off-Road and CHE	Replacement	CAPP, VW	460~~118~~	0.78~~0.24~~	0.02~~0.01~~
Marine	Repower	CM, CAPP, VW, AQIP	501~~769~~	1.52~~2.12~~	0.06~~0.07~~
TRU	Replacement	CM, CAPP, AQIP	224~~145~~	0.03~~0.02~~	0.00
Locomotives	Replacement	CM, CAPP, VW, AQIP	54~~37~~	0.61~~0.35~~	0.04~~0.02~~
TOTAL			9,480~~14,768~~	7.22~~10.40~~	0.22~~0.19~~

TABLE MOB-11-D

Projected NOx and PM Emission Reductions in 2032 Associated with Future Funding*

Project Sector	Project Type	Funding Source	No. of Units	NOx (tons/day)	PM (tons/day)
On-Road HD Trucks	Replacement	CM, Prop1B, CAPP, VIP, VW, AQIP	5,703~~9,937~~	1.00~~1.83~~	0.01
School Buses	Replacement	LESBP, VW	1,185~~2,371~~	0.23~~0.44~~	0.00
Agriculture	Replacement	FARMER, CAPP	125~~388~~	0.10~~0.85~~	0.02~~0.05~~
Construction	Repower	CM, CAPP, AQIP	653~~742~~	1.68~~2.57~~	0.06~~0.02~~
Construction	Replacement	CM, CAPP, AQIP	362~~560~~	0.88~~1.68~~	0.02
Other Off-Road and CHE	Replacement	CAPP, VW	448~~108~~	0.69~~0.19~~	0.01
Marine	Repower	CM, CAPP, VW, AQIP	531~~840~~	1.58~~2.26~~	0.05~~0.07~~
TRU	Replacement	CM, CAPP, AQIP	222~~144~~	0.02	0.00
Locomotives	Replacement	CM, CAPP, VW, AQIP	66~~41~~	0.72~~0.36~~	0.04~~0.02~~
TOTAL			9,295~~15,131~~	6.89~~10.20~~	0.22~~0.19~~

TABLE MOB-11-E

Projected NOx and PM Emission Reductions in 2037 Associated with Future Funding*

Project Sector	Project Type	Funding Source	No. of Units	NOx (tons/day)	PM (tons/day)
On-Road HD Trucks	Replacement	CM, Prop1B, CAPP, VIP, VW, AQIP	8,214~~16,083~~	1.34~~2.67~~	0.01
School Buses	Replacement	LESBP, VW	8,032~~8,937~~	0.30~~0.31~~	0.00
Agriculture	Replacement	FARMER, CAPP	125~~388~~	0.08~~0.59~~	0.02~~0.04~~
Construction	Repower	CM, CAPP, AQIP	656~~746~~	1.19~~2.00~~	0.05~~0.02~~
Construction	Replacement	CM, CAPP, AQIP	365~~564~~	0.62~~1.30~~	0.02
Other Off-Road and CHE	Replacement	CAPP, VW	428~~90~~	0.37~~0.05~~	0.00
Marine	Repower	CM, CAPP, VW, AQIP	683~~1199~~	1.83~~2.61~~	0.06~~0.07~~
TRU	Replacement	CM, CAPP, AQIP	224~~145~~	0.01	0.00
Locomotives	Replacement	CM, CAPP, VW, AQIP	125~~57~~	0.99~~0.39~~	0.06~~0.02~~
TOTAL			18,851 ~~28,209~~	6.74~~9.93~~	0.21~~0.17~~

*CM: Carl Moyer Program; CAPP: Community Air Protection Program; VP: Voucher Incentive Program; VW: Volkswagen Environmental Mitigation Trust for California; AQIP: Air Quality Improvement Program; LESBP: Lower-Emission School Bus Program; FARMER: Funding Agricultural Replacement Measures for Emission Reductions Program

Cost Effectiveness

The cost-effectiveness will vary depending on the programs that are used to fund individual projects. Generally, the cost-effectiveness limits will be mainly based on the latest Carl Moyer Program Guidelines, which is currently set at $33,000 per weighted ton (NOx + ROG + 20 x PM) for conventional technology projects. The limit increases to $109,000 per weighted ton for optional advanced technology, and $300,000 per weighted ton for school buses. For on-road projects, higher limits could be applied at the discretion of air districts: up to $200,000 per weighted ton for on-road optional advanced technology (0.02 g/bhp-hr of NOx or cleaner), and up to $500,000 per weighted ton for on-road optional zero emission technology. Based on the projected funding level and project types, the overall average cost-effectiveness for this measure is estimated to be $87,000 per ton of NOx reduced using the Modified Levelized Cash Flow method.

Implementing Agency

South Coast AQMD

References

CARB. Carl Moyer Memorial Air Quality Standards Attainment Program. https://ww2.arb.ca.gov/our-work/programs/carl-moyer-memorial-air-quality-standards-attainment-program/about

CARB. (2017). Carl Moyer Program Guidelines, 2017 Revisions. April 2017. https://ww2.arb.ca.gov/sites/default/files/classic/msprog/moyer/guidelines/2017/2017_cmpgl.pdf

CARB. (2021). Proposed Amendments to the Carl Moyer Memorial Air Quality Standards Attainment Program 2017 Guidelines. November 2021. https://ww2.arb.ca.gov/resources/documents/proposed-updates-carl-moyer-memorial-air-quality-standards-attainment-program

CARB. Proposition 1B: Goods Movement Emission Reduction Program. https://ww2.arb.ca.gov/our-work/programs/proposition-1b-goods-movement-emission-reduction-program

CARB. (2015). Proposition 1B: Goods Movement Emission Reduction Program – Final 2015 Guidelines for Implementation. June 2015. https://ww2.arb.ca.gov/sites/default/files/2020-07/Final%20Prop.%201B%20June%202015%20Guidelines%20ADA%20Version%202020.pdf

CARB. (2020). Community Air Protection Incentives 2019 Guidelines. Revised October 14, 2020. https://ww2.arb.ca.gov/resources/documents/community-air-protection-incentives-guidelines

CARB. Community Air Protection Program. https://ww2.arb.ca.gov/capp/about

CARB. Volkswagen Environmental Mitigation Trust for California. https://ww2.arb.ca.gov/our-work/programs/volkswagen-environmental-mitigation-trust-california/about

CARB. Volkswagen Environmental Mitigation Trust. https://www.californiavwtrust.org/

CARB. (2017). On-Road Voucher Incentive Program Fact Sheet. https://www.arb.ca.gov/msprog/moyer/voucher/vip_factsheet_onroad_7_13_17.pdf?_ga=2.144358834.643713679.1636434848-833871300.1622306158

CARB. Low Carbon Transportation Investments and Air Quality Improvement Program. https://ww2.arb.ca.gov/our-work/programs/low-carbon-transportation-investments-and-air-quality-improvement-program/about

CARB. Lower-Emission School Bus Program. https://ww2.arb.ca.gov/our-work/programs/lower-emission-school-bus-program/about

CARB. FARMER Program. https://ww2.arb.ca.gov/our-work/programs/farmer-program/about

South Coast AQMD. (2021). FARMER Program. https://www.aqmd.gov/docs/default-source/aqmd-forms/moyer/farmer_pps.pdf

MOB-12: PACIFIC RIM INITIATIVE FOR MARITIME EMISSION REDUCTIONS [NOx]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	OCEAN-GOING VESSELS			
CONTROL METHODS:	COORDINATED PROGRAMS, E.G., PER-PORT-CALL INCENTIVES, AMONG PARTICIPATING PORT REGIONS ACROSS THE PACIFIC RIM TO ENCOURAGE DEPLOYMENT OF CLEANER SHIPS TO THE TRANSPACIFIC TRADE LANE			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	**2018**	**2031**	**2032**	**2037**
NOx INVENTORY	32.21	32.84	33.24	30.65
NOx REDUCTION		TBD	TBD	TBD
NOx REMAINING		TBD	TBD	TBD
SUMMER PLANNING	**2018**	**2031**	**2032**	**2037**
NOx INVENTORY	32.21	32.84	33.24	30.65
NOx REDUCTION		TBD	TBD	TBD
NOx REMAINING		TBD	TBD	TBD
CONTROL COST:	TO BE DETERMINED			
INCENTIVE COST:	TO BE DETERMINED			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD AND OTHER DOMESTIC AND INTERNATIONAL PARTNERING AUTHORITIES			

Description of Source Category

An ocean-going vessel (OGV) is a commercial, government, or military vessel, excluding articulated tug barges, meeting any of the following criteria: (1) a vessel greater than or equal to 400 feet in length overall; (2) a vessel greater than or equal to 10,000 gross tons under the convention measurement (international system); or (c) a vessel propelled by a marine compression ignition engine with a per-cylinder displacement of greater than or equal to 30 liters, i.e., Category 3 marine diesel engines. (See California Code of Regulations Section 93130.2.(b)(50).)

Background

The Port of Long Beach and the Port of Los Angeles (jointly referred to as “Ports”) are co-located at the San Pedro Bay, within the South Coast Air Basin. They are the two largest commercial marine ports in North America in terms of cargo container throughput. When combined, the twin ports would rank among the ten largest container ports in the world. In recent years, OGVs of various types make between 3,700-

4,000 port calls each year to the San Pedro Bay Ports Complex, with container ships accounting for slightly over half of these calls (1,900-2,200 annual calls), followed by tanker ships (500-700 annual calls). Correspondingly, based on the most recent emissions inventory reports published by the Ports for calendar year 2020 activities, container ships accounted for 59 percent of total OGV emissions that are directly related to port operations, with 21 percent for tankers, and 20 percent for the remaining vessels.

Shipping emissions have been a major concern for the residents in the port adjacent communities and the surrounding regions, particularly from vessel maneuvering, berthing, and anchoring in and around the harbor area. Additionally, when ships transit to and from the ports, much of the associated emissions occur along the coast and impact the air quality in downwind areas. Since 2014, California Air Resource Board (CARB)'s OGV At Berth Regulation has significantly reduced Nitrogen Oxides (NOx) and other pollutant emissions from auxiliary engines of container, passenger, and refrigerated cargo vessels. Further emission reductions are expected as the amended At Berth Regulation extends to more vessel types and further increases rule stringency. In the meantime, nearshore vessel speed reduction (VSR) programs have proven to be highly effective in reducing vessel fuel consumption, and correspondingly air pollutant emissions. In 2005, the Ports began incentivizing voluntary VSR by all OGVs down to 12 knots, initially within 20 nautical miles (nm) from Point Fermin and later expanded to 40 nm. In recent years, the Protecting Blue Whales and Blue Skies (BWBS) program also began incentivizing VSR by container ships and auto carriers down to 10 knots, which greatly supplements the annual voluntary VSR request issued jointly by the United States Coast Guard and the National Oceanic and Atmospheric Administration for large swaths of Southern California waters.[47]

According to the CARB's projections developed for the 2016 SIP, without additional control programs and regulations, transit emissions allocated to the South Coast Air Basin were expected to increase by more than 60 percent from 2012 to 2031, and most of the projected increase would come from the combustion of marine fuel in the vessel's main (propulsion) engine. Despite the success of abovementioned regulations and programs, NOx emissions from OGVs today and in the future are expected to make up about 40 percent of the entire air basin's carrying capacity for the 2015 ozone standard of 70 ppb.

A major factor is the slow turnover of the OGV fleet to cleaner engine tiers, due to long OGV service life ranging from at least 20 years for vessels serving transoceanic routes to 40 years for vessels serving regional and other shorter routes. As a result, even though the International Maritime Organization (IMO)'s cleanest Tier III NOx engine standards are applicable to OGVs with keels laid in 2016 or later when operating in the North American Emission Control Area (ECA)—which encompasses the entire California OGV emissions inventory domain, only 2 percent of all port visits at the San Pedro Bay Complex were made by Tier III vessels in 2020. In the same year, 34 percent of port calls were made by Tier II vessels, indicating the majority (more than 60 percent) of port calls were made by Tier I or unregulated vessels. Compared to the older engine tiers, Tier III standards are on average 75 percent cleaner than Tier II and

[47] See https://www.ourair.org/wp-content/uploads/2021-Attachment-A-VSR-Zone-Maps.pdf, which shows the BWBS program area in Southern California and is overlaid with the 40-nm radius of the Ports VSR program area.

80 percent cleaner than Tier I when measured by the average NOx emission rates weighted by engine certification load points.[48]

Among the 1,900-2,200 annual calls by container ships at the San Pedro Bay Ports, an estimated two-thirds to three-quarters of these port calls were made by vessels serving the transpacific trade lane. This is not surprising given that the Ports of Long Beach and Los Angeles are the largest U.S. gateway for imports originating from Asia, accounting for about 50 percent of containerized import value from East and Southeast Asia according to international trade data published by the U.S. Department of Commerce.[49] Figure MOB-12-A below plots the tier and age distributions of all vessels that were deployed to the transpacific routes between the Ports and at least one major Asian Pacific port between 2016 and 2019.[50] Consistent with the Ports' emissions inventory reports, it shows: 1) the majority of these vessels are subject to IMO Tier I emission limits or unregulated; 2) the unregulated vessels are slowly being replaced by Tier II vessels; and 3) many newly build ships were constructed on keels laid before 2016, thereby not subject to Tier III standards. In fact, the spikes in keels built (left panel of Figure MOB-12-A) are largely driven by the effective date of each IMO marine engine standard, whereas vessel ages (right panel of Figure MOB-12-A) show a smoother distribution reflecting a steadier trend of natural turnover coupled with market demand.

[48] NOx emissions vary by engine load, and the engine certification test cycles for OGV propulsion engine rely on a weighted average of NOx emission rates at various engine loads: 100 percent (weighting factor: 0.15), 75 percent (weighting factor: 0.15), 50 percent (weighting factor: 0.5), and 25 percent (weighting factor: 0.2). However, a typical container ship calling the San Pedro Bay Ports are estimated to operate at about 10 percent (off-cycle) propulsion engine load if slowing down to 10 knots. NOx emissions at such very low loads are expected to be much higher per unit of energy consumed (measured in g/kWh); meantime, due to less energy consumed when operating at slow speeds, it is generally expected that the increase in NOx emission rates would be more than offset by fuel/energy consumption.

[49] Data accessible at: https://usatrade.census.gov.

[50] Asian Pacific ports included in the analysis are Busan, Cai Mep-Vung Tau, Dalian-Yingkou, Fuzhou, Guangzhou (Nansha) , Haiphong, Hong Kong, Incheon, Kaohsiung, Keelung, Kobe-Osaka, Laem Chabang, Lianyungang, Nagoya-Yokkaichi, Naha, Ningbo-Zhoushan, Port Klang, Qingdao, Shanghai (including Yangshan), Shenzhen (including Chiwan, Dachan Bay, Mawan, Shekou and Yantian) , Shimizu, Singapore, Taipei, Tianjin, Tokyo-Yokohama-Kawasaki, Xiamen-Zhangzhou, and Yosu.

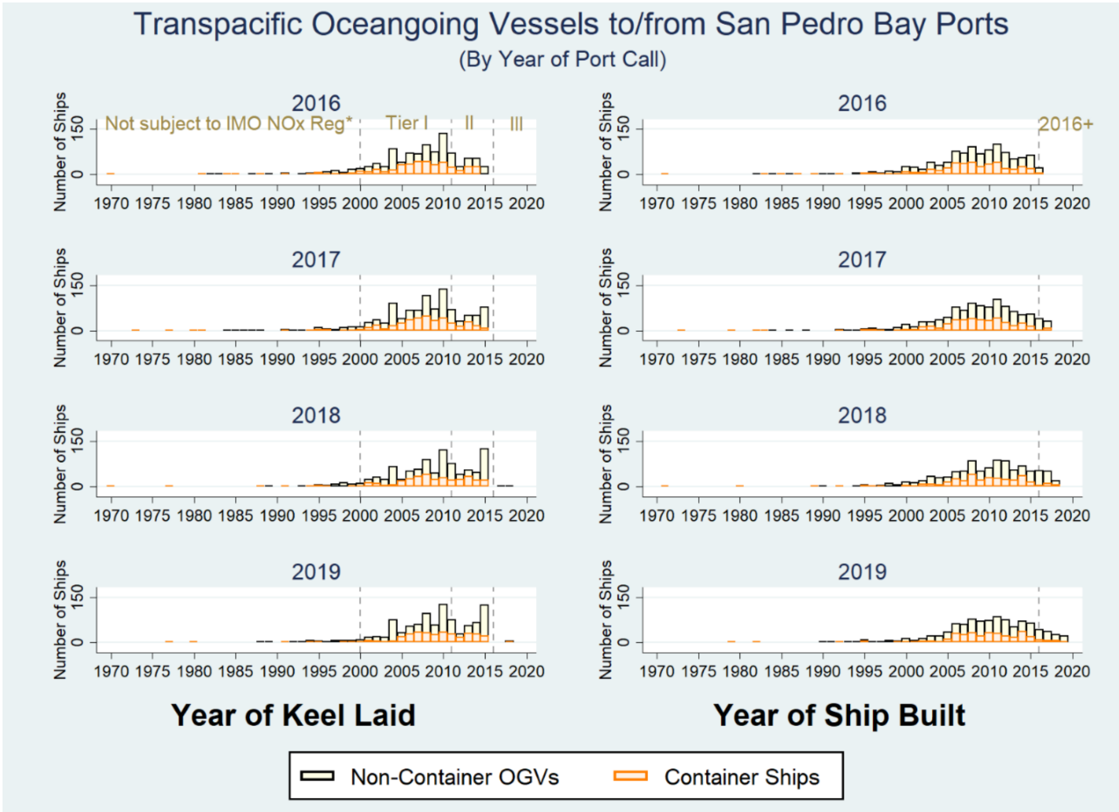

FIGURE MOB-12-A
TRANSPACIFIC OGVS CALLING SAN PEDRO BAY PORTS

In order to achieve emission reductions to attain health-protective federal and state air quality standards as expeditiously as possible, it is necessary to accelerate the deployment of newer vessels meeting IMO Tier III emission limits. But with the long service life of OGVs, a concurrent focus must be placed on retrofitting Tiers I and II OGVs to the extent practicable. However, given the lack of any in-use NOx emission requirements (which typically fall under federal/international authority) and the high project cost and complexity in retrofitting OGVs with the most common Tier III technologies including exhaust gas recirculation (EGR) and selective catalytic reduction (SCR), the most feasible pathway would be to incentivize NOx retrofit with significantly more cost-effective technologies. One potential candidate would be water-in-fuel emulsion (WiF), which has more than a decade of research and development (R&D) history but has remained in the stage of technology demonstration due to the lack of regulation-driven market demand. While WiF cannot achieve Tier III standards, it may result in up to 40 percent NOx reductions for nearshore operations, or when main engine is operated at less than 50 percent loads. In comparison, the effectiveness of Tier III technologies, especially SCR, are expected to exponentially decrease when engine loads become too low to maintain the required exhaust gas temperature for SCR to function properly.

At the same time, any effort to reduce marine engine emissions at California ports could potentially benefit the port and coastal communities located on the other side of the Pacific as well. Based on staff's compilation of multiple reports and studies using data between 2013 and 2018, shipping accounted for significant shares of emissions in many major port cities in Asia. In Hong Kong and the entire country of

Japan, where land-based sources have been subjected to increasingly stringent emissions and energy efficiency requirements, shipping accounted for 41-49 percent of primary PM2.5 emissions alone, not counting secondarily formed particulates, and 37 percent of their NOx emissions are also attributable to both domestic and international shipping. In Shanghai, Shenzhen, Qingdao, Tianjin, and Kaohsiung, shipping was also found to account for 9-24 percent of citywide NOx emissions. Similar to Southern California, shipping's share of NOx emissions is expected to increase further across our trading partners in East and Southeast Asia, due to limited scope and applicability of domestic programs and regulations in reducing OGV NOx emissions when compared to emission reduction efforts for land-based sources, particularly power plants and freight moving trucks.

Figure MOB-12-B shows that container ships accounted for approximately three-quarters of all OGV port calls made in 2016-2019 across the San Pedro Bay Ports, the San Francisco Bay Ports, and all large-scale East and Southeast Asian ports. In contrast, this fleet of container ships made up just over one-third of all OGVs deployed to this trade lane during the same period. Furthermore, container ships constituted nearly all of the "transpacific frequent callers," defined for analytical purposes as those OGVs making a combination of 5 or more calls at the San Pedro Bay ports in a given year and also 5 or more calls in the same year at one or more ports on the other side of the Pacific Rim. On average, a frequent caller container ship made about 50 calls per year across the Pacific Rim ports. In contrast, a non-container OGV made only an average of 7 port calls per year in the same trade lane. In 2019, out of the approximately 120 frequently calling container ships deployed to the transpacific trade lane, more than half of them had visited major Asian ports including the ports of Busan, Shanghai, Ningbo-Zhoushan, Shenzhen, and Hong Kong, and more than a third of them had also called the ports of Tokyo Bay Ports (Keihin Port) and Kaohsiung. This port call pattern implies that many of the Pacific Rim port regions, including Southern California, share the common interest in investing in greener containerized goods movement.

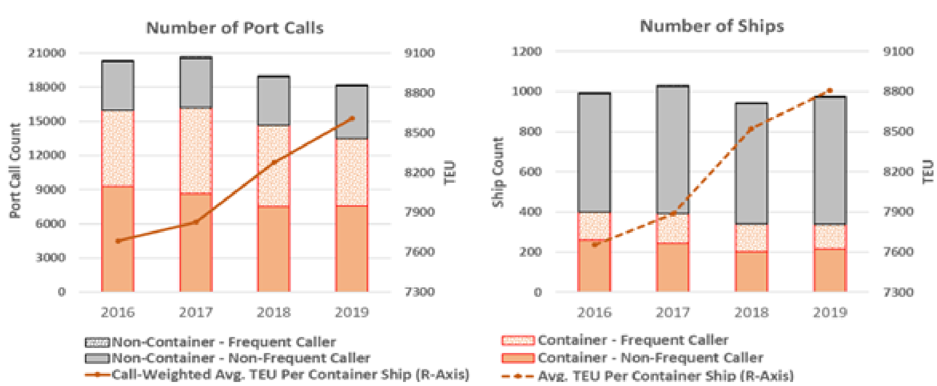

FIGURE MOB-12-B

PORT CALL PATTERN OF TRANSPACIFIC OGVS

With the common need and shared opportunity to reduce shipping emissions and to protect the health of port community residents across the Pacific, this control measure proposes to establish partnerships with other Pacific Rim ports and port regions in developing and implementing the Pacific Rim Initiative for Maritime Emission Reductions (PRIMER). PRIMER is envisioned as a multi-regional framework where all partnering regions can coordinate individual incentives and program requirements in order to maximize the effectiveness of all programs. There are several potential advantages of PRIMER:

Targeted approach. PRIMER partners will be encouraged to continue their existing or adopt new non-regulatory mechanisms to facilitate voluntary adoption of cleaner marine technologies by OGV owners and operators. The mechanism can be either monetary or non-monetary incentives that will be awarded based on each port visit, and the program participating requirements will be coordinated to the maximal extent feasible to ensure a participating OGV can take full advantage of the incentive offered by any PRIMER partner. Such per-port-call incentive will be most attractive to the OGVs frequently calling the partnering Pacific Rim ports, with minimal impact on the other OGVs whose owners/operators do not find a business case in undertaking the clean technology investment to qualify for the incentives.

Suitable for both new and in-service OGVs. Unlike the engine emission standards that are generally applicable to newbuilds only, the non-regulatory incentives can encourage retrofit investments among the in-service OGVs deployed to the transpacific shipping routes while also motivating the deployment of cleaner new OGVs to these routes.

Cost-effective for incentive providers. Investing in cleaner marine technology is no small feat, especially for the vessel-based emission abatement technologies. The required upfront capital investment tends to be very high while the payback period sought by the industry is short. The short payback period is further complicated by the industry's need to maintain enough flexibility in vessel deployment, which is the case for both liner and tramp services alike. By coordinating clean shipping incentives with other Pacific Rim ports on a targeted group of frequently calling OGVs, each PRIMER partner will be able to reduce the level of incentive needed by each individual port to effectively attract visits by cleaner OGVs, and the collective efforts will also shorten the payback period for the ship owner/operator who has made the technology investment.

Minimized free riding. Most emission abatement technologies, specifically for NOx reductions, are auxiliary devices that can be switched on and off. While this means that reporting requirements by participating OGV operators will be necessary for the PRIMER partnering port regions to verify emission reductions realized at each port visit, it also means that concerns of potential free riding by non-partnering ports will be possibly minimized if there is no incentive for those OGVs equipped with emission abatement technology to switch to lower-emitting operating mode.

Additionally, PRIMER can also serve as a platform for information exchange and experience sharing among partnering ports. In light of the IMO decarbonization targets and the corresponding global efforts to identify low- and zero-carbon solutions, NOx abatement technologies are expected to remain highly relevant in the deep-sea-going sector. This is because, without significant technology breakthrough, internal combustion engines fueled by low-carbon biofuel blends or zero-carbon alternatives such as ammonia, hydrogen, and methanol, are commonly acknowledged as the most feasible propulsion technologies to achieve decarbonization goals among those ships serving the transoceanic routes. However, the combustion process will inevitably produce NOx, so the installation of pretreatment (e.g., WiF and EGR) or aftertreatment (e.g., SCR) system may be still necessary pursuant to the IMO Tier III requirements for any dual- or multi-fuel vessels. Given that NOx control will likely remain highly relevant in the future, incentivizing investments in optimizing NOx abatement nearshore will not only help address the disproportionate air quality impacts on port regions from the in-service fleet, but also from the future low- and zero-carbon OGVs.

Finally, PRIMER can complement and work in conjunction with the Clydebank Declaration for Green Shipping Corridors, which is a multi-nation initiative announced at the 26th United Nations Climate Change Conference of the Parties (COP 26) at the end 2021. The Clydebank Declaration aims to promote zero-carbon emission maritime routes between 2 or more ports, with the goal of establishing at least 6 such routes/corridors by 2025. The U.S., being one of the signatories, is anticipated to either work towards decarbonizing one or more domestic shipping routes, or work with other current and prospective signatories in establishing international green shipping corridors. Given the outsized importance and cargo throughput of the San Pedro Ports among all U.S. ports, it would be of utmost priority for the U.S. to work with our Asian Pacific trade partners to explore such partnerships to achieve both climate and air quality objectives.

Regulatory History

IMO Emissions and Fuel Standards. The IMO's International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI, which came into force in May 2005, set new international NOx emission limits in Regulation 13 on marine diesel engines installed on new vessels retroactive to the year 2000. The NOx limits are applicable to diesel engines of over 130 kW output power (other than those used solely for emergency purposes) irrespective of the tonnage of the ship where such engines are installed. In October 2008, the IMO adopted an amendment which places a global limit on marine fuel sulfur content of 0.1 percent by 2015 for specific ECAs including the North American ECA, which extends 200 nm from the U.S. coast. The Basin off-coast waters are included in the ECA and ships calling at the Ports have to meet this new fuel standard. In addition, the 2008 IMO amendment required new ships built after January 1, 2016 that enter an ECA to meet a Tier III NOx emission standards which are 80 percent lower than the Tier I emission standards and 75 percent lower than Tier II standards. In 2018, IMO adopted an initial strategy to reduce GHG emissions from the global ship fleet. Compared to the 2008 levels, the strategy set a reduction target of 40 percent by 2030 for carbon intensity and a reduction target of at least 50 percent by 2050 for total annual GHG emissions from international shipping. Several programs have been adopted in recent years as short-term measures to attain the decarbonization targets, including the energy efficiency design index (EEDI) for newbuilt ships, the efficiency existing ship index (EEXI) for in-service ships, and the carbon intensity indicator (CII). Collectively, by reducing fuel consumption, these measures may indirectly lower NOx emissions albeit to a limited extent.

U.S. EPA Marine Vessel Regulations. In 2010, the U.S. Environmental Protection Agency (U.S. EPA) adopted standards that apply to C3 engines installed on U.S. vessels and to marine diesel fuels produced and distributed in the United States. That rule added two new tiers of engine standards for C3 engines consistent with the IMO standards described above. It also includes a regulatory program to implement IMO MARPOL Annex VI in the United States, including engine and fuel sulfur limits, and extends the ECA engine and fuel requirements to U.S. internal waters (i.e., rivers, lakes, etc.). U.S. is a member of IMO and provided input to the fuel sulfur and NOx emission standards adopted by IMO and works within international organizations to establish global engine and fuel standards. The U.S. delegation to the IMO is generally led by the State Department, with Coast Guard, the U.S. EPA, and other relevant agencies provide any necessary support and technical advice.

CARB Regulation for Fuel Sulfur and Other Operational Requirements. Beginning in 2009, CARB began implementing the State's fuel sulfur regulation, applicable to both domestic and foreign flagged vessels, in waters out to 24 nm of the California baseline (i.e., Regulated California Waters or RCW). The rule initially limited sulfur content in marine gas oil (MGO) to 1.5 percent sulfur by weight and in marine diesel fuel (MDO) to 0.5 percent sulfur by weight. Beginning in January 1, 2012, all OGVs when operating in the RCW must switch to either type of distillate grade fuel with at maximum 0.1 percent sulfur content in weight, and unlike the IMO sulfur oxides (SOx) ECA requirements, the use of SOx scrubber is not permitted as an alternative compliance method.

CARB OGV At Berth Regulation. Adopted in 2007, the original At Berth regulation was designed to reduce NOx and PM emissions from the operation of auxiliary engines on container vessels, passenger vessels, and refrigerated cargo vessels while these vessels are docked at berth at a California port. As such, starting from 2014, 50 percent of a regulated fleet's visits to the Ports were required to plug into shore power (also known as alternative maritime power (AMP) or cold ironing), or use other compliance options to achieve equivalent emission reductions. The percentage of fleet-based requirement would increase to 80 percent in 2020. In 2020, several amendments were adopted which, from 2023, would require rule compliance at each and every vessel visit by container vessels, passenger vessels, and refrigerated cargo vessels; from 2025, by roll-on and roll-off vessels, as well as tanker vessels visiting the ports of Los Angeles and Long Beach; and from 2027, all remaining tanker vessels.

Proposed Method of Control

This measure seeks to supplement the implementation of the State SIP (State Implementation Plan) Strategy "Federal Action: Cleaner Fuel and Vessel Requirements for Ocean-Going Vessels." It is not expected for this measure to achieve the full emission reductions associated with this specific SIP measure, but rather, this measure seeks to recognize OGV emission reductions that are the result of voluntary actions and may be considered surplus to the emission reduction commitments of the State SIP Strategy (see Appendix IV-B for details). Vessel owner/operator would register their vessels with verified emission reductions from the IMO Tier II emission limits and would be eligible for port-specific incentives for every port call made by a registered vessel at a port covered by program(s) administered by one of the PRIMER partners.

Emission Reductions

The amount of emission reductions that can be achieved from this control measure will be dependent on the type of OGVs and number of port calls affected by the measure and the actions or strategies identified through the public process. Any emission reductions that can be quantified and considered surplus to the region's overall emission reduction targets will be attributed towards the emission reduction commitment associated with the SIP Measure "Federal Action: Cleaner Fuel and Vessel Requirements for Ocean-Going Vessels" and could be recognized in the SIP as part of the Rate-of-Progress reporting or in future AQMP revisions as long as the reductions meet the U.S. EPA determination that such reductions are approvable as part of the SIP.

Rule Compliance and Test Methods

The proposed measure is an incentive program, and therefore, rule compliance is not applicable. However, program participation would require pre-registration by vessel owner/operator, and emission reductions will be verified through submittal and review of records, reports, and emission inventories. Approved emission quantification protocols by federal, State or local agencies will be used to track and report emission reductions for SIP purposes.

Cost Effectiveness

The cost-effectiveness of this measure will be based on cost of commercialized technologies, frequency of ports calls, the number of PRIMER partnering ports and the collective incentive amounts.

Implementing Agency

The South Coast AQMD, along with other domestic and international partners, will collectively be the implementing agencies for port-specific incentive programs designed to encourage frequently calling OGVs to adopt cleaner and low NOx marine engine technologies.

References

California Air Resource Board. (2018). *CEPAM: 2016 SIP - Standard Emission Tool*. https://www.arb.ca.gov/app/emsinv/fcemssumcat/fcemssumcat2016.php

Chatani, S., Shimadera, H., Itahashi, S., Yamaji, K. (2020). Comprehensive analyses of source sensitivities and apportionments of PM2.5 and ozone over Japan via multiple numerical techniques. *Atmospheric Chemistry and Physics*, 20, 10311–10329. https://doi.org/10.5194/acp-20-10311-2020

Chen, D., Zhao, Y., Nelson, P., Li, Y., Wang, X., Zhou, Y., Lang, J., Guo X. (2016). Estimating ship emissions based on AIS data for port of Tianjin, China. *Atmospheric Environment*, 145, 10-18. http://dx.doi.org/10.1016/j.atmosenv.2016.08.086

Chen, D., Wang, X., Nelson, P., Li, Y., Zhao, N., Zhao, Y., Lang, J., Zhou, Y., Guo, X. (2017). Ship emission inventory and its impact on the PM2.5 air pollution in Qingdao Port, North China. *Atmospheric Environment*, 166, 351-361. http://dx.doi.org/10.1016/j.atmosenv.2017.07.021

Chen, D., Tian, X., Lang, J., Zhou, Y., Guo, X., Wang, W., Liu, B. (2019). The impact of ship emissions on PM2.5 and the deposition of ROG

and sulfur in Yangtze River Delta, China. *Science of the Total Environment*, 649, 1609-1619. https://doi.org/10.1016/j.scitotenv.2018.08.313

Eco-Mo Foundation. (2020). *Transport and Environment in Japan 2020*. http://www.ecomo.or.jp/english/pdf/tej2020.pdf

Feng, J., Zhang, Y., Li, S., Mao, J., Patton, A.P., Zhou, Y., Ma, W., Liu, C., Kan, H., Huang, C., An, J., Li, L., Shen, Y., Fu, Q., Wang, X., Liu, J., Wang, S., Ding, D., Cheng, J., Ge, W., Zhu, H., Walker, K. (2019). The influence of spatiality on shipping emissions, air quality and potential human exposure in the Yangtze River Delta/Shanghai, China. *Atmospheric Chemistry and Physics,* 19, 6167-6183. https://doi.org/10.5194/acp-19-6167-2019

Fu, Q. (2015). *Status and control strategies on shipping emission in Shanghai port*. Presentation at the 4th Pacific Ports Clean Air Collaborative Conference, October 27. Shanghai. http://www.ppcac.org/images/fupres2015.pdf

Journal of Commerce (JOC). (2020). *JOC Global Port Rankings: Asian ports grew fastest in 2019*. August 18. https://www.joc.com/port-news/joc-global-port-rankings-asian-ports-grew-fastest-2019_20200818.html

Liang, Y., et al. (2016). *Estimation of vessels air pollution emissions in Shenzhen port*. https://ste.cnki.net/kcms/detail/detail.aspx?filename=YNHK201602006&dbcode=CEIJ&dbname=CEITLKCJFDLAST2016&v=

Liu, H., Fu, M., Jin, X., Shang, Y., Shindell, D. (2016). Health and climate impacts of ocean-going vessels in East Asia. *Nature Climate Change*, 6, 1037-1041. https://doi.org/10.1038/nclimate3083

Hong Kong Environmental Protection Department. (2020). *Hong Kong Air Pollutant Emission Inventory*. https://www.epd.gov.hk/epd/english/environmentinhk/air/data/emission_inve.html

Ministry of Environment of Japan. (2019). *"平成30年度PM2.5インベントリ及び発生源プロファイル策定委託業務" (2018 PM2.5 inventory and source profile formulation consignment work,* in Japanese).

Ng, S.K.W., Lin, C., Chan, J.W.M., Yip, A.C.K., Lau, A.K.H., Fung, J.C.H.. (2012). *Study on Marine Vessels Emission Inventory – Final Report submitted to the Environmental Protection Department of HKSAR*. https://www.epd.gov.hk/epd/sites/default/files/epd/english/environmentinhk/air/studyrpts/files/EPD_MVEIS_Final_Report_v7_approved_120528.pdf

Starcrest Consulting Group (Starcrest). (2017). *San Pedro Bay Ports Clean Air Action Plan 2017 – Bay Wide Ocean-Going Vessel International Maritime Organization Tier Forecast 2015-2050*. https://kentico.portoflosangeles.org/getmedia/a23bdf8e-7df2-42f5-873f-803c36be8a57/CAAP_Vessel_Tier_Forecasts_2015-2050-Final

Starcrest. (2021a). *Port of Los Angeles Inventory of Air Emissions – 2020*. https://kentico.portoflosangeles.org/getmedia/7cb78c76-3c7b-4b8f-8040-b662f4a992b1/2020_Air_Emissions_Inventory

Starcrest. (2021b). *Port of Long Beach Air Emissions Inventory – 2020*. https://polb.com/download/14/emissions-inventory/12958/2020-air-emissions-inventory.pdf

Shon, Z.-H. (2015). Emissions of Ozone Precursors from a Biogenic Source and Port-related Sources in the Largest Port City of Busan, Korea. *Asian Journal of Atmospheric Environment, 9*(1), 39-47. https://doi.org/10.5572/ajae.2015.9.1.039

Song, S.-K., Shon, Z.-H., Kim, Y.-K., Kang, Y.-H., Oh, I.-B., Jung, C.-H.. (2010). Influence of Ship Emissions on Ozone Concentrations around Coastal Areas during Summer Season. *Atmospheric Environment, 44*(5), 713-723. https://doi.org/10.1016/j.atmosenv.2009.11.010

South Coast Air Quality Management District. (2017). *Final 2016 Air Quality Management Plan*. https://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2016-air-quality-management-plan/final-2016-aqmp/final2016aqmp.pdf

Taiwan Environmental Protection Administration. (2017). *Taiwan Emission Data System*. https://air.epa.gov.tw/EnvTopics/AirQuality_6.aspx

Tian, J. (2019, January 21). 我国三大船舶排放控制区的大气污染物排放量下降明显 (Air Pollutants Have Substantially Reduced in China's Three Domestic Emission Control Areas, in Chinese). *Xinhua News Agency*. http://www.xinhuanet.com/politics/2019-01/21/c_1124018769.htm

United Kingdom Department of Transport. (2022). *COP 26: Clydebank Declaration for green shipping corridors*. https://www.gov.uk/government/publications/cop-26-clydebank-declaration-for-green-shipping-corridors/cop-26-clydebank-declaration-for-green-shipping-corridors

United Nations Conference on Trade and Development (UNCTAD). (2019). *Review of Maritime Transport 2019*. https://unctad.org/webflyer/review-maritime-transport-2019

UNCTAD. (2020). *Review of Maritime Transport 2020*. https://unctad.org/webflyer/review-maritime-transport-2020

United States Census Bureau. *USA Trade® Online*. https://usatrade.census.gov/

MOB-13: FUGITIVE VOC EMISSIONS FROM TANKER VESSELS [VOCs]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	OCEAN-GOING PETROLEUM TANKER VESSELS DURING MARINE TRANSIT			
CONTROL METHODS:	TO BE DEVELOPED			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
POLLUTANT INVENTORY	7.8	8.1	8.1	8.2
POLLUTANT REDUCTION		TBD	TBD	TBD
POLLUTANT REMAINING		TBD	TBD	TBD
SUMMER PLANNING	2018	2031	2032	2037
POLLUTANT INVENTORY	TBD	TBD	TBD	TBD
POLLUTANT REDUCTION		TBD	TBD	TBD
POLLUTANT REMAINING		TBD	TBD	TBD
CONTROL COST:	TBD			
INCENTIVE COST:	N/A			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

Description of Source Category

Ocean-going petroleum tankers and barges transport approximately 400 million barrels per year of crude oil, refined petroleum products and unfinished petroleum products through the Ports of Los Angeles and Long Beach. These tanker vessels spend, on average, 3 days at anchorage in the San Pedro Bay. While these vessels are at anchorage, temperature variations from day to night and other operational factors can cause pressure fluctuations in the vessels' cargo storage tanks. Each vessel is equipped with multiple pressure/vacuum regulating valves (P/V valves) to ensure that the cargo tanks stay within safe operating limits. Vessels that transport volatile products such as crude oil and gasoline are most susceptible to pressure increases. These vessels must vent to the atmosphere to control cargo tank pressure and these venting events can result in the release of several tons of VOCs in a 15-to-30-minute period.

In addition to venting events, vessel inspections have identified numerous instances of leaking pressure /vacuum (P/V) valves even when the cargo tank pressures are within the normal operating range. These leaks have been attributed to maintenance issues or improper sealing of the valves due to fouling from previous venting events.

The goal of this measure is to better quantify VOC emissions of petroleum tankers in transit and at anchorage, and also to develop control strategies and best management practices to control these VOC emissions.

Background

For over 20 years, the coastal communities of Long Beach and Seal Beach have experienced brief, intense odor events. Data collected by the South Coast AQMD shows that the frequency of events and the number of complaints increased in 2016 and 2017. Coastal communities further south of Seal Beach and Long Beach, such as Huntington Beach, also began reporting hydrogen sulfide odor events from an unknown offshore source. Complainants described the odors as "rotten egg," "natural gas," "sulfur," or "petroleum" type odors. Investigation of these events was difficult because they were usually brief with as many as one hundred complaints in one hour. As a result, staff began investigating all potential on and offshore sources, including offshore oil platforms, on and offshore oil production facilities, and ocean-going petroleum tankers.

In 2017, a team of South Coast AQMD inspectors observed a large plume of VOCs being vented from a petroleum tanker using an Optical Gas Imaging (OGI) camera. Immediately following this observation, staff increased surveillance efforts of petroleum tankers. Multiple venting events were observed, and these were shown to coincide with coastal odor events. The South Coast AQMD also sent data requests to all vessel operators who were observed to be venting and to other vessels that were observed to be in the vicinity of coastal odor events. In addition, the Office of Compliance and Enforcement (OCE) subscribed to "MarineTraffic.com," a website, to track marine vessels from point of origin to destination. "Marinetraffic.com" assisted staff to better track oil tankers suspected of transporting high sulfur crudes from middle eastern ports into "South Coast Waters."

The OCE also collaborated with the California State Lands Commission which boards and inspects vessels berthing in Marne Terminals. In many cases, the vessels confirmed VOC releases and provided calculations showing that several tons of VOCs were released in a short period of time. The OCE then launched a marine tanker surveillance program which includes daily coastal imaging surveys with OGI cameras of marine tankers visible from various beach front observation points as far south as Huntington Beach north to Long Beach, and up to Manhattan and Playa Del Rey.

Increased surveillance, on-board inspections and enforcement actions have raised awareness of the problem to the maritime industry, and more specifically to oil companies which were purchasing the oil. As a result, there has been a reduction in the number of major coastal odor events since 2017. However, staff still observe hydrocarbons being vented during surveillance routes and continue to identify leaks from P/V valves on oil tankers during vessel inspections. Occasionally, vessels will self-report venting events that would have otherwise not been detected.

South Coast AQMD staff also estimated VOC emissions from petroleum tankers in transit and at anchorage in the San Pedro Bay. The VOC emissions were calculated to be 7.8 tons per day and most of these emissions were attributed to crude oil and gasoline at 88 percent and 8 percent respectively. Emission factors in "EPA AP-42 - Compilation of Air Emissions Factors" were used for the calculations and the transport throughputs were provided by the California State Lands Commission for the Los Angeles and Long Beach Harbors.

Regulatory History

The South Coast AQMD Rule 1142 – Marine Tank Vessel Operations was adopted in 1991. The primary focus of this rule is to control VOC emissions during vessel loading. Although Rule 1142 has a general provision on proper maintenance of vessels to be free of liquid and gaseous leaks, the rule does not have specific requirements for venting events that occur in transit or at anchorage. Furthermore, Rule 1142 does not include any monitoring or inspection requirements while the vessels are in transit or anchored within "South Coast Waters."

Since 1991, the volume of crude oil imported via ocean going tankers through the Los Angeles and Long Beach Harbors has increased. In addition, refineries are better equipped to process less expensive high sulfur crudes resulting in higher sulfur and hydrogen sulfide (H_2S) concentrations in imported crude oil. Furthermore, larger oil tankers are being used to transport crudes over longer voyages. Larger vessels anchor farther south in deeper water. These operational changes may explain why coastal odor events increased and extended farther south. The higher sulfur crude oils contain higher concentrations of hydrogen sulfide in the gases which are released into the atmosphere from P/V valves when venting. The vented gases are carried on shore by prevailing wind conditions into shoreline communities resulting in many nuisance odor complaints.

Amendments to Rule 1142 may be needed to address on-going operational venting events, venting or leaks from faulty pressure relief valves, and the impact of operational changes as described above.

Proposed Method of Control

This measure seeks to amend Rule 1142 or develop a new rule, if necessary, to address and control fugitive VOC emissions from petroleum tanker vessels during transit and at-anchorage in South Coast Waters. South Coast AQMD staff plans to establish a working group, as part of the rule development process, which will consist of industry representatives, P/V valve manufacturers, environmental/community organizations and other stakeholders. The working group will be open to the public and will work together on the development of control strategies and best management practices to control fugitive VOC emissions from petroleum tanker vessels. During rule development, staff will consider technical feasibility, identify industry-specific affordability issues, cost-effectiveness and incremental cost-effectiveness, and may consider alternative compliance mechanisms.

Emission Reductions

VOC emission reductions are not estimated at this time as it will depend on various factors including P/V valve technologies, type and frequency of monitoring, inspection and reporting requirements as well as improved maintenance and operating practices to be implemented. Also, collection of more comprehensive data on the frequency and duration of venting events, the cargo volume and product type on venting vessels as well as the duration of transit and at anchorage within "South Coast Waters" will help us to more accurately calculate the amount of VOC emissions vented.

Rule Compliance and Test Methods

Traditional measurement of gaseous leaks has been based on U.S. EPA Method 21. Largely due to portable handheld Toxic Vapor Analyzers complying with U.S. EPA Method 21 and are commercially available and able to detect hydrocarbon emissions as low as 1 ppm to 100,000 plus ppm. Consideration should be also given to -the use of optical gas imaging (OGI) cameras to demonstrate compliance. OCE has successfully identified fugitive hydrocarbon emissions using a combination of portable hydrocarbon analyzers and OGI cameras. All vessels have portable monitors on board, however, most do not have portable toxic vapor analyzers or OGI cameras and the associated calibration equipment needed to perform accurate measurements.

Cost Effectiveness

TBD.

Implementing Agency

The South Coast AQMD would implement any rule it adopts, however other agencies may also have a role, such as CARB, the U.S. EPA, the U.S. Coast Guard, etc.

References

US Environmental Protection Agency "EPA AP-42 – Compilation of Air Emissions Factors https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors

South Coast AQMD Rule 1142 – Marine Tank Vessel Operations

http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1142.pdf?sfvrsn=4

Overview of California Ocean and Coastal Laws With Reference to the Marine Environment http://www.opc.ca.gov/webmaster/ftp/pdf/docs/Documents_Page/Noteworthy/Overview_Ocean_Coastal_Laws.pdf

CARB - Appendix B ARB's Legal Authority (2005) https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2008/fuelogv08/appbfuel.pdf

CARB - Proposed Measure for Auxiliary diesel engines operated on ocean-going ships in California Coastal Waters (2004) https://ww3.arb.ca.gov/ports/marinevess/meetings/111004/draftregconcepts.pdf

MEPC.1/CIRC 680 – Technical Information on Systems and Operation to Assist Development of VOC Management Plans, 27-July-2009https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/Circ-680.pdf

MEPC.185(59) - Guidelines for the Development of a VOC Management Plan, 17-July-2009

https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/185(59).pdf

MOB-14: RULE 2202 – ON-ROAD MOTOR VEHICLE MITIGATION OPTIONS [VOCs, NOx, CO]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	MOBILE SOURCES			
CONTROL METHODS:	STREAMLINE VARIOUS RIDESHARE STRATEGIES AND TELECOMMUTING OPTIONS			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
VOC INVENTORY	49.93	24.24	23.27	19.41
VOC REDUCTION		TBD	TBD	TBD
VOC REMAINING		TBD	TBD	TBD
NOx INVENTORY	44.58	14.31	13.82	12.34
NOx REDUCTION		TBD	TBD	TBD
NOx REMAINING		TBD	TBD	TBD
CO INVENTORY	488.25	245.96	241.69	226.14
CO REDUCTION		TBD	TBD	TBD
CO REMAINING		TBD	TBD	TBD
SUMMER PLANNING	2018	2031	2032	2037
VOC INVENTORY	51.94	25.20	24.23	20.10
VOC REDUCTION		TBD	TBD	TBD
VOC REMAINING		TBD	TBD	TBD
NOx INVENTORY	39.90	12.94	12.49	11.18
NOx REDUCTION		TBD	TBD	TBD
NOx REMAINING		TBD	TBD	TBD
CO INVENTORY	515.04	253.74	249.23	232.88
CO REDUCTION		TBD	TBD	TBD
CO REMAINING		TBD	TBD	TBD
CONTROL COST:	TBD			
INCENTIVE COST:	TBD			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

Description of Source Category

Rule 2202 has been designed to reduce emissions from mobile sources. Specifically, larger employers in the region with more than 250 employees are required to mitigate employee commute trips into the worksite. Rule 2202 is designed to reduce emissions of Volatile Organic Compounds (VOCs), Oxides of Nitrogen (NOx), and Carbon Monoxide (CO), by an equal or greater amount to that achievable through trip reduction. Rule 2202 provides employers with a menu of options to select from to implement a combination of emission reduction strategies in order to meet the emission reduction target (ERT) for their worksite. The types of vehicles included in Rule 2202 emission calculations are passenger vehicles and light-duty vehicles (LT1 and LT2).

Background

There are three main compliance options for Rule 2202, with varying levels of complexity:

Air Quality Investment Program (AQIP)

Employers may participate in the AQIP by submitting an air quality investment, to be placed in a restricted fund as set forth in Rule 311 - Air Quality Investment Program Fees. These funds are then used for air quality improvement projects that will achieve the emission reduction targets for a given compliance period. Some examples of projects that have been funded using AQIP funds are diesel-powered street sweeper fleet replacement projects with compressed natural gas (CNG) sweepers, heavy-duty truck engine replacement projects, various port-related clean air projects, gasoline-powered lawn and garden equipment replacement with electric-powered equipment.

Emission Reduction Strategies (ERS)

Emission Reduction Credits (ERCs) may be used to meet an employer's emission reduction target. These credits are purchased by the regulated employer from a third-party credit vendor/broker. These credits are then transferred to the South Coast AQMD and taken out of circulation. ERCs that were approved for transfer into the program before June 6, 2014 and were issued in accordance with Regulation XIII may be used to meet an employer's emission reduction target. These ERCs have been primarily generated through facility shutdowns and equipment replacement projects. Mobile source emission reduction credits (MSERCs) issued in accordance with the provisions of Regulation XVI - Mobile Source Offset Programs may also be used. These credits have been primarily generated through old vehicle scrapping services.

Employee Commute Reduction Program (ECRP)

As an alternative to meeting an ERT, Rule 2202 also allows employers the option to implement an ECRP that meets the rule exemption requirements. The implementation of an ECRP is expected to lead to achievement and maintenance of the employer's designated average vehicle ridership (AVR) target, determined by the worksite's AVR Performance Zone pursuant to Rule 2202(l)(3), through the reduction of work-related vehicle trips. As part of the ECRP, employers must choose 15 commute reduction strategies to implement at their worksite from a larger menu of strategies. These strategies can be developed and implemented to meet the individual needs of employers in achieving the designated AVR target.

Regulatory History

Rule 2202 has been amended several times and replaced Rules 1501 - Work Trip Reduction Plans and 1501.1 - Alternatives to Work Trip Reduction Plans. In 1987, Regulation XV was adopted which required trip reduction plans for employers with 100 or more employees. Rule 1501 was amended in 1993 and Rule 1501.1 was adopted in 1995 to comply with federal and state requirements for "extreme" nonattainment areas. In 1995, Rule 2202 was adopted to respond to state legislation prohibiting mandatory trip reduction plans. Subsequently, Rule 2202 provided worksites of 100 or more employees a menu of emission reduction options to meet an emission reduction target for their worksite. The passage of SB 836 in 1996 directed the South Coast AQMD to raise the employee threshold level from 100 to 250 employees, while SB 432 permanently exempted worksites with fewer than 250 employees from complying with the rule. Rule 2202 continues to allow affected employers the option of implementing a traditional trip reduction program as a means to comply with the rule.

Proposed Method of Control

Telecommuting

Rule 2202 currently provides credit for telecommuting under the ECRP compliance option, by providing worksites with a telecommuting option under the menu of Direct Strategies. As defined, telecommuting is characterized as working at home, off-site, or from a telecommuting center for a full workday that eliminates the trip into the worksite or reduces travel distance to the worksite by greater than 50 percent. Other information obtained from Rule 2202 compliance forms include questions such as whether a written telecommuting policy exists, how many days per week employees are allowed to telecommute, and if an orientation/training program exists.

During the COVID-19 pandemic in 2020 and 2021, many Rule 2202 regulated employers (where applicable) have incorporated telecommuting practices which have shown to be a very effective way of eliminating emissions caused by employee commute trips into the worksite. Many employers have reported extremely high AVR scores, primarily due to the increased amount of telecommuting, over the 2020/2021 reporting period. Additionally, some employers have anecdotally also shared that employee productivity and workflow have not decreased during this increased period of telecommuting.

While Rule 2202 does currently provide credit for telecommuting, future rule amendments may include a larger focus on telecommuting strategies and provide additional incentives for regulated employers to adopt telecommuting policies. Through evidence provided during the time of the COVID-19 pandemic, telecommuting has shown to be an extremely effective measure for reducing employee-related transportation emissions. Other future rule amendments may include enhancements on current basic support and direct strategies, as well as streamlined compliance and reporting options. Options for inclusion of Rule 2202 for State Implementation Plan (SIP) creditability will also be explored.

Emission Reductions

The following emission reductions were achieved by Rule 2202 activities for year 2018:

TABLE MOB-14-A

Rule 2202 Emission Reductions for 2018

Program Type	VOC tons/day	NOx tons/day	CO tons/day
Employee Commute Reduction Program (including Offset)	0.47	0.35	3.97
Air Quality Investment Program	0.55	0.15	3.16
Emission Reduction Strategies	0.96	0.55	6.14
Total Achieved	1.98	1.05	13.27
Target	1.46	0.93	10.39

Rule Compliance and Test Methods

TBD

Cost Effectiveness

TBD

Implementing Agency

South Coast Air Quality Management District

References

South Coast Air Quality Management District. (2014). Rule 2202 – On-Road Motor Vehicle Mitigation Options (Amended June 6, 2014). http://www.aqmd.gov/docs/default-source/rule-book/reg-xxii/rule-2202.pdf

South Coast Air Quality Management District. (2016). Employee Commute Reduction Program Guidelines. http://www.aqmd.gov/docs/default-source/rule-book/support-documents/rule-2202/rule-2202-employee-commute-reduction-program-guidelines-(ecrp).pdf

South Coast Air Quality Management District. (2014). Rule 2202 – On-Road Motor Vehicle Mitigation Options Implementation Guidelines. http://www.aqmd.gov/docs/default-source/rule-book/support-documents/rule-2202/rule-2202-implementation-guidelines.pdf

South Coast Air Quality Management District. (2019). Rule 2202 – On-Road Motor Vehicle Mitigation Options Emission Factor and Emission Reduction Target Methodology. http://www.aqmd.gov/docs/default-source/transportation/supplemental-documents/r2202_ef_methodology_emfac2017_2019.pdf

South Coast Air Quality Management District. (2005). Employee Commute Reduction Program AVR Survey Support Guide. http://www.aqmd.gov/docs/default-source/transportation/supplemental-documents/avr-survey-support-guide.pdf

South Coast Air Quality Management District. (2014). Board Letter to Amend Rule 2202 - On-Road Motor Vehicle Mitigation Options, Rule 2202 Implementation Guidelines, Rule 301 Permitting and Associated Fees, and Rule 311 Air Quality Investment Program Fees. http://www.aqmd.gov/docs/default-source/Agendas/Governing-Board/2014/brdpkg-2014-jun6.pdf

MOB-15: ZERO EMISSION INFRASTRUCTURE FOR MOBILE SOURCES [ALL POLLUTANTS]

CONTROL MEASURE SUMMARY				
SOURCE CATEGORY:	MEDIUM/HEAVY-DUTY ZERO EMISSION VEHICLES			
CONTROL METHODS:	DEVELOP WORK PLAN TO ACCELERATE ZERO EMISSION INFRASTRUCTURE DEPLOYMENT			
EMISSIONS (TONS/DAY):				
ANNUAL AVERAGE	2018	2031	2032	2037
POLLUTANT INVENTORY	TBD	TBD	TBD	TBD
POLLUTANT REDUCTION		TBD	TBD	TBD
POLLUTANT REMAINING		TBD	TBD	TBD
SUMMER PLANNING	2018	2031	2032	2037
POLLUTANT INVENTORY	TBD	TBD	TBD	TBD
POLLUTANT REDUCTION		TBD	TBD	TBD
POLLUTANT REMAINING		TBD	TBD	TBD
CONTROL COST:	TBD			
INCENTIVE COST:	TBD			
IMPLEMENTING AGENCY:	SOUTH COAST AQMD			

Description of Source Category

Zero Emissions Charging/Fueling Infrastructure is needed for all Zero Emissions On-Road and Off-Road Motor Vehicles and Equipment.

Background

The 2022 Air Quality Management Plan (AQMP) relies on a significant transition to zero emissions ~~(ZE)~~ technologies across many sectors. Two leading fuels for zero emissions technologies today that have the potential to be adopted at scale by 2037 are electricity and hydrogen. Each of these fuels present unique challenges including production, regional and local distribution, fueling locations, policy approaches, regulatory environment, costs, incentive programs, etc. These challenges require many different levels of government to engage and participate in policy development to ensure that they are appropriately addressed to meet the many goals of the state, including attainment of air quality standards.

This control measure includes a work plan, to be implemented in conjunction with the California Energy Commission, the California Public Utilities Commission, and other partner agencies, to support and accelerate the deployment of zero emission infrastructure needed for the widespread adoption of zero emission vehicles and equipment. The workplan includes broad strategies as well as specific actions that South Coast AQMD would take to implement those strategies. All actions would require close partnership with many different stakeholders. Potential actions include identifying and carrying out key research needs, targeted advocacy for policy goals with other agencies, developing specific data products for other agencies to use in their assessments, convening stakeholders together to focus on air quality goals as a primary component of zero emissions planning efforts, and potentially including zero emissions fueling and charging infrastructure in proposed rules (e.g., indirect source rules).

This work plan will support a fuel transition to zero emission technologies at the scale needed to meet air quality goals and the federal National Ambient Air Quality Standards (NAAQS) standards. Meeting these timelines will require unprecedented fuel transitions in the stationary and mobile source sectors away from traditional fuels, particularly conventional diesel fuel which is a major contributor to Nitrogen Oxides (NOx) emissions. Although the clean air goals of the South Coast Air Quality Management District (South Coast AQMD) are focused on reducing criteria air pollutants, the actions taken in this workplan to support a rapid transition to zero emission technologies will also reduce greenhouse gas emissions as a co-benefit. The NAAQS and California's Climate Change Programs have similar sources and mitigating solutions, and the state's efforts to reduce GHG emissions are aligned with the clean air goals of the South Coast AQMD and can be leveraged to meet NAAQS timelines.

Preliminary estimates of the ~~ZE~~ zero emission infrastructure needs have been developed by the California Energy Commission (CEC) and the California Air Resources Board (CARB) based on existing state goals and mandates. These preliminary estimates are largely based on a transition to ~~ZE~~ zero emission vehicles for on-road transportation sources, and do not fully address the adoption of ~~ZE~~ zero emission technologies by other emission sources, including stationary, locomotives, and off-road equipment. The projections include the ~~ZE~~ zero emission infrastructure needs statewide and will need to be further developed to address the unique needs of the South Coast and Coachella Valley Air Basins. Through this workplan, the South Coast AQMD will work alongside and in coordination with these agencies and other entities to develop region-focused cost estimates and logistical projections that can then be used as policy encouragement. Where appropriate, the South Coast AQMD can serve as a lead facilitator for stakeholders to contribute their expertise and perspectives while identifying key areas that require further study or development to meet clean air goals in the South Coast AQMD.

Regulatory History

AB 2127 assessed the charging infrastructure needs for achieving the state's goals for zero emission vehicles by 2030 and found that over 700,000 chargers are needed to support 5 million Zero Emission Vehicles (ZEVs) (or nearly 1.2 million chargers for 8 million ZEVs), and an additional 157,000 Electric Vehicle (EV) chargers will be needed for the Medium-Duty /Heavy-Duty fleet.

AB 8 assessed the infrastructure needs for hydrogen fuel cell vehicles (FCEVs) and estimated that approximately 1,700 H2 stations would be needed statewide to support 1.8 million FCEVs by 2035.

CA Governor's Executive Order N-79-20 set a goal that 100 percent of in-state sales of new passenger cars and light-duty trucks be zero emission by 2035. In addition, this executive order set a goal of 100 percent zero emission drayage trucks by 2035, 100 percent zero emission off-road vehicles and equipment (where feasible) by 2035, and 100 percent zero emission medium and heavy-duty vehicles (where feasible) by 2045.

Proposed Method of Control

Strategy 1 – Assess Zero Emission Infrastructure Needs

The work plan is anticipated to involve coordination with all stakeholders and identify informational gaps and challenges in planning and development of zero emission infrastructure to support the State's goals and requirements for zero emission vehicles and equipment. Information gathered can then be used to create or support policies and incentives that will ease this transition. A more precise the South Coast AQMD-focused assessment of the number and types of zero emission infrastructure is critically needed to support the future ZEV population.

In addition, there are several other important unknowns that would be addressed by this control measure:

Strategies in Proposed South Coast AQMD Workplan for Zero Emissions Fueling / Charging Infrastructure
• *Assess Zero Emission Infrastructure Needs for the South Coast AQMD* • *Assist in Developing Cost Projections* • *Assist in Assessing Funding Needs* • *Identify Targeted Policies and Strategies to Support Zero Emission Vehicle Adoption* • *Collaborate with Local Utilities* • *Identify Policy Needs Across Different Sectors* • *Pursue Equitable and Affordable Solutions* • *Align Efforts with Other Local, State, and Federal initiatives*

Fuel Pathways – Zero emission technologies include battery electric vehicles (BEVs) and hydrogen fuel cell electric vehicles (FCEV), however these technologies will not be fully developed or commercialized for all vehicle/equipment types or duty cycles at the same time. Preliminary estimates include the number of BEVs and FCEVs expected to be deployed based on existing state goals and mandates with the caveat that these numbers are likely to change as these technologies and the market for these technologies develop more fully. The exact breakdown of the charging and hydrogen fueling infrastructure that would be needed within the South Coast AQMD is unknown. Understanding what the future mix of BEVs vs. FCEVs is crucial for understanding future investment needs.

Applications – The infrastructure needed to support ZEVs should be accessible to a wide range of duty cycles and demand. For example, current charging time for a BEV truck is not compatible with 24-hour operations. Likewise, drivers operating heavy-duty FCEVs do not currently have widespread hydrogen fueling options. The existing stations for FCEVs are largely designed for the light-duty FCEV market and are inadequate for their uses. The appropriate type and quality of the zero- emission infrastructure needs to be available for diverse applications of ZEVs.

Location – Gasoline and diesel fueling stations are ubiquitous across the South Coast AQMD today, but it is unclear if that is the correct model for future zero emission infrastructure. BEVs are ideally charged during a natural downtime in operations, with drivers starting the next day with a fully charged vehicle at their garage or overnight parking lot. Public charging stations might best serve either drivers who are from outside the South Coast AQMD or for those who do not have access to their own charging station. The distribution of public charging stations can be adjusted to best serve the needs of these operators. FCEVs operate in a much more similar fashion to a conventional-fueled vehicle. Depending on the fuel pathways and the application, the exact distribution of hydrogen fueling stations may be concentrated in specific areas for specific populations of drivers.

Reliability – Traditional fossil fuel stations had the benefit of developing multiple layers of reliability and distribution over the last hundred years, but the urgency for ZEV adoption means that zero emission infrastructure must replicate that within a few short years. Reliability refers to both the individual components of a charging station or hydrogen fueling station, as well as having trained technicians, a robust supply chain of parts, cybersecurity, and communication with customers during downtime. Grid-level reliability is another important aspect, such as backup power and load management.

Other emerging technologies – Other future technologies may emerge that could enhance ZEV adoption, such as battery swapping, vehicle to grid support, autonomous driving, charging management systems, and more.

Strategy 2 – Develop Cost Projections

Once projections on the number and types of zero emission infrastructure is defined using Strategy 1, projections on how much it will cost to build out the ~~ZE~~ zero emission infrastructure can be developed. Due to the complexity of the specific needs, the true total cost of the infrastructure has been unclear. The South Coast AQMD can assist in the development of cost projections for infrastructure unique to its jurisdiction. Assessments undertaken in this strategy should be cognizant of the aspects identified in Strategy 1 as well as the unique role of other agencies involved in planning assessments for ~~ZE~~ zero emission infrastructure.

Strategy 3 – Assess Funding Needs

The South Coast AQMD has a long history of supporting research, development, demonstration, and early deployment of cleaner technologies. This expertise would be leveraged to support the development of zero emission infrastructure based on the results of Strategy 2 and may include support for projects or programs that would advance the technology or accelerate the build out of ~~ZE~~ zero emission infrastructure, and identification of potential funding sources, such as incentives, to address the unique challenges of the South Coast AQMD. The South Coast AQMD can also identify specific sectors that are well positioned for transitioning to zero emission technologies but lack support otherwise addressed by local, State, or federal programs.

Strategy 4 – Identify Policy and Strategies to Support ZEV Adoption

For many drivers, ZEV adoption comes with a large upfront cost in the form of the vehicle and the supporting infrastructure. For some vehicle types the "total cost of ownership" (TCO) can work out to be cheaper than a conventional-fueled vehicle because the fueling cost is significantly lower compared to gasoline and diesel, however this TCO viewpoint is often not readily available to drivers deciding on whether to adopt a ZEV.

The South Coast AQMD can support studies that investigate the TCO for specific ZEV operations or applications to tackle this issue facing many drivers and vehicle operators. When the TCO for ZEVs, including both the vehicle purchase price and infrastructure development cost, is less than the cost of a conventional-fueled vehicle, widespread ZEV adoption becomes much easier to achieve. Funding support through incentives have been focused on helping offset the purchase price of a zero-emission vehicle.

Infrastructure costs are considered in TCO calculations by consumers, even if those costs are not included in the funding program. The South Coast AQMD will identify potential policy and strategies to support adoption of ZEVs as the preferred fuel choice.

Strategy 5 – Collaborate with Local Utilities

Many local utilities have programs that provide funding support for the design and installation of ~~ZE~~ zero emission infrastructure, however these programs require long lead times for planning, design, engineering, and approvals prior to construction/installation of the ~~ZE~~ zero emission infrastructure. Early planning and coordination are key factors to assuring the ~~ZE~~ zero emission infrastructure will be ready in time for ZEV deployment. This process will be further exacerbated with the rapid rollout of ZEVs that are expected. In addition, these utility programs that offer funding for ZEV infrastructure are not typically aligned with the vehicle incentives causing delays in ZEV deployments. The South Coast AQMD will coordinate with the local utilities on funding programs with the goal of aligning the vehicle incentives with ~~ZE~~ zero emission infrastructure funding, maximizing funding opportunities, and encourage fleet owners to plan early for the timelines involved in obtaining approvals and installing the ~~ZE~~ zero emission infrastructure. The South Coast AQMD will also collaborate with local utilities, and CPUC as needed, to provide feedback and input on rate structures that will accelerate the adoption of ZEVs across multiple sectors of vehicles/equipment.

Working together with Strategy 4, the South Coast AQMD will specifically work with utilities within its territory to align efforts and develop a comprehensive approach to support a widespread adoption of zero emission vehicles, including advocacy, information sharing, and coordination of funding programs for ~~ZE~~ zero emission infrastructure. Each utility has a unique role to play, and the South Coast AQMD can coordinate a united effort that makes the most sense for drivers in its jurisdiction.

Strategy 6 – Identify Policy Needs Across Different Sectors

Each sector within the transportation industry and beyond has a different readiness level, and a targeted policy unique to that sector will accelerate the ZEV adoption rate. For example, transit buses were one of the first sectors identified to fully transition to zero emission due to a long history of targeted policies and public funding. This strategy can be replicated for other sectors, such as drayage trucks, cargo vans, street sweepers, and off-road vehicles. Each of these vehicle types has a different duty cycle and demand, so it may be possible to develop policies to promote ZEVs within each sector.

Strategy 7 – Ensure Equity and Affordability

A significant portion of the South Coast AQMD is comprised of disadvantaged communities, which are defined as the top 25% highest scoring communities measured by CalEnviroScreen, a screening tool developed by the California Office of Environmental Health Hazard Assessment (OEHHA) to help identify communities that are disproportionally burdened by multiple sources of pollution and have population characteristics that make them more sensitive to pollution. The higher scoring communities experience a high amount of pollution burden combined with sensitive population characteristics and socioeconomic factors.

Several programs have been implemented that target these communities for actions that will reduce emissions or provide funding support for projects that will reduce emissions and/or exposure to air pollution. The South Coast AQMD will advocate and identify actions that will accelerate ZEV adoption and infrastructure rollout in these communities. More broadly, the South Coast AQMD will work with stakeholders involved in ~~ZE~~ zero emission infrastructure to ensure that zero emission technologies are distributed affordably and equitably.

Strategy 8 – Align Efforts with Other Local, State, and Federal initiatives

The South Coast AQMD will work in tandem with state agencies and other stakeholders involved in planning and development of ~~ZE~~ zero emission infrastructure to align our efforts and avoid duplication of actions that will be taken by these respective entities. While the South Coast AQMD will deliver results specific to its jurisdiction, other agencies may produce similar reports for a different region with a different focus, potentially creating confusion. The South Coast AQMD will coordinate with relevant local, State, and federal agencies to ensure that activities undertaken by this workplan add value beyond the actions taken by other local, State, or federal initiatives and will address the specific needs of the South Coast AQMD.

Actions to Implement Strategies

The South Coast AQMD will take the following actions to implement strategies outlined in this work plan. These actions may be revised or amended as additional information becomes available during the implementation of the work plan.

Research

The South Coast AQMD will identify informational gaps in the current body of research and specific areas where further study is warranted to address the zero-~~-~~ emission infrastructure needs in the South Coast Air Basin. Specifically, South Coast AQMD will seek to address cost estimates, funding needs, vehicle to grid capabilities, technological opportunities and limitations, policy gaps and other research needs for the South Coast AQMD. The South Coast AQMD will support research studies as well as technology development/demonstration projects involving zero emission infrastructure in the South Coast Air Basin through advocacy, funding, and other mechanisms to accelerate a transition to ZEVs across all sectors of vehicles and equipment.

The state goals and mandates requiring ZEVs demands an unprecedented level of new charging and fueling infrastructure. Given public comments at the workgroup meetings for this control measure, further research and development is needed to address concerns related to reliability, access, and affordability. The South Coast AQMD has extensive experience working jointly with other agencies and private partners to fund projects involving research, development, and demonstration of advanced technologies for stationary and mobile sources. The South Coast AQMD will leverage this experience to identify potential zero emission infrastructure projects or related technology areas for research, development and/or demonstration based on the needs in the South Coast Air Basin, and/or coordinate with other agencies and stakeholders to identify funding sources for these projects.

In addition, the South Coast AQMD will monitor the progress of research studies conducted by other entities and provide feedback and input to address the needs of the South Coast AQMD.

Funding

The South Coast AQMD will identify funding needs and pursue potential funding mechanisms (e.g., legislative, grants, incentives, and other programs) to secure and/or identify funding sources that can be used to maximize funding opportunities for zero emission infrastructure in the South Coast AQMD. South Coast AQMD's experience with incentives and other funding programs will assist in identification of improvements to existing programs and/or identify potential sources of new funding with the goal of maximizing funding opportunities for zero emission infrastructure. Through this workplan the South Coast AQMD will consider all federal, State, and local sources with the goal of maximizing investments for zero emission infrastructure in the South Coast AQMD. The South Coast AQMD will also coordinate with local utilities where possible to identify areas where funding programs could be modified, amended, or better aligned to maximize funding opportunities for customers in the South Coast AQMD.

Stakeholder Collaboration

This action will involve significant collaboration with state agencies, local utilities and various other stakeholders involved in the planning, design, permitting, construction, operation, and maintenance of zero emission infrastructure in the South Coast AQMD. For example, this action will involve close coordination with CARB and CEC by sharing information, aligning efforts, and providing feedback and input on zero emission vehicle projections and infrastructure assessments and related policies. The South Coast AQMD will also work with CARB and CEC to develop specific estimates of the charging/fueling infrastructure needed to support a widespread adoption of ZEVs across multiple sectors of vehicles and equipment for the South Coast air district. Current estimates are limited and do not fully consider the infrastructure needs for all sources that are expected to transition to zero emission technologies, such as stationary applications, and many off-road vehicles/equipment.

The South Coast AQMD will closely coordinate with local utilities on their energy demand analyses and identify prioritized locations for zero emission infrastructure, including the level of upgrades needed. In addition, the South Coast AQMD will coordinate with city/county jurisdictions, as needed, on any potential land use issues and propose policy solutions. And, finally, the South Coast AQMD will collaborate with private industry to understand practical and business model constraints to transitioning to zero emission technologies.

Advocacy

The South Coast AQMD will provide targeted advocacy to advance air quality goals of the South Coast AQMD. Targeted areas for advocacy may include, but are not limited to funding, legislation, equity issues, policy support, utility actions, and education/outreach. For example the South Coast AQMD may consider targeted advocacy for utility rates through supporting energy pricing structures that will result in an accelerated adoption of ZEVs. The South Coast AQMD will also work with local agencies to support their efforts to obtain funding where a lack of funding for zero emission infrastructure planning and development is identified.

Regulation

The South Coast AQMD may consider rulemaking to accelerate the adoption of ZEVs in the South Coast AQMD, such as Rule 2305 - Warehouse Actions and Investments to Reduce Emissions (WAIRE). This rule requires warehouse operators to annually take actions to reduce emissions or that will facilitate emission reductions, and warehouse operators may install zero emission infrastructure as a compliance option under this rule. Other Indirect Source Rules (ISR) may include similar options to support ZEV infrastructure development. Similarly, this action may also include providing public testimony in support of CARB or the U.S. Environmental Protection Agency (U.S. EPA) regulations to support their requirements for ZEV infrastructure.

Emission Reductions

This control measure would not directly reduce emissions but would support other strategies that would, and for that reason cannot be directly connected to forecasted emission reductions.

Rule Compliance and Test Methods

N/A.

Cost Effectiveness

N/A.

Implementing Agency

South Coast AQMD

References

AB 2127 (2018) requires the California Energy Commission to biennially assess the electric vehicle charging infrastructure needed to meet the state's goals of putting at least 5 million zero-emission vehicles on California roads by 2030 and reducing greenhouse gas emissions to 40 percent below 1990 levels by 2030. https://www.energy.ca.gov/programs-and-topics/programs/electric-vehicle-charging-infrastructure-assessment-ab-2127

Report on AB 8: Attaining 100 Hydrogen Refueling Stations https://cafcp.org/blog/report-ab-8-attaining-100-hydrogen-refueling-stations

Hydrogen Station Network Self-Sufficiency Analysis per Assembly Bill 8

https://ww2.arb.ca.gov/sites/default/files/2020-11/ab_8_self_sufficiency_report_draft_ac.pdf

CA Executive Order N-79-20 https://www.gov.ca.gov/wp-content/uploads/2020/09/9.23.20-EO-N-79-20-Climate.pdf