

SS1: Fluid Catalytic Cracking in Refineries

Brief Summary:

This control measure will reduce emissions of condensable particulate matter (PM) from fluid catalytic cracking units (FCCUs) at the four Bay Area refineries where these devices are operated, as well as precursors to the formation of secondary PM. These reductions will be achieved through Air District Regulation 6, Rule 5 (Rule 6-5), adopted in December 2015, (“Particulate Emissions from Refinery Fluidized Catalytic Cracking Units”) and possible further amendments to this rule.

Purpose:

Reduce health impacts of fine PM from refinery FCCUs. FCCUs are large sources of fine PM (classified as PM_{2.5} in Air District inventories) which is emitted both as filterable matter, and also as condensable gases which are not captured or detected with filters, but which condense into solid or liquid PM_{2.5} after they are emitted from the FCCU and cool to ambient temperature. Secondary PM is formed in the atmosphere, not as a result of condensation, but as a result of a reaction between ammonia and both nitrogen oxides (NO_x) and sulfur oxides (SO_x). Rule 6-5 was adopted, and may be further amended, to address condensable PM and secondary PM from refinery FCCUs.

Source Category:

Stationary Source - petroleum refineries

Regulatory Context and Background:

An FCCU is a complex processing unit that cracks heavy oils from crude distillation units into lighter oils using a chemical reaction that is promoted by a powdered catalyst. The emissions from an FCCU come from the “regenerator” portion of the FCCU where used catalyst, that has become coated with coke during the cracking reaction, is heated to burn off the coke so that the catalyst may be reused. The FCCU emissions consist of the combustion emissions from this coke burn-off process. In the Bay Area, four of the five petroleum refineries operate an FCCU (Chevron, Shell, Tesoro, Valero). All four FCCUs are equipped with add-on particulate controls: three refineries use electrostatic precipitators (ESPs), while Valero operates a tertiary cyclone. ESPs and tertiary cyclones are expected to remove about 99 percent of filterable PM from the FCCU regenerator exhaust, although they are ineffective in removing the vapors that constitute condensable PM. Valero also operates a wet scrubber on its FCCU exhaust which probably provides significant condensable PM control. Ammonia occurs in the FCCU exhaust because it is added to promote the operation of ESPs, although it appears that excessive ammonia is being used.

District Regulation 6, Rule 1 (Rule 6-1) addresses filterable PM emissions from many sources, including FCCUs. However, the test methods used to monitor compliance with this rule only quantify filterable PM emissions, and are incapable of measuring condensable PM. Similarly, federal rules, NSPS Subpart J and NESHAP Subpart UUU, have PM emission limits for FCCUs that do not address condensable PM emissions because of monitoring limitations. In addition, because of the high exhaust temperature of an FCCU, it is unlikely that the opacity limits in Rule

6-1 and Subpart J constitute a limit on condensable PM emissions from FCCUs. Therefore, no federal or Air District regulation, or Air District permit condition, currently addresses condensable PM or secondary PM from refinery FCCUs.

In 2003, the South Coast AQMD adopted Rule 1105.1 to limit emissions of both filterable PM and ammonia from FCCUs. The ammonia limits were proposed because of ammonia's role in the formation of both condensable PM and secondary PM. Prior to the adoption of the Air District's Rule 6-5, Rule 1105.1 appeared to be the only air pollution rule in California to address either condensable PM or secondary PM from refinery FCCUs.

In December 2015, the Air District adopted Rule 6-5 to impose the same 10 ppmv ammonia emission limit as South Coast Rule 1105.1. Rule 6-5 allows a refinery, in lieu of compliance with the 10 ppmv limit, to perform an ammonia optimization study and to propose a higher ammonia limit that results in lower overall condensable PM emissions; this may be possible because ammonia, in addition to contributing to condensable and secondary PM formation, also promotes the capture of PM at ESPs.

Implementation Actions:

The Air District will:

- During development of Rule 6-5, the Air District began a program of testing Bay Area FCCUs for condensable PM emissions using a relatively new EPA test method (Method 202). This testing is expected to continue through 2016.
- During 2016 and 2017, the Air District will evaluate refinery progress in performing ammonia optimizations, as well as the results of Method 202 testing, to determine appropriate further actions. These may include limits on condensable PM emissions as well as limit on SO₂ emissions, or other measures.

Emission Reductions:

Pollutants*	2020	2030
PM _{2.5}	1,222	1,222
TACs	241	241

**criteria pollutants and TACs are reported in lbs/day*

The ammonia emission limit adopted in Regulation 6-5 was estimated to result in an ammonia emission reduction of 44 tons/year by January 2018, with a corresponding reduction of 223 tons/year of condensable PM_{2.5}. Further reductions of PM_{2.5} and other pollutants will be determined by the specific future implementation actions in a future amendment of Regulation 6-5.

Exposure Reductions:

Emissions from the Bay Area's five major oil refineries have been steadily decreasing over the past several decades, however, refineries are major sources of criteria air pollutants, TACs, and GHGs. Refineries are also located in impacted communities, including in Richmond. In October 2014, the Air District Board of Directors adopted a Refinery Emissions Reduction Resolution,

which established a goal of reducing refinery criteria air pollutant emissions by 20 percent or as much as feasible by 2020. In response to that directive, the Air District has developed a Bay Area Refinery Emissions Reduction Strategy. The Refinery Strategy ensures that refineries are taking the strongest feasible steps to reduce emissions and minimize their health impacts on neighboring residents and the region as a whole. This measure is one of twelve control measures in the 2017 Plan that make up the Refinery Strategy. Specifically, Rule 6-5, as adopted in 2015, will achieve emission reductions of ammonia and a corresponding reduction of condensable PM_{2.5}. Ammonia is a toxic air contaminant (TAC). Also, exposure to PM_{2.5} is by far the leading public health risk from air pollution in the Bay Area, accounting for more than 90 percent of premature mortality related to air pollution. Further emission reductions through a future amendment of Rule 6-5 will be estimated based on Method 202 emission testing that will be completed in 2016.

Emission Reduction Trade-Offs:

The ammonia emission limit in Rule 6-5 allowed an ammonia optimization option to prevent increases in overall PM emissions as a result of ammonia use reductions. Future amendments of Rule 6-5 must consider all of the pollutants emitted from FCCUs and ensure that emission limits that target PM_{2.5} do not result in unintended emission increases of other pollutants.

Costs:

The cost of further reductions of PM_{2.5} will depend on the specific future implementation actions proposed for Rule 6-5. However, there are expected to be cost-effective control options given that the costliest option in terms of capital cost – installation of a wet scrubber on the FCCU exhaust – has been demonstrated at several US refineries.

Co-Benefits:

Further reductions in condensable PM emissions are expected to result in reductions in secondary PM_{2.5} formation.

Issue/Impediments:

None.

Sources:

1. South Coast AQMD: Final Staff Report, Rule 1105.1 (“Reduction of PM₁₀ and Ammonia Emissions from Fluid Catalytic Cracking Units”), September 16, 2003.
2. Bay Area Air Quality Management District: Bay Area 2010 Clean Air Plan, Executive Summary, September 2010.
3. Bay Area Air Quality Management District: Final Staff Report, Petroleum Refinery Emissions Reduction Strategy, Appendix A (FCCUs), December 2015.

SS2: Equipment Leaks

Brief Summary:

This control measure would further reduce emissions of total organic gases (TOG) – including reactive organic compounds (ROG) and methane – from equipment leaks at petroleum refineries.

Purpose:

The purpose of this control measure is to achieve further reductions in fugitive emissions of total organic gases (including ROG, toxic organics, and methane) at refineries.

Source Category:

Stationary sources – petroleum refineries, chemical plants, bulk plants and bulk terminals.

Regulatory Context and Background:

Component leaks commonly occur at the joints or connections between sections of piping, at valves, at pumps or from barrier fluid contained between seals, and at leaking pressure relief devices (PRDs).

The Air District originally adopted Regulation 8, Rule 18 in 1980 and has amended it twice, first in 1992 and again in 2004. In addition, some minor changes were made to the rule in 1998 and 2002. The original intent of the rule was to control fugitive organic gas leaks from valves and connectors at refineries, chemical plants, bulk plants, and bulk terminals. Rule amendments adopted in 1992 significantly lowered the allowable leak concentration limits to the lowest levels in the country and required more effective inspection and repair programs in order to reduce emissions and promote self-compliance. The 1992 amendments reduced ROG emissions by an estimated 1,200 pounds/day.

The allowable leak standard is 500 parts per million volume (ppmv) for pumps, compressors, and PRDs.¹ For valves and other equipment, the allowable leak standard is 100 ppmv. Leaks are detected using a portable combustible gas indicator.

The U.S. Environmental Protection Agency (EPA) has promulgated leak detection and repair (LDAR) standards for facilities in the synthetic organic chemical manufacturing industry but not for petroleum refineries. The EPA's standards in 40 CFR parts 60 and 63 include LDAR provisions for monitoring and repairing equipment in heavy liquid service and do not rely on instrumental monitoring, but instead rely on "visual, audible, olfactory, or any other detection method."

Implementation Actions:

In December 2015, the Air District amended Rule 8-18. The Air District will develop an implementation plan for the Rule. The amendments strengthened the Rule through the

¹ PRDs are also subject to the requirements of Air District Regulation 8, Rule 28, *Episodic Releases from Pressure Relief Devices at Petroleum Refineries and Chemical Plants*.

following changes:

- Requiring future monitoring of equipment in heavy liquid service;
- Reducing the amount of equipment that can be added to the “non-repairable” equipment list;
- Addition of a maximum mass emission rate for fugitive equipment subject to the rule;
- Requiring facilities to identify the causes of background readings greater than 50 ppmv;
- Adding a maximum leak concentration and maximum mass emission rate for fugitive equipment placed on the “non-repairable” equipment list;
- Clarification of definitions; and
- Provisions for heavy liquid components will take effect on Jan 1, 2018.

Emission Reductions:

Pollutants*	2020	2030
ROG	4,546	4,546
CO _{2e}	340	340

**criteria pollutants are reported in lbs/day; CO_{2e} is reported in metric tons/year (100 yr GWP)*

Once in full effect, Regulation 8, Rule 18 is anticipated to reduce ROG emissions from the five Bay Area refineries by approximately 4,546 pounds per day. About 2,000 pounds per day of these reductions would come from methane, resulting in estimated GHG emission reductions equivalent to 860 MT CO_{2e} per year, on a 20-year timeframe, and 340 MT CO_{2e} per year, on a 100-year timeframe.

Exposure Reductions:

Emissions from the Bay Area’s five major oil refineries have been steadily decreasing over the past several decades, however, refineries are major sources of criteria air pollutants, TACs, and GHGs. Refineries are also located in impacted communities, including in Richmond. In October 2014, the Air District Board of Directors adopted a Refinery Emissions Reduction Resolution, which established a goal of reducing refinery criteria air pollutant emissions by 20 percent or as much as feasible by 2020. In response to that directive, the Air District has developed a Bay Area Refinery Emissions Reduction Strategy. The Refinery Strategy ensures that refineries are taking the strongest feasible steps to reduce emissions and minimize their health impacts on neighboring residents and the region as a whole. This measure is one of twelve control measures in the 2017 Plan that make up the Refinery Strategy. Specifically, a reduction in organic compounds will result in a reduction in air toxics exposures.

Emission Reduction Trade-Offs:

None

Costs:

Expansion of leak detection and repair program is anticipated to cost approximately \$6.8 million per year (capital costs: \$250,000).

Co-Benefits:

None identified.

Issue/Impediments:

There are thousands of additional equipment components in heavy liquid service that would be required to be identified and monitored under an expanded LDAR program. This would be a major undertaking for refineries. In addition, equipment in heavy liquid service is handled at an elevated temperature and may require special equipment to handle safely.

Sources:

1. Bay Area Air Quality Management District, Proposed Regulation 8, Rule 18: Equipment Leaks, December 16, 2015
2. EPA Method 21 – Determination of Volatile Organic Compound Leaks
3. Bay Area Air Quality Management District, staff report for Refinery Emissions Reduction Strategy, October 2015.

SS3: Cooling Towers

Brief Summary:

Petroleum refineries use cooling towers to return waste heat to the environment through the evaporation of water. Leaks in heat exchange systems can result in emissions of total hydrocarbons (THC) and, sometimes, toxic air contaminants (TACs). This control measure is intended to reduce THC and TAC emissions from cooling towers in petroleum refineries. The amendments to Air District Regulation 11, Rule 10, *Hexavalent Chromium Emissions from Cooling Towers* which has been renamed *Hexavalent Chromium from All Cooling Towers and Total Hydrocarbon Emissions from Petroleum Refinery Cooling Towers* were adopted by the Air District's Board of Directors on December 16, 2015.

Purpose:

To reduce THC and TAC emissions from cooling towers at Bay Area refineries by requiring more rapid detection and repair of leaking heat exchangers.

Source Category:

Stationary sources – petroleum refineries

Regulatory Context and Background:

The Bay Area has five large-scale petroleum refineries which operate a total of 34 cooling towers. These cooling towers are large, industrial heat exchangers that dissipate significant heat loads to the atmosphere through the evaporation of water. Process liquids, which often contain THC and sometimes TACs, may leak into cooling tower water and then be evaporated into the environment. The longer leaks go undetected and unrepaired, the greater the quantity of emissions.

The Air District developed Regulation 11, Rule 10 (Rule 11-10) in 1989 to eliminate the use of hexavalent chromium additives in cooling towers.

In 2009, US EPA promulgated, and, in 2013, amended, 40 CFR, part 63, subpart CC, National Emission Standards for Hazardous Air Pollutants from Petroleum Refineries (MACT CC). MACT CC requires periodic monitoring (monthly or quarterly) of heat exchangers in organic TAC service and requires repair of leaks as soon as is practicable (but no later than 45 days after detection).

Implementation Actions:

On December 16, 2015, the Air District Board of Directors adopted the following amendments to Rule 11-10, which went into effect July 1, 2016:

- Owners and operators of cooling towers at petroleum refineries will be required to install continuous THC monitors or test for THC in cooling water daily unless the APCO approves an alternative monitoring regime.
- The amended regulation establishes a THC concentration standard of 6 ppmv (by volume) for existing cooling towers and a 3 ppmv standard for new cooling towers when measured

in stripped air by a continuous analyzer. The THC concentration standard is 84 ppbw (by weight) when measured in cooling water.

- Refineries are required to minimize the leak within 5 calendar days and shall repair the leak within 21 days.

Because the scope of the regulation has increased, the title has been amended from “Hexavalent Chromium Emissions from Cooling Towers” to “Hexavalent Chromium Emissions from All Cooling Towers and Total Hydrocarbon Emissions from Petroleum Refinery Cooling Towers.” Staff is preparing an implementation plan for the amended regulation.

Emission Reductions:

Pollutants*	2020	2030
ROG	5,200	5,200

**criteria pollutants are reported in lbs/day*

Exposure Reductions:

Emissions from the Bay Area’s five major oil refineries have been steadily decreasing over the past several decades, however, refineries are major sources of criteria air pollutants, TACs, and GHGs. Refineries are also located in impacted communities, including in Richmond. In October 2014, the Air District Board of Directors adopted a Refinery Emissions Reduction Resolution, which established a goal of reducing refinery criteria air pollutant emissions by 20 percent or as much as feasible by 2020. In response to that directive, the Air District has developed a Bay Area Refinery Emissions Reduction Strategy. The Refinery Strategy ensures that refineries are taking the strongest feasible steps to reduce emissions and minimize their health impacts on neighboring residents and the region as a whole. This measure is one of twelve control measures in the 2017 Plan that make up the Refinery Strategy. Specifically, a reduction in THC will result in reduced exposure to air toxics.

Emission Reduction Trade-Offs:

None

Costs:

Air District staff expect the cost to implement the amended regulation to be in the range of \$1-3 million per year divided among the five major Bay Area refineries, depending on the monitoring methods selected and the number of leaks that need to be repaired.

Co-Benefits:

A co-benefit of Rule 11-10 will be reduction of TAC emissions that are present in some process liquids.

Issue/Impediments:

None identified

Sources:

1. Bay Area Air Quality Management District, 2011 Base Year Emissions Inventory,
2. Bay Area Air Quality Management District, Petroleum Refinery Emissions Reduction Strategy: Staff Report, October 2015

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SS4: Refinery Flares

Brief Summary:

The Air District's refinery flare monitoring Regulation 12, Rule 11 (Rule 12-11) has been in place since 2003, and the flare reduction Rule 12-11 has been in place since 2005. Air District staff will review the results of these rules at each of the five refineries in the Bay Area to identify amendments that may make the rules more effective at reducing emissions.

Purpose:

Reduce frequency and magnitude of flaring events, thereby reducing particulate matter (PM), black carbon, and unburned hydrocarbons that may occur during a significant flare event.

Source Category:

Permitted Point Sources – refinery flares

Regulatory Context and Background:

July 20, 2005, the Air District adopted Regulation 12, Rule 12 (Rule 12-12) to reduce flaring at the Bay Area's five oil refineries. The rule, the first of its kind in the nation, affected flares that were in operation at the time of the rules adoption. The rule was intended to reduce air pollution by minimizing flaring during normal operations. Flaring – the burning off of excess gases at refineries to prevent them from being vented directly into the atmosphere – would still be allowed when necessary to safely operate a refinery.

In June 2003, the Board adopted a flare monitoring rule which required refineries to monitor and report flare emission data to the Air District. By installing compressors to recover refinery gases and by instituting better operating practices, flare emissions have been reduced by 75 percent - from 1,600 pounds per day of total organic compounds, on average, to 4,000 pounds per day at the present time. The 2005 rule built on the 2003 rule by making the reductions permanent.

The 2005 rule requires that each refinery prepare a Flare Minimization Plan (FMP) that determines how best to further minimize flaring. Air District staff carefully reviews the plans for effectiveness and takes public comment on them. The FMPs must include:

- Detailed information about equipment and operating practices related to flares,
- Steps the refinery has taken and will take to minimize the frequency and duration of flaring, a schedule for implementation of all feasible flare prevention measures.

Plans must be approved by the Air District. The FMPs are updated annually to incorporate the latest technologies and practices.

Rule 12-12 also requires a causal analysis of flaring events involving the emission of more than 500,000 cubic feet of gases. Less significant events will also be included in a required annual report and feasible prevention measures will be incorporated into the FMPs. These evaluation processes will result in continuous improvement and management of major flaring events.

The entire structure of this rule relies on critical review of the causes of flaring so that effective corrective actions can be determined, and implemented. Without commitment to this process, flaring events and resulting emissions are not prevented to the degree they could be with such commitment.

Implementation Actions:

The Air District will:

- Propose amending Rule 12-12 to mirror the “breakdown” requirements in Regulation 1. This will allow both the Air District and the refineries to evaluate areas of opportunity to further reduce emissions from flares and to redefine flaring that should be allowed in the FMP.

Emission Reductions:

Pollutants*	2020	2030
ROG	60	60
SO ₂	100	100

**criteria pollutants are reported in lbs/day*

Exposure Reductions:

Emissions from the Bay Area’s five major oil refineries have been steadily decreasing over the past several decades, however, refineries are major sources of criteria air pollutants, TACs, and GHGs. Refineries are also located in impacted communities, including in Richmond. In October 2014, the Air District Board of Directors adopted a Refinery Emissions Reduction Resolution, which established a goal of reducing refinery criteria air pollutant emissions by 20 percent or as much as feasible by 2020. In response to that directive, the Air District has developed a Bay Area Refinery Emissions Reduction Strategy. The Refinery Strategy ensures that refineries are taking the strongest feasible steps to reduce emissions and minimize their health impacts on neighboring residents and the region as a whole. This measure is one of twelve control measures in the 2017 Plan that make up the Refinery Strategy. Specifically, this measure will reduce exposure to toxic air contaminants, which have included in smoke from flares.

Emission Reduction Trade-Offs:

None

Costs:

The work associated with conducting root cause failure analysis is typically done by existing refinery staff. Implementing preventive/corrective actions can be significant, and costly if refinery process units, infrastructure, or flare systems must be redesigned. However, these costs are offset by the benefits of reducing costs associated with a refinery incident, fire damage, equipment repair and associated lost production.

Co-Benefits:

Improved production, less equipment damage, and potential for reduced methane emissions. Methane is typically a component of flared gas, but usually burns effectively at the flare tip.

Very little quantitative information is available regarding unburned methane during flare events.

Issue/Impediments:

None, however, adequate follow up will be required to prevent recurrence.

Source:

1. <http://www.baaqmd.gov/Divisions/Compliance-and-Enforcement/Refinery-Flare-Monitoring/Emissions.aspx>

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SS5: Sulfur Recovery Units

Brief Summary:

Each of the five Bay Area refineries operates one or more sulfur recovery units (SRUs) that produce marketable, elemental sulfur from gaseous sulfur compounds removed from petroleum feedstocks. SRUs in the Bay Area are subject to a 30 year-old limit (both federal and Air District imposed via Rule 9-1) on sulfur dioxide (SO₂). This control measure is projected to reduce actual SO₂ emissions from sulfur recover units by about 68 percent based on current, achievable practices.

Purpose:

Reduce SO₂ emissions from SRUs at petroleum refineries.

Source Category:

Permitted Sources – petroleum refineries

Regulatory Context and Background:

Crude petroleum naturally contains some sulfur compounds. California crude oils typically contain between one and two percent sulfur by weight. Because gasoline, diesel fuel, and other refined petroleum products are required to contain sulfur in concentrations on the order of parts per million, this sulfur must be removed, most of it recovered in the SRU. Unrecovered sulfur is emitted, mostly as SO₂.

In 1983, the Air District established a 250 ppm limit on emissions of SO₂ from SRUs through Rule 9-1. The United States Environmental Protection Agency (U.S. EPA) subsequently established identical limits in its *Standards of Performance for Petroleum Refineries* and *Standards of Performance for Petroleum Refineries for which Construction, Reconstruction, or Modification Commenced after May 14, 2007*. The Air District's limit, however, applies to all SRUs regardless of the date of construction, reconstruction or modification.

In November, 2010, the South Coast Air Quality Management District (SCAQMD) published a staff report on the SO₂ limits of equipment subject to its Regional Clean Air Incentives Market (RECLAIM) program. SCAQMD found SO₂ limits of 10 ppm to be feasible through SRU and tail gas treating system process improvement, and SO₂ limits of 5 ppm to be achievable by installing wet caustic scrubbers¹. However, cost effectiveness of wet caustic scrubbers sometimes exceeded \$50,000 per ton of SO₂ removed. SCAQMD elected to establish a limit of 5 ppm for SRUs as part the RECLAIM cap-and-trade program.

A review of the Bay Area refineries' SRUs' emissions show that all of them easily attain the 250 ppm limit. Two of them already achieve the 10 ppm SO₂ limit. A third SRU has achieved a 10 ppm limit during a source test using existing equipment, though it normally emits SO₂ at about twice this rate. The two remaining refineries have SRUs that would require 75-85 percent emission reductions to attain the 10 ppm SO₂ limit.

¹ A wet caustic scrubber is a control method that removes a pollutant by bringing the polluted gas stream into contact with a caustic (or alkaline) scrubbing liquid.

Implementation Actions:

The Air District will:

- Consider amendments to Rule 9-1, *Sulfur Dioxide* to achieve the lowest SO₂ emission feasible through increased efficiency of sulfur recovery units and improved tail gas treatment (i.e., an SO₂ limit of 10 ppm).
- Consider amendments to Rule 9-1 to achieve the lowest SO₂ emission feasible through installation of wet caustic scrubbers (i.e., an SO₂ limit of 5 ppm).
- Review cost effectiveness and incremental cost effectiveness of controls required to achieve the SO₂ limits of 5 ppm and 10 ppm.

Emission Reductions:

Pollutants*	2020	2030
SO ₂	900	900

*criteria pollutants are reported in lbs/day

Exposure Reductions:

Emissions from the Bay Area’s five major oil refineries have been steadily decreasing over the past several decades, however, refineries are major sources of criteria air pollutants, TACs, and GHGs. Refineries are also located in impacted communities, including in Richmond. In October 2014, the Air District Board of Directors adopted a Refinery Emissions Reduction Resolution, which established a goal of reducing refinery criteria air pollutant emissions by 20 percent or as much as feasible by 2020. In response to that directive, the Air District has developed a Bay Area Refinery Emissions Reduction Strategy. The Refinery Strategy ensures that refineries are taking the strongest feasible steps to reduce emissions and minimize their health impacts on neighboring residents and the region as a whole. This measure is one of twelve control measures in the 2017 Plan that make up the Refinery Strategy.

Costs:

There is considerable uncertainty in the cost of control as emission reductions can result from efficiency improvements within the unit itself, from a variety of proprietary tail gas treatment technologies, or the addition of add-on control equipment (e.g., wet caustic scrubbers).

Co-Benefits:

There will be less secondary PM_{2.5} formation from reduced sulfates.

Issue/Impediments:

None

Sources:

1. Code of Regulations, Title 40, part 60, subpart J, *Standards of Performance for Petroleum Refineries* [54 FR 34031, August 17, 1989, as amended at 55 FR 40178, Oct. 2, 1990]

2. Code of Regulations, Title 40, part 60, subpart Ja, *Standards of Performance for Petroleum Refineries for which Construction, Reconstruction, or Modification Commenced after May 14, 2007* [77 FR 56480, September 12, 2012]
3. *California Crude Oil Production and Imports*, Margaret Sheridan, Fossil Fuels Office, Fuels and Transportation Division, California Energy Commission, April, 2006
4. SCAQMD Rule 2002: RECLAIM
5. SCAQMD, Final Staff Report: SOx RECLAIM, Part 1, BARCT Assessment & RTC Analysis, November 2, 2010

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SS6: Refinery Fuel Gas

Brief Summary:

The lightest components of crude oil separated by a refinery's atmospheric fractionator are methane and ethane, which are also the primary components of natural gas. These products, along with gases produced at other refinery process units, commonly called refinery fuel gas (RFG), are used as fuel in steam generators, process heaters, and other combustion units. Because RFG contains naturally occurring sulfur compounds, it produces sulfur dioxide (SO₂) as a combustion byproduct.

Purpose:

Reduce SO₂ emissions from RFG combustion at petroleum refineries.

Source Category:

Permitted Sources - petroleum refineries

Regulatory Context and Background:

RFG can contain between a few hundred and a few thousand parts per million-volume (ppmv) sulfur in the form of hydrogen sulfide (H₂S) and organic sulfur compounds, such as mercaptans. During combustion, the sulfur in all of these compounds will oxidize to form SO₂, which is a criteria air pollutant and a precursor to particulate matter. Scrubbing with an amine solution can be effective at removing H₂S and some acidic sulfur containing compounds, but is generally ineffective at removing nonacidic sulfur compounds. Hydrotreating, a catalytic chemical process, converts these sulfur compounds to hydrogen sulfide which can then be removed by scrubbing.

In 1990, the Air District modified Regulation 9, Rule 1: *Sulfur Dioxide*, requiring all refineries that process more than 20,000 barrels per day of crude oil to operate a sulfur removal and recovery system that removes and recovers, on a refinery wide basis, 95 percent of the H₂S from RFG.

In 2008, the United States Environmental Protection Agency (EPA) promulgated 40 CFR part 60, subpart Ja, *Standards of Performance for Petroleum Refineries for which Construction, Reconstruction, or Modification Commenced after May 14, 2007*. The regulation limits H₂S concentration in combustion units to 162 ppmv, determined hourly on a three-hour rolling average, and to 60 ppmv, determined daily on a 365-day rolling average. Alternatively, refiners can choose to comply with post-control SO₂ emission limits of 20 parts per million- volume, dry (ppmvd), determined hourly on a three-hour rolling average, and 8 ppmvd, determined daily on a 365-day rolling average, with all SO₂ concentrations corrected to 0 percent oxygen.

The South Coast Air Quality Management District's (SCAQMD) Rule 431.1 limits the sulfur content of RFG, calculated as H₂S, to 40 ppmv, four-hour average. The initial compliance date was May 4, 1994 for large refineries and May 4, 1996 for small refineries. SCAQMD allows facilities to demonstrate equivalent SO₂ emission reductions within the facility, provided alternative plans have been approved by the Executive Officer in writing.

All of the major refineries in the Bay Area are complying with federal limits for H₂S, but two of them combust RFG with elevated levels of organic sulfur compounds in some or all of their combustion units.

Implementation Actions:

The Air District will:

- Consider amendments to Rule 9-1, *Sulfur Dioxide*, that would reduce fuel sulfur limits for RFG and determine the appropriate averaging periods.

Emission Reductions:

Pollutants*	2020	2030
SO ₂	6,000	6,000

**criteria pollutants and TACS are reported in lbs/day*

Exposure Reductions:

Emissions from the Bay Area’s five major oil refineries have been steadily decreasing over the past several decades, however, refineries are major sources of criteria air pollutants, TACs, and GHGs. Refineries are also located in impacted communities, including in Richmond. In October 2014, the Air District Board of Directors adopted a Refinery Emissions Reduction Resolution, which established a goal of reducing refinery criteria air pollutant emissions by 20 percent or as much as feasible by 2020. In response to that directive, the Air District has developed a Bay Area Refinery Emissions Reduction Strategy. The Refinery Strategy ensures that refineries are taking the strongest feasible steps to reduce emissions and minimize their health impacts on neighboring residents and the region as a whole. This measure is one of twelve control measures in the 2017 Plan that make up the Refinery Strategy.

Emission Reduction Trade-Offs:

None

Costs:

Because sulfur processing and removal is linked with nearly all refinery processes, costs are difficult to estimate. If improved sulfur removal is combined with other refinery upgrades (e.g. propane and butane recovery or processing sweeter crudes), there could be revenue enhancements and a net cost reduction. Without increased revenue, the two refineries with elevated levels of organic sulfur compounds in their RFG could see net costs in the range of \$1-3 million per year. The other refineries could see more modest costs to improve refinery processes depending on the form of the final rule.

Co-Benefits:

There will be less secondary PM_{2.5} formation from reduced sulfates.

Issue/Impediments:

None

Sources:

1. Regulation 9, Rule 1, Sulfur Dioxide, last modified March 15, 1995
2. 40 CFR part 60, subpart J, *Standards of Performance for Petroleum Refineries* [54 FR 34031, August 17, 1989, as amended at 55 FR 40178, Oct. 2, 1990]
3. 40 CFR part 60, subpart Ja, *Standards of Performance for Petroleum Refineries for which Construction, Reconstruction, or Modification Commenced after May 14, 2007* [77 FR 56480, September 12, 2012]
4. SCAQMD Rule 431.1: Sulfur Content of Gaseous Fuels, amended June 12, 1998

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SS7: Sulfuric Acid Plants

Brief Summary:

Sulfuric acid is used as a catalyst in alkylation units at petroleum refineries. Over time, sulfuric acid is contaminated with petroleum products and needs to be regenerated.

The first step in the process is thermal decomposition of spent sulfuric acid in a furnace, producing sulfur dioxide (SO₂). The catalytic reaction oxidizing SO₂ to SO₃ (which then reacts with water to form fresh sulfuric acid) is an equilibrium reaction which is never 100 percent efficient. As a result, there is always some unreacted SO₂ that is vented to the atmosphere.

There are three acid plants associated with Bay Area refineries. The Tesoro Refinery near Martinez operates an acid plant; Eco Services in Martinez operates an acid plant as a support facility for the Shell and Valero refineries on a regular basis and serves as a backup facility for the Tesoro Refinery when Tesoro's acid plant is shut down; and Chemtrade West in Richmond operates an acid plant as a support facility for Chevron Products.

Purpose:

Reduce SO₂ emissions from sulfuric acid regeneration associated with petroleum refining.

Source Category:

Permitted Sources – sulfuric acid plants

Regulatory Context and Background:

In 1977, the United States Environmental Protection Agency (EPA) promulgated 40 CFR part 60, subpart H, *Standards of Performance for Sulfuric Acid Plants*. The regulation limits SO₂ emissions to 4 pounds per ton of acid produced and limits sulfuric acid mist emissions to 0.15 pounds per ton of acid produced. Air District Regulation 9, Rule 1 (Rule 9-1) establishes emission limits for sulfur dioxide from all sources including ships, and limits ground level concentrations of sulfur dioxide. In 1992, the Air District amended Rule 9-1, establishing an SO₂ emission limit of 300 parts per million-volume (ppmv) for sulfuric acid plants, calculated at 12 percent oxygen.

In 2007, Rhodia, Inc. entered into a consent decree with EPA and the United States Department of Justice limiting SO₂ emissions from the acid plant (now operated by Eco Services) to 2.2 pounds per ton of 100 percent sulfuric acid produced, 365-day average, and 3.0 pounds per ton of 100 percent sulfuric acid produced, three-hour average.¹

In their November 2010, RECLAIM Report, South Coast Air Quality Management District (SCAQMD) staff recommended a limit of 0.14 lbs per ton of acid produced (10 ppmv), which was adopted by SCAQMD.

¹ This was part of a nation-wide consent decree and was not limited to the Martinez acid plant.

A review of EPA’s RACT/BACT/LAER Clearinghouse² (RBLC) revealed a 2006 synthetic minor permit from New Jersey with an SO₂ limit of 0.2 lbs per ton of acid produced and a 2012 PSD permit from Indiana with an SO₂ BACT limit of 0.25 lbs per ton of acid produced, 24-hour average.

The New Jersey Department of Environmental Protection provided the Air District with two recent source test reports for the facility in Union County, New Jersey with the 0.2 pound per ton limit. The State of New Jersey confirmed that the facility was in compliance with its emission limits.

Implementation Actions:

Consider amendments to Rule 9-1, *Sulfur Dioxide*, that would limit SO₂ emissions from acid plants associated with petroleum refining. Consider establishing BARCT limits of 0.2 lbs. of acid mist per ton of acid produced.

Emission Reductions:

Pollutants*	2020	2030
SO ₂	2,800	2,800

*criteria pollutants are reported in lbs/day

Exposure Reductions:

Emissions from the Bay Area’s five major oil refineries have been steadily decreasing over the past several decades, however, refineries are major sources of criteria air pollutants, TACs, and GHGs. Refineries are also located in impacted communities, including in Richmond. In October 2014, the Air District Board of Directors adopted a Refinery Emissions Reduction Resolution, which established a goal of reducing refinery criteria air pollutant emissions by 20 percent or as much as feasible by 2020. In response to that directive, the Air District has developed a Bay Area Refinery Emissions Reduction Strategy. The Refinery Strategy ensures that refineries are taking the strongest feasible steps to reduce emissions and minimize their health impacts on neighboring residents and the region as a whole. This measure is one of twelve control measures in the 2017 Plan that make up the Refinery Strategy.

Emission Reduction Trade-Offs:

None

Costs:

BARCT limits of 0.2 lbs per ton of acid produced will require wet scrubbers at each of the three acid plants. One acid plant already has a wet scrubber, but it may need to be upgraded or replaced to meet the new standards. Capital costs are estimated at \$7,000,000 for each facility, amortized to \$700,000 annually. Operating costs are estimated at \$200,000 per year at two facilities, and \$300,000 per year for the third (higher caustic costs for higher SO₂ reductions). Total costs are \$2,800,000 per year.

² The RBLC is a national database of case-by-case emission limitations made by permitting authorities when authorizing new sources of air pollution.

Co-Benefits:

There will be less secondary PM_{2.5} formation from reduced sulfates.

Issue/Impediments:

None

Sources:

1. 40 CFR part 60, subpart H, *Standards of Performance for Sulfuric Acid Plants* [42 FR 37936, July 25, 1977]
2. South Coast Air Quality Management District, Final Staff Report: Sox RECLAIM, Part 1, BARCT Assessment & RTC Analysis, November 2, 2010
3. US Environmental Protection Agency, RACT/BACT/LAER Clearinghouse (RBLC) Clean Air Technology Center
4. Bay Area Air Quality Management District, Regulation 9: Rule 1, *Inorganic Gaseous Pollutants: Sulfur Dioxide*, last amended March 1995

DRAFT

SS8: Sulfur Dioxide from Petroleum Coke Calcining

Brief Summary:

This control measure will limit emissions of sulfur dioxide (SO₂) from petroleum coke calcining by requiring that emission controls at coke calcining kilns remove an equivalent of 59 percent of the SO₂ created by the calcining process. These reductions will be achieved through Air District Regulation 9, Rule 14 (Rule 9-14), adopted in April 2016.

Purpose:

Reduce SO₂ and particulate matter emissions.

Source Category:

Stationary source – petroleum coke calcining operations

Regulatory Context and Background:

The Air District is a nonattainment area for the California PM₁₀ and PM_{2.5} clean air standards and for the national PM_{2.5} standards. Particulate matter (PM) comes from natural sources (dust, sea salt), motor vehicles (mostly diesel soot), and industrial sources (catalyst emissions from refineries, black carbon from power plants). Particulates can also form in the air from reaction of ammonia with NO_x and sulfur oxides (SO_x). Exposure to PM pollution has the greatest health impact because the smallest particles can penetrate deep into the lungs, causing damage to lung tissue. The finest of these particles can penetrate through lung tissue into the bloodstream causing a large variety of health issues such as aggravating existing heart disease.

SO₂ is a pungent-smelling gas commonly formed from the burning of fossil fuel materials that contain sulfur, such as coal or oil, and from certain industrial processes, such as petroleum refining, chemical production, and metal smelting. It is also released from natural sources such as volcanoes, geothermal hot springs and wildfires.

Once emitted into the atmosphere, SO₂ reacts with chemicals in the air, such as ozone, or in the presence of water to form sulfuric acid and eventually reacts with ammonia in the air to form ammonium sulfate, a component of PM_{2.5}.

Two coke calcining kilns at the Bay Area's only petroleum coke calcining facility emit a total of 4.0 tons per day of sulfur dioxide when the Carbon Plant is fully operational. Air District staff has investigated more stringent SO₂ limits at coke calcining facilities. The Carbon Plant currently operates a dry sorbent injection abatement device to control SO₂ emissions to maintain compliance with the current SO₂ limit in Regulation 9, Rule 1 (Rule 9-1) of 400 ppm by volume or 113 kg (250 pounds) per hour, whichever is more restrictive. The Carbon Plant as well as Air District staff have source tested the calcining operation and have determined that the Carbon Plant currently reduces SO₂ emissions, on average, by approximately 42 percent overall, which is higher than previously known. The South Coast AQMD and San Luis Obispo County APCD both require a minimum of 80 percent SO₂ control, which is more restrictive than the Air District's current requirements.

An analysis of the impact of an 80 percent SO₂ control showed a significant impact on the Bay Area's Carbon Plant. Therefore, the Air District adopted Rule 9-14: Coke Calcining Operations which would allow for a mass emission limit of 1,050 tons per year (tpy) which is equivalent to 59 percent control in a typical year. This emission limit is a combined limit for both kilns. Staff anticipates this mass emission standard will realize an SO₂ emission reduction of 430 tpy. The rule also proposes an hourly limit of 320 pounds per hour for the combined SO₂ emissions from both kilns.

Implementation Actions:

The Air District will:

- Ensure that both of the Carbon Plant's kilns comply with the SO₂ pounds per hour emission limit by January 1, 2019.
- Ensure that both kilns comply with the tons per year emission limit by January 1, 2020.

Emission Reductions:

Pollutants*	2020	2030
SO ₂	2,356	2,356

**criteria pollutants are reported in lbs/day*

Exposure Reduction:

Emissions from the Bay Area's five major oil refineries have been steadily decreasing over the past several decades, however, refineries are major sources of criteria air pollutants, TACs, and GHGs. Refineries are also located in impacted communities, including in Richmond. In October 2014, the Air District Board of Directors adopted a Refinery Emissions Reduction Resolution, which established a goal of reducing refinery criteria air pollutant emissions by 20 percent or as much as feasible by 2020. In response to that directive, the Air District has developed a Bay Area Refinery Emissions Reduction Strategy. The Refinery Strategy ensures that refineries are taking the strongest feasible steps to reduce emissions and minimize their health impacts on neighboring residents and the region as a whole. This measure is one of twelve control measures in the 2017 Plan that make up the Refinery Strategy.

Emission Reductions Trade-offs:

None identified.

Costs:

Air District staff has estimated that it will cost between \$4 and \$5 million to upgrade the existing SO₂ controls system to meet the requirements of Rule 9-14. Under the Air District's standard method for distributing one-time capital costs over the life of the equipment, that translates to an annual cost of \$680,000/year. Another significant cost is the purchase of dry sorbent material to react with the SO₂ in the process stream and to convert it to an inert solid that is captured in the existing particulate matter control system. Based on cost quotes from a sorbent supplier, Air District staff estimates these costs to be \$500 per ton of additional sorbent.

In summary, the estimated annual cost for the Carbon Plant to improve their current Dry Sorbent Injection (DSI) system to comply with the 1,050 tpy emission requirement in Rule 9-1 is approximately \$1.87 million.

Issues/Impediments:

None identified.

Sources:

1. South Coast AQMD Rule 1119: Petroleum Coke Calcining Operations – Oxides of Sulfur.
2. San Luis Obispo County Air Pollution Control District Rule 440: Petroleum Coke Calcining and Storage Operations.
3. South Coast AQMD November 2010 SO_x Reclaim BARCT Assessment Staff Report.
4. Applied Development Economics October 2015 Socioeconomic Analysis of Carbon Plant and draft Regulation 9 Rule 14.
5. Bay Area Air Quality Management District, Draft Staff Report: Proposed Regulation 9, Rule 14: Petroleum Coke Calcining Operations, January 2016.

SS9: Enhanced NSR Enforcement for Changes in Crude Slate

Brief Summary:

This measure would enhance the Air District's New Source Review (NSR) permit program to ensure that refineries are complying with all applicable NSR permit requirements when they change the type of crude oil they process, i.e. changes to the crude slate. This requirement would compel refineries to submit a permit application providing details of any significant change in crude slate, which would allow the Air District to review the change and determine whether it is subject to NSR requirements. Requiring a review of all such significant crude slate changes will allow the Air District to evaluate such changes in detail and ensure that they will comply with applicable NSR permitting requirements.

Purpose:

To ensure compliance with NSR program requirements.

Source Category:

Stationary Source – petroleum refineries

Regulatory Context and Background:

The Air District's NSR program is a comprehensive air permitting program that applies to a wide range of stationary source facilities within the Air District's regulatory jurisdiction. The program requires a facility to obtain a permit and implement state-of-the-art air pollution control technology whenever a facility installs a new source of air emissions or makes a modification to an existing source.

The Air District's NSR program is set out in Regulation 2, Rule 2 (Rule 2-2) and is the Air District's fundamental permitting requirement for regulating criteria pollutant emissions. It requires facilities to obtain an NSR permit for any new or "modified" source of air emissions, and to satisfy a number of air pollution control requirements in order to be eligible for the permit.¹ These requirements vary somewhat depending on the pollutant involved, being somewhat more stringent for pollutants for which the region is not in attainment of the applicable ambient air quality standards (non-attainment pollutants) and somewhat less stringent for pollutants for which the region is in attainment of the applicable ambient air quality standards (attainment pollutants).

This control measure is designed to ensure that refineries comply with applicable NSR permitting requirements when they change the types of crude oil – known as the refinery's

¹ "Modified source" is defined in Regulation 2-1-234 as (i) any physical change, change in the method of operation, increase in throughput or production, or other similar change to a source that will result in an increase in the source's permitted emissions (or for "grandfathered" sources that are not subject to any permit limits, in increase in the source's physical capacity to emit air pollutants); or (ii) for sources at "major" facilities, which includes all Bay Area refineries, any change that will result in a "significant" increase in the source's actual emissions as defined in EPA's federal NSR regulations.

“crude slate” - that they process.² Concerns have been raised that refineries may be making changes associated with moving to new crude oil slates that are subject to NSR permitting requirements, but without obtaining NSR permits or complying with the substantive requirements of the NSR program. A situation could arise where a refinery makes a physical change or change in its method of operations associated with a change in crude slate that meets the definition of a “modification” and would thus require the refinery to obtain an NSR permit under Rule 2-2 and implement the NSR program requirements before making the change. If a refinery makes such a “modification” associated with crude slate changes without applying for or obtaining an NSR permit, it may be difficult or impossible for the Air District (and the public) to discover that the modification was made. Refineries are large, complex operations, and any modifications associated with crude slate changes may be relatively subtle and not immediately obvious.

In 2000, the Air District added the term “alteration” in Regulation 2, Rule 1 (Rule 2-1) Section 233, defined as a change at a source that does *not* increase emissions and is therefore not a “modification” (i.e., a change that does increase emissions). Rule 2-1 Section 301 requires facilities to obtain a permit before making either an “alteration” or a “modification,” and so a permit is required for all such changes, whether they increase emissions (a modification) or do not increase emissions (an alteration). In this manner, *all* changes at a facility that may impact emissions require a permit review, which allows the Air District to determine whether or not they are subject to NSR requirements.

Air District staff is investigating potential amendments to Rule 2-1 to expand the definition of “alteration” to include any significant crude slate change at a petroleum refinery. A crude slate change that increases emissions would be a “modification,” and a crude slate change that does not increase emissions would be an “alteration.” In both cases the refinery would need to obtain a permit before making the change. If the refinery believes that the crude slate change will involve an emissions increase (i.e., will be a “modification”), it can apply for an NSR permit and implement the NSR requirements as it would for any other modification. If the refinery believes that the crude slate change will not involve an emissions increase (i.e., will be an “alteration”), it can apply to have the change permitted as an alteration, which is not subject to NSR. The Air District will then review the application to determine whether there will in fact be any emissions increase or not. If the Air District confirms that there will not be any increase, it will issue a permit and authorize the change as an alteration. If the Air District finds that there will be an increase, however, it will require the change to be treated as a modification and will require the refinery to implement the NSR requirements as a condition to making the crude slate change.

² The term “crude slate” refers to the mix of crude oil types that a refinery processes, and it reflects various characteristics of the crude oil such as sulfur content and density. The crude slates being refined by Bay Area refineries have been changing recently, and they are expected to continue to change in the future as California’s crude oil resources in the Central Valley start to become depleted and refineries look to other sources of crude oil.

Implementation Actions:

The Air District would revise the definition of “alteration” in Rule Section 2-1-233 to clarify that any significant crude slate change is an alteration, such that refineries will need to obtain Air District approval before making such a change. The approval process will allow the Air District to review the change and determine whether it is subject to NSR permitting requirements, and if so, to ensure compliance with any applicable NSR requirements.

Emission Reductions:

This proposed revision is primarily aimed at improving compliance with and enforcement of the Air District’s NSR program; it is difficult to quantify the extent of any additional emission reductions associated with such revisions. In situations where a refinery making a crude slate change would have complied with all NSR permitting requirements anyway, the proposed amendment would have essentially no impact. If refineries are making crude slate changes subject to NSR without complying with the regulations, then better enforcement to require the refineries to implement these requirements - as called for in this measure - will have substantial emission reduction benefits.

Exposure Reductions:

Emissions from the Bay Area’s five major oil refineries have been steadily decreasing over the past several decades, however, refineries are major sources of criteria air pollutants, TACs, and GHGs. Refineries are also located in impacted communities, including in Richmond. In October 2014, the Air District Board of Directors adopted a Refinery Emissions Reduction Resolution, which established a goal of reducing refinery criteria air pollutant emissions by 20 percent or as much as feasible by 2020. In response to that directive, the Air District has developed a Bay Area Refinery Emissions Reduction Strategy. The Refinery Strategy ensures that refineries are taking the strongest feasible steps to reduce emissions and minimize their health impacts on neighboring residents and the region as a whole. This measure is one of twelve control measures in the 2017 Plan that make up the Refinery Strategy.

Emission Reduction Trade-Offs:

None identified at this time.

Costs:

This measure would entail compliance costs, however, they would not be new costs imposed by additional regulations; they are simply existing compliance costs. These costs may be viewed as “additional” by refineries if they have not been complying with existing regulations, and therefore incurring compliance costs of the existing regulation. The extent of any such compliance costs is unknown, given that the scope of any such non-compliance is unknown.

Co-Benefits:

None.

Issue/Impediments:

None.

SS10: Petroleum Refining Emissions Tracking

Brief Summary:

On April 20, 2016, the Air District Board adopted Regulation 12, Rule 15 (Rule 12-15). The regulation includes provisions to: 1) improve petroleum refinery emissions inventories of criteria pollutants, toxic air contaminants (TACs) and greenhouses gases (GHGs), 2) collect volume and composition data on crude oil and other feedstocks processed by refineries, and 3) expand refinery fence line air monitoring. The improved emission inventory requirement also applies to five refinery support facilities.

Purpose:

The purpose of this control measure is to implement Rule 12-15; to improve the quality of refinery air emissions data, so that the public may be better informed, and to better inform future rulemaking efforts. Rule 12-15 itself does not include emission limits or trigger levels for emission mitigation actions, although the information provided through implementation of Rule 12-15 could lead to emission limits or emission mitigation triggers in separate, future rulemaking.

Source Category:

Stationary sources – petroleum refineries

Regulatory Context and Background:

A petroleum refinery is an industrial facility that converts crude oil into gasoline, diesel fuel, heating oil, lubricating oil, and other products. The Bay Area has five large-scale petroleum refineries that rank among the ten largest sources of air pollution in the air basin and are classified as major sources of criteria pollutants, toxic air contaminants, and greenhouse gases. As a result, the refineries are subject to Air District major source permitting requirements to operate, as well as when constructing or modifying operations.

Numerous federal, state, and local regulations apply emission limits and associated monitoring, record keeping, and reporting requirements to owners and operators of equipment commonly found at petroleum refineries including:

- Federal standards under 40 CFR parts 60 and 63 that apply to storage tanks, combustion equipment, equipment leaks, wastewater treatment plants, sulfuric acid plants, sulfur recovery units, flares, and common refinery process units;
- State Air Toxics Control Measures that apply to combustion units; and
- Air District Rules that apply to storage tanks, combustion equipment, equipment leaks, wastewater treatment plants, sulfur dioxide emissions, hydrogen sulfide emissions, flares, and other common refinery process units.

In addition, petroleum refineries are required under 40 CFR part 98 to report greenhouse gas emissions annually to the federal government and by California's Mandatory Reporting Rule to report greenhouse gas emissions annually to the State of California.

Implementation Actions:

Air District staff will prepare an implementation plan to identify required actions and deadlines for both refineries and responsible District staff. New Rule 12-15 requires refineries to:

- Prepare reports of emissions of criteria pollutants, toxic air contaminants, and greenhouse gases from the refinery (refineries and certain refinery support facilities),
- Generate a crude slate report describing the characteristics of crude oil and imported feedstocks processed by the refinery, and
- Develop air monitoring plans and install and operate fence-line air monitoring systems.

Emission Reductions:

None. Rule 12-15 is intended to provide information rather than reduce emissions.

Exposure Reductions:

Rule 12-15 is intended to provide information rather than reduce emissions.

Emission Reduction Trade-Offs:

None.

Costs:

According to the socioeconomic study prepared for Rule 12-15, the costs associated with this rule include:

- \$315,000 per refinery, per year for 10 years as the annualized cost of preparing Air Monitoring Plans and installing fence-line air monitors, and
- \$140,000 per refinery, each year, for new emissions inventories and crude/feedstock reports, and operation and maintenance of air monitoring systems.

Co-Benefits:

Increased transparency and tracking of refining emissions.

Issue/Impediments:

None.

Sources:

1. Regulation 12, Rule 15: Petroleum Refining Emissions Tracking, April 20, 2016.
2. Socioeconomic Analysis of Proposed Regulation 12, Rule 15, prepared for Bay Area Air Quality Management District, Applied Development Economics, Inc., March, 2016.

SS11: Petroleum Refining Facility-Wide Emissions Limits

Brief Summary:

This control measure would limit facility-wide emissions of greenhouse gases (GHG) and three criteria air pollutants - particulate matter (PM), oxides of nitrogen (NO_x), and sulfur dioxide (SO₂) - from Bay Area petroleum refineries through Air District Regulation 12, Rule 16.

Purpose:

The purpose of this control measure is to prevent increases of GHG and certain criteria air pollutant emissions that could result from operational changes at Bay Area refineries in order to protect the climate, and the region's air quality.

Source Category:

Stationary sources – petroleum refineries

Regulatory Context and Background:

A petroleum refinery is an industrial facility that converts crude oil into gasoline, diesel fuel, jet fuel, lubricating oil, and other products. The Bay Area has five large-scale petroleum refineries that rank among the ten largest sources of air pollution in the air basin. Refineries and their associated facilities contribute significantly to carbon dioxide (CO₂) emissions (the primary driver of climate change), criteria pollutant emissions (including NO_x, SO₂, and PM), and toxic air contaminant emissions which can exacerbate community health risks. While refinery criteria pollutant emissions have declined over time, refinery GHG emissions have been relatively stable in the last few years¹, so there is a possibility that changes in facility operations, crude or product slates, or increases in production could increase GHGs and other emissions from refineries.

Given community concern about the potential for emission increases from oil refineries, the Board of Directors directed Air District staff to evaluate draft Regulation 12, Rule 16 (Rule 12-16) as an option to address potential emission increases from operational changes at the Bay Area refineries. Draft Rule 12-16 reflects a policy recommendation from Communities for a Better Environment (CBE) and their associated organizations. The rule, as proposed by CBE, would limit the emissions of climate pollutants and three criteria pollutants: PM, NO_x, and SO₂ from Bay Area petroleum refineries and three associated facilities. The draft rule would establish facility-wide emissions limits for the covered pollutants at each of the affected facilities to ensure that each facility does not increase emissions. Each facility emissions limit would be set at the historical maximum-annual emissions reported for that facility, with an additional allowance over the maximum annual emission rate for each pollutant to allow for normal variation. Rule 12-16 will be evaluated alongside Regulation 11, Rule 18, which focuses on existing sources of toxic air contaminants (TACs) such as refineries (see SS20: Air Toxics Risk Cap and Reduction from Existing Facilities).

¹ According to ARB's GHG mandatory reporting data from 2008 through 2015.

Implementation Actions:

The Air District will develop draft language for new regulation, Rule 12-16, based on CBE's proposal, in order to evaluate its cost-effectiveness and socioeconomic impacts as part of the rule development process. Staff will also evaluate Rule 12-16, alongside Rule 11-18, in a combined Environmental Impact Report to ensure that all of the potential environmental impacts for both rules are considered and addressed.

Emission Reductions:

Emission reductions are not expected from Rule 12-16 because the rule is designed to prevent future facility-wide emissions increases over a baseline based on the latest years of operations.

Exposure Reductions:

Refineries are major sources of criteria air pollutants, TACs, and GHGs and are also located in impacted communities, including in Richmond. In October 2014, the Air District Board of Directors adopted a Refinery Emissions Reduction Resolution, which established a goal of reducing refinery criteria air pollutant emissions by 20 percent or as much as feasible by 2020. In response to that directive, the Air District has developed a Bay Area Refinery Emissions Reduction Strategy. The Refinery Strategy ensures that refineries are taking the strongest feasible steps to reduce emissions and minimize their health impacts on neighboring residents and the region as a whole. This measure is one of twelve control measures in the 2017 Plan that make up the Refinery Strategy.

Costs:

The costs and economic impacts of Rule 12-16 to refineries and other affected parties will be analyzed as part of the rule development process.

Source:

1. California Air Resources Board (2016) 2030 Target Scoping Update Plan Concept Paper. June 17. Available at:
http://www.arb.ca.gov/cc/scopingplan/document/2030_sp_concept_paper2016.pdf

SS12: Petroleum Refining Climate Impacts Limit

Brief Summary:

This control measure would limit facility-wide carbon intensity at each Bay Area petroleum refinery through a new Air District regulation. Carbon intensity for each refinery would be tracked with a Refining Climate Index (RCI). Emission increases that result in RCI increases over an established baseline would be required to be offset using the existing Low Carbon Fuel Standard (LCFS) framework.

Purpose:

The purpose of this control measure is to prevent increases in carbon dioxide (CO₂) from Bay Area refineries, at current levels of production.

Source Category:

Stationary sources – petroleum refineries

Regulatory Context and Background:

The Bay Area has five large-scale petroleum refineries that, along with their associated facilities, contribute significantly to greenhouse gas (GHG) emissions, among other pollutants. Though refinery GHG emissions have stabilized over time, there is concern that changes in crude or product slate could increase these emissions, even at current levels of production. As conventional oil resources dwindle and technology advances, unconventional hydrocarbon deposits such as shale oil, tar sands, and heavy oils in once-unreachable areas have become viable resources. The emission profiles, and resulting climate and health impacts, of these new sources of crude oil are not well understood.

There are numerous existing federal, state, and local regulations that apply emission limits and associated monitoring, record keeping, and reporting requirements to refineries, though not all refinery sources are covered. In April 2016, the Air District adopted a new rule (Regulation 12, Rule 15) to improve the quality of refinery air emissions data so that the public may be better informed, and to better inform future rulemaking to further reduce emissions. Rule 12-15 requires that all refineries: 1) submit consistent, enhanced periodic emissions inventory information; 2) submit periodic crude slate information; and 3) install and operate new air monitoring facilities at refinery fence lines (see SS10: Petroleum Refining Emission Tracking).

Meanwhile, the Air District continues to seek to minimize the health and environmental impacts of emissions from refinery sources. One way to address any GHG emission increases resulting from refineries changing crude slates is to establish a limit on their carbon intensity, generally characterized as the average GHG emissions released per barrel of crude oil processed.¹ The Air District will explore the use of the Oil-Climate Index, developed by the

¹ There is no standard way to calculate carbon intensity; it is generally defined as the average rate of carbon emissions relative to the intensity of a specific activity (in this case, refining). Air District staff has currently chosen to calculate carbon intensity based on crude oil processed but this definition may change in the future.

University of Calgary, to systematically estimate the total GHG emissions embodied in crude oil from different origins. The Oil-Climate Index (OCI) is a streamlined tool that integrates three open-source models to estimate GHG emissions from all stages of the life cycle of a barrel of crude oil: upstream (oil production and transport to the refinery), midstream (oil refining and distribution to the consumer), and downstream (consumption of oil products as transportation fuels) (Gordon et al., 2016). Refineries are already held accountable for the upstream and downstream portion of their emissions at the state level through the Low Carbon Fuel Standard (LCFS) regulation. In fact, the LCFS uses the same model that the OCI employs to estimate oil production and transport emissions, the Oil Production Greenhouse Gas Estimator (OPGEE). However, the LCFS assumes an average refining carbon intensity for all California refineries hence it does not track changes in the carbon intensity of crude processing at the individual refineries.

Air District staff proposes the use of the OCI model that estimates refining energy use and GHG emissions, the Petroleum Refinery Life Cycle Inventory Model (PRELIM)², to establish a benchmark Refining Climate Index (RCI) for each Bay Area refinery. This baseline RCI would be based on the GHG emissions produced by the specific crude slates processed at each refinery during the baseline period for crude slate reporting in Rule 12-15, namely 2013 – 2016. On every consequent year, an RCI value would be calculated for each individual Bay Area refinery and compared with its baseline RCI. Staff proposes the use of the existing LCFS market as a framework to prevent emission increases over the baseline, since the emissions accounting in the RCI would be consistent that in the LCFS. Any increase in a refinery yearly RCI from their baseline RCI would generate LCFS debits. Each refinery would be required to obtain LCFS credits as needed to balance the account by the end of following year.

Implementation Actions:

The Air District will evaluate the cost-effectiveness and socioeconomic impacts of establishing a Refining Climate Index limit for each of the Bay Area refineries as part of the rule development process.

Emission Reductions:

Emission reductions are not expected from this measure since a facility-wide carbon intensity limit for refineries would be based on the current carbon intensity of each refinery. This approach is designed to prevent increases in facility GHG emissions, within each facility's current level of production. However, facility GHG emissions may still increase with production increases since capping carbon intensity only limits GHG emissions per unit produced.

Exposure Reductions:

Criteria air pollutant emissions from the Bay Area's five major oil refineries have generally been decreasing over the past several decades, while GHG emissions have been relatively stable in

² The PRELIM is an Excel-based model that estimates energy use and GHG emissions associated with petroleum refining. Results are presented by product type, based on crude oil assay's properties, for two types of refinery configurations: coking and hydro.

the last few years.³ However, refineries are major sources of criteria air pollutants, TACs, and GHGs. Refineries are also located in impacted communities, including in Richmond. In October 2014, the Air District Board of Directors adopted a Refinery Emissions Reduction Resolution, which established a goal of reducing refinery criteria air pollutant emissions by 20 percent or as much as feasible by 2020. In response to that directive, the Air District has developed a Bay Area Refinery Emissions Reduction Strategy. The Refinery Strategy ensures that refineries are taking the strongest feasible steps to reduce emissions and minimize their health impacts on neighboring residents and the region as a whole. This measure is one of twelve control measures in the 2017 Plan that make up the Refinery Strategy.

Costs:

The costs and economic impacts of a refinery carbon intensity limit will be analyzed as part of the rule development process.

Source:

1. Deborah Gordon, Adam Brandt, Joule Bergerson, and Jonathan Koomey, Oil-Climate Index, <http://oci.carnegieendowment.org/>, created 2015 and updated 2016

³ According to ARB's GHG mandatory reporting data from 2008 through 2015.

SS13: Natural Gas and Crude Oil Production, Processing and Storage

Brief Summary:

Upstream natural gas and crude oil production, processing and storage operations are responsible for significant emissions of organic compounds including methane, a potent greenhouse gas (GHG), toxic air contaminants (TACs), and volatile organic compounds (VOCs). This control measure seeks to control fugitive and vented emissions from these operations by working with the California Air Resources Board (ARB) on their upcoming oil and gas rule, and by potentially amending an existing Air District rule (Rule 8-37) to address any local concerns specific to the Bay Area.

Purpose:

To reduce emissions of methane, a potent GHG, and other organic compounds from natural gas and crude oil production, processing and storage facilities throughout the Bay Area.

Source Category:

Stationary sources – oil and gas production facilities

Regulatory Context and Background:

In 2011, the California Air Resources Board (ARB) completed a comprehensive survey of the oil and gas industry for the calendar year 2007 with the intention of developing a rule to address emissions of GHGs from these industrial sectors. This survey found 68 active crude oil and natural gas facilities^{1,2} in the Air District, which ARB estimated to emit a total of 198,987 MT CO₂e, using a 20-year time horizon, during that year (ARB, 2013)³. However, this source-level estimate may be considered as conservatively low given that recent studies have shown a large gap between atmospheric (or “top down”) estimates and source-level (or “bottom up”) estimates of methane emissions from this sector nationally and state-wide (Brandt *et al.*, 2014; Jeong *et al.*, 2013).

Laws Affecting Organic Emissions from the Oil & Gas Sector:

Federal

In 2015, the U.S. Environmental Protection Agency (EPA) proposed a suite of actions to reduce methane and further reduce VOC emissions from the oil and natural gas industry. Some of these actions are focused on regulation, such as updating the 2012 New Source Performance Standards to address methane and clarifying the agency’s air permitting rules for oil and gas production. However, EPA’s recent proposed regulatory actions for methane emission

¹ In ARB’s survey, any facility that extracts crude oil, natural gas or both was considered as an individual facility, regardless of the size of the operation. In this context, crude oil or natural gas wells may be counted as facilities.

² While more recent data from California’s Division of Oil, Gas & Geothermal Resources (DOGGR) and the Air District indicate a higher number of wells, ARB’s 2007 data are presented as a conservative estimate.

³ Calculated using ARB’s estimates of carbon dioxide and methane emissions for the Air District, and a global warming potential (GWP) for methane of 86 over 20 years, per Chapter 8 of the IPCC Fifth Assessment Report.

reductions apply to new and modified sources only, and not to existing facilities which are responsible for the majority of this sector's emissions (EPA, 2015). In March 10, 2016, EPA announced its intention to explore regulating methane emissions from existing oil and gas operations. EPA started outreach efforts with stakeholders in March 2016 and launched a formal information collection process in April of 2016 (EPA, 2016).

State

In April 2015, ARB released the first draft of its proposed regulation to address GHGs from this industry, titled "Greenhouse Gas Emissions Standards for Crude Oil and Natural Gas Facilities." If adopted, this rule would apply to existing and new, onshore and offshore oil and gas production, processing and storage facilities, including natural gas underground storage and transmission compressor stations. It would regulate fugitive and vented methane emissions from equipment at these facilities, such as at uncontrolled oil and produced water tanks (also known as degassing units), compressor seals, and pneumatic control systems. ARB staff has also proposed controlling vapors from well stimulation (fracking and acid stimulation) and incorporating methane-leaking components into air districts' leak detection and repair (LDAR) programs. ARB staff formed a local air district workgroup in which Bay Area Air District staff members are actively participating. The final draft of this rule was released for public comment on May 31, 2016. This draft of the rule was presented by ARB staff to its Board on July 21, 2016 for initial recommendations. ARB's Board directed staff to continue to work with local districts and other state agencies on implementation and coordination, address significant comments, and then bring the final environmental analysis and proposed regulation for approval at a subsequently scheduled public hearing. ARB staff currently intends that most aspects of the regulation, such as reporting, record-keeping and flash testing requirements, as well as LDAR and compressor strategies, will come into effect on January 1, 2017. Provisions requiring retrofits of existing sources will be effective January 1, 2018, to provide time for covered entities to come into compliance with new requirements.

Regional

Air District Regulation 8, Rule 37, (Rule 8-37) adopted in March 20, 1985 and amended in October 17, 1990, limits emissions of organic compounds from natural gas and crude oil production facilities. However, methane is exempted from this rule because it was aimed at reducing ozone formation at the time of the rule's adoption and subsequent amendment.⁴ Rule 8-37 also lacks regulatory requirements for important sources of organic emissions from this sector such as liquid storage tanks, dehydration units and separators. Staff also expects to find other opportunities for emission reductions as this rule is updated.

South Coast Rule 1148.1, adopted in March 5, 2004 and amended in September 2015, limits emissions of VOCs, TACs and total organic compounds (TOCs), which includes methane, from crude oil and natural gas wells and associated equipment that produce more than a barrel of oil

⁴ EPA has officially excluded methane from the definition of VOCs—organic compounds that participate in atmospheric photochemical reactions, such as the formation of ozone—since methane has negligible photochemical reactivity. In other words, methane is not considered an ozone precursor.

or 200 standard cubic feet of gas per day. It requires closed ventilation for any tank systems with 95 percent abatement of all tank and process vapors. Rule 1148.1 has an equipment leak standard of 500 ppm for TOCs (SCAQMD, 2015).

Implementation Actions:

Air District staff will continue working with ARB staff on the development of its Oil and Natural Gas Production, Processing and Storage rule. Once adopted, the Air District plans to collaborate with ARB on the implementation and enforcement of the Oil & Gas rule, including its provisions for natural gas underground storage facilities. The Air District will also consider amending Rule 8-37 to ensure it properly addresses local needs and concerns that may not be the focus of ARB's rule, including:

- **Applicability of Thresholds**
 - The Air District wants to ensure that any emissions applicability threshold applies to facilities and associated equipment in the Bay Area. ARB's rule provides flexibility for a local air district to implement lower leak thresholds or require more frequent inspections, which the Air District may do if deemed necessary and cost-effective.
- **Testing Methodology**
 - The Air District wants to ensure that all testing and sampling methodology required by ARB and Air District rules is scientifically sound, cost effective, and appropriate. To this purpose, Air District staff will continue to provide comments on testing and sampling procedure, particularly in their areas of expertise such as leak detection and flash emissions⁵ testing methodology as collection of a representative sample is very complex.
- **Storage Tanks and Loading**
 - There may be significant flash, working and weathering losses to the atmosphere associated with storage tanks at some well sites within the Air District. Air District staff will evaluate whether closed (vapor collection system) tankage would be a cost effective control strategy. Tank vapors can be controlled onsite by routing these vapors back to process equipment, to onsite combustion equipment or to other abatement equipment. Additionally, significant emissions may result from the transfer of liquid materials into mobile tankage and vacuum trucks. Air District staff will evaluate potential control strategies for these loading operations, including the utilization of a balance system where displaced vapors are routed back to onsite tankage.

The Air District will monitor the progress of EPA's rulemaking for existing oil and gas facilities to make sure any proposed rule amendments are in harmony with federal efforts. In addition, the Air District will leverage its current efforts to develop a fixed site GHG monitoring network over the region and deploy a mobile GHG measurement platform to collect source-specific data on active oil and gas wells and associated facilities with the long-term goal to better characterize

⁵ Flash emissions occur when volatile compounds in a liquid are exposed to temperature increases or pressure decreases, as is the case when produced liquid separated from extracted natural gas or crude oil is transferred from the production separators to atmospheric storage tanks.

GHG and toxic emissions from this sector (see SL3: GHG Monitoring and Emissions Measurement Network).

Emissions Reductions:

Pollutants*	2020	2030
CO _{2e}	35,530	35,530

* CO_{2e} is reported in metric tons/year (100 yr GWP)

Emissions Reductions Methodology:

Applying the control strategies required in ARB’s rule to Bay Area oil and gas facilities, including installing vapor collection on open separators and tank systems, upgrading to low-bleed pneumatic devices and pumps (or installing gas capture), maintaining and repairing compressors, and implementing an LDAR program, would be expected to reduce methane emissions on the order of 89,870 MT CO_{2e} per year (20-year GWP), or 35,530 Mt CO_{2e} per year (100 yr GWP). Though some of these strategies have control efficiencies over 95 percent for emissions, this estimate assumes a 50 percent reduction of methane emissions in order to be conservative. More precise emission reduction estimates will be calculated as more detailed equipment inventory for these facilities is developed.

Costs:

The cost to oil and gas facilities to implement an LDAR program will be approximately \$100,000 – 200,000 per year, based on the overall LDAR cost estimated by ARB and the number of LDAR components in the Bay Area (ARB, 2016). ARB estimated that fitting separators and tank systems with vapor recovery units (VRUs) would cost \$35,000 – 100,000 per two tank system. Some additional costs may also be incurred from the replacement of polyethylene tanks with tanks of steel or a similar material compatible with pressure applications such as VRUs.

Co-Benefits:

Reduction of methane emissions from oil and gas facilities will likely reduce toxic air emissions frequently co-emitted with methane. Toxic air emissions detected in testing of the headspace vapors of storage tanks in the Oil and Gas industry include benzene, toluene, ethylbenzene, xylenes (collectively known as BTEX) and n-Hexane.

Issue/Impediments:

None at this time.

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3. Brandt, A.R. *et al.* (2014) Methane Leaks from North American Natural Gas Systems. *Science* 343: 733-735, doi: 10.1126/science.1247045.
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SS14: Methane and Other Fugitive Emissions from Capped Oil and Gas Wells

Brief Summary:

Recent studies have shown that capped oil and gas wells have the potential of emitting methane, volatile organic compounds (VOCs) and toxic air contaminants (TACs). There are over 1,200 capped oil and gas wells in the Bay Area but no emissions data are available for these facilities. This control measure seeks to better characterize emissions from these capped oil and gas wells, and to explore rulemaking to address these emissions.

Purpose:

To reduce fugitive emissions of methane, VOCs and toxic pollutants from capped oil and gas wells in the Bay Area in order to provide climate protection, prevent ozone formation and reduce health impacts in the region.

Source Category:

Stationary source – oil and gas production facilities

Regulatory Context and Background:

Currently, there are a total of 1,442 oil and gas wells in the nine districts within the jurisdiction of the Bay Area Air Quality Management District (Air District) (DOGGR, 2016). Of these wells, only 113 are actively producing oil and/or gas while 1,250 are plugged/capped and 72 are idle. A recent study by Kang *et al.*, published in the Proceedings of the National Academy of Sciences, has been the first to measure methane leak rates from abandoned oil and gas wells. The study focused on 19 abandoned wells in Pennsylvania, five of which were plugged. The median methane leak rate at these wells (1.3×10^{-3} kg/day per location) was significantly higher than at forested, wetland, grassland and river locations near the wells, chosen with identical aerial footprint to the nearest well to serve as controls in the study (1.6×10^{-7} kg/day per location). Methane measurements obtained from the wells ranged from 1.5×10^{-5} to 2.1 kg/day per well, with three out of the 19 wells found to be high emitters, having methane flow rates three orders of magnitude larger than the median leak rate. In addition, the study found higher ratios of ethane, propane and n-butane to methane emissions at well locations than at their surroundings, indicating that abandoned wells may also emit certain VOCs. These results are not surprising since natural gas is known to contain up to five percent ethane, propane, n-butane and other VOCs.

At the present time, there are no emissions data available for capped or abandoned oil and gas wells in the Bay Area. As an initial estimate, methane emissions from Bay Area capped wells were calculated to be approximately 51 MT CO₂e/yr¹, using the median leak rate from the Kang *et al.* (2014) study. However, methane emissions could be up to three orders of magnitude higher if the Bay Area wells have leak rates comparable to the high emitter wells in the study. Moreover, these capped wells may also be emitting toxic pollutants that have been associated with active wells in the past. McKenzie *et al.* (2012) estimated elevated cancer and non-cancer

¹ Using the 20-yr time horizon global warming potential of methane, 86, per the IPCC Fifth Assessment Report.

risks for residents within ½ mile of an active natural gas well due to benzene, trimethylbenzene, xylene and aliphatic hydrocarbon emissions.

Laws Affecting Fugitive Emissions from Capped Wells:

In the Air District, fugitive emissions of organic compounds from oil and gas production facilities, such as oil and gas wells, are regulated under Regulation 8, Rule 37 – Natural Gas and Crude Oil Production Facilities (Rule 8-37). However, methane is explicitly exempt from this regulation (8-7-112) because it was aimed at reducing ozone formation at the time of the rule’s adoption and subsequent amendment.² Rule 8-37 may be updated to remove the methane exemption and improve the VOC control requirements (See SS13: Oil and Gas Production, Processing and Storage). Furthermore, the definitions of natural gas production facility (8-37-213) and crude oil production facility (8-37-214) appear to exclude any facility not engaged in the active production of natural gas or crude oil, and thus would exclude capped wells. Methane emissions from capped oil and gas wells are not addressed by ARB’s Cap and Trade Program.

Implementation Actions:

To support the development of an Air District program to regulate fugitive emissions from capped oil and gas wells, the Air District will:

- Gather background data: Engage the Division of Oil, Gas & Geothermal Resources (DOGGR) to obtain more information on inactive oil and gas wells in the Bay Area, including any applicable requirements and regulations, and to identify any other relevant stakeholders. Review existing regulation and programs from other local air districts, and conduct extensive literature search on fugitive emissions of inactive or capped oil and gas wells.
- Characterize emissions from these facilities: Coordinate with and leverage the Air District’s current efforts to develop a fixed site GHG monitoring network over the region and deploy a mobile GHG measurement platform to collect source-specific data (see SL3: Greenhouse Gas Monitoring and Emissions Measurement Network).
- Consider rulemaking for these facilities: Draft a new rule or amend Rule 8-37 to establish limits for methane emissions, in support of the objectives in the Air District’s 10-Point Climate Action Work Program and of ARB’s AB 32 Scoping Plan, and for VOC and toxic pollutant emissions, consistent with existing regulations.

Emission Reductions:

Pollutants*	2020	2030
CO _{2e}	19	19

CO_{2e} is reported in metric tons/year (100 yr GWP)

Due to accessibility issues (e.g., plugged wells under built structures), it likely will not be possible to repair all leaking wells. Assuming Bay Area capped wells were emitting methane at the median leak rate from the Pennsylvania well study (Kang *et al.*, 2014), repairing 90 percent

² EPA has officially excluded methane from the definition of VOCs—organic compounds that participate in atmospheric photochemical reactions, such as the formation of ozone—since methane has negligible photochemical reactivity. In other words, methane is not considered an ozone precursor.

of leaking wells would result in emissions reductions on the order of 47 MT CO₂e per year (20 year GWP) or 19 MT CO₂e per year (100 year GWP). However, if a fourth of the Bay Area wells were in the “high emitter” category (a fraction similar to that found in the same study), emissions reductions could be on the order of 18,000 metric tons of CO₂e per year. In addition, leaking plugged wells are likely emitting toxic pollutants such as BTEX³ in addition to methane (Warneke *et al.*, 2014). Based on typical mixing ratios of methane to toxic VOCs emitted from active oil and gas wells, these repairs could also result in emissions reductions on the order of 200 pounds per year of benzene, 340 pounds per year of toluene, and 225 pounds per year of C8 aromatics such as ethylbenzene and xylenes.

Emission Reduction Trade-Offs:

None.

Costs:

TBD. The operator cost of re-plugging abandoned wells that are leaking natural gas depends on the number and depth of these wells, as well as the price of cement in the Bay Area Region. In California, DOGGR plugged 1,307 orphan wells from 1977 to 2010 at a total cost of \$23.7 million, an average cost of about \$18,000 per well (DOGGR, 2016).

Co-Benefits:

Reduction in fugitive emissions from capped oil and gas wells would reduce methane emissions, a potent greenhouse gas, resulting in climate protection. It would also have potential health benefits on populations near capped wells by reducing toxic emissions such as benzene and toluene, which can increase the risk of cancer and other serious health effects.

Issues/Impediments:

The Air District will coordinate with state agencies, including ARB and the DOGGR, to ensure non-duplicative regulations. The Air District will also coordinate with the Yolo-Solano Air Quality Management District to strive for consistent treatment of sources within Solano County. In addition, some wells may be buried, or otherwise not accessible for testing and compliance verification.

Sources:

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³ BTEX stands for benzene, toluene, ethylbenzene, and xylenes.

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SS15: Natural Gas Processing, Storage and Distribution

Brief Summary:

This control measure would seek to ensure reductions of methane emissions from natural gas pipelines, storage and processing operations by working with the California Public Utilities Commission (CPUC) to develop rules and procedures to reduce methane emissions as required by Senate Bill 1371.

Purpose:

Significantly reduce the emissions of methane, a potent greenhouse gas, from the natural gas processing, storage and distribution network throughout the Bay Area and improve climate protection.

Source Category:

Stationary sources – natural gas processing, storage and distribution

Regulatory Context and Background:

Overview: In 2014, approximately 93 million metric tons (MMT) of natural gas were consumed in the nine Bay Area counties (CEC, 2015). Based on a 0.2 percent line loss rate, 0.02 MMT of natural gas were lost due to fugitive emissions (leaks) from natural gas pipelines (Markey, 2013; EIA, 2012). This loss translates to 1.4 MMT of CO₂e, when using a 20-year time horizon.^{1,2} It is worth noting that this estimate does not account for large, undetected natural gas leaks such as the Aliso Canyon storage facility leak. Preliminary calculations by the Air Resources Board (ARB) estimate that 2.4 MMT of CO₂e were released from the time this leak was discovered, in October 2015, until it was controlled in February 2016 (ARB, April 2016). It is difficult to incorporate large and unanticipated natural gas leaks, such as the Aliso Canyon leak, into emissions estimates since their frequency is unknown and their magnitude is difficult to quantify accurately even if detected. However, top-down methane emissions estimates for the U.S., California and for its San Francisco and South Coast air basins suggest that there are large, unaccounted emissions from the oil and gas system in bottom-up inventories, and that a large fraction of these originate from a small number of “super-emitters” (Brandt et al., 2014; Jeong et al., 2013; Fairley and Fischer, 2015; Cui et al., 2015).

There are approximately 1,450 miles of natural gas transmission lines within boundaries of the nine Bay Area counties, about 1,300 miles of which are owned by one entity (PHMSA, 2013). A natural gas Leak Detection Repair, Rehabilitation and Replacement (LDAR) program could have a major beneficial impact on greenhouse gas emissions. Pipes constructed out of cast iron or bare steel are the pipes most likely to leak, releasing 27.25 and 12.58 cubic feet of methane per hour, per mile, respectively, according to the U.S. Environmental Protection Agency (EPA) (40 CFR Part 98). PHMSA also lists these materials as high-risk pipeline infrastructure that is prone

¹ Calculated using a 20-yr global warming potential (GWP) of 86 for methane, per the IPCC Fifth Assessment Report.

² Calculated assuming that natural gas consists of 90 percent methane, and varying amounts of ethane, propane, butane and inert compounds.

to failure (PHMSA, 2011). Cast iron and bare steel leak 18 times more gas than plastic pipes and 57 times more gas than protected steel (40 CFR Part 98).

Laws Affecting GHG Emissions from Natural Gas Pipelines: Senate Bill 1371: Natural Gas Leakage Abatement, Leno, was signed into law by Governor Brown on September 21, 2014 (California Public Utilities Code, Sections 975-978). SB 1371 seeks to reduce natural gas leaks and associated greenhouse gas emissions (methane) from California utility gas systems. Methane emissions from natural gas lines are not addressed by ARB's Cap and Trade Program (ARB, 2015). SB 1371 requires the CPUC, in consultation with the ARB, to reduce emissions of natural gas from intrastate transmission and distribution natural gas lines to the maximum extent feasible in order to advance the state's goals in reducing emissions of greenhouse gases pursuant to the California Global Warming Solutions Act of 2006 (CA PUC 975(B)(2)).

The CPUC adopted rule(s) must:

- Provide for the technologically-feasible and cost-effective repair of leaks and leaking components within a reasonable time after discovery, consistent with the California Global Warming Solutions Act of 2006 and established safety requirements and the goals of reducing air pollution and the climate change impacts of methane emissions.
- Evaluate the operations, maintenance, and repair practices to determine whether existing practices are effective at reducing methane leaks and promoting public safety and whether alternative practices may be more effective at reducing natural gas emissions.
- Establish and require the use of best practices for leak surveys, patrols, leak survey technology, leak prevention, and leak reduction.
- Establish protocols and procedures for the development and use of metrics to quantify the volume of emissions from leaking gas pipelines, and for evaluating and tracking leaks geographically and over time, that may be used for required plans or other state emissions tracking systems, including the regulations for the reporting of greenhouse gases to ARB.
- Require the calculation and reporting to the CPUC and the ARB of a baseline system-wide leak rate and periodically update that system-wide leak rate calculation, and annually report on measures that will be taken in the following year to reduce the system-wide leak rate.

Under this statute, the CPUC started the rulemaking process in January 2015 under proceeding number R.15-01-008. Air District staff has actively participated in the rulemaking process, including presenting at the policy and technology panels on the initial workshop of the proceeding as well as attending all subsequent meetings to date. In May 2015, in accordance with the requirements of SB 1371, affected utilities reported the following to the CPUC:

- A summary of their leak management practices.
- A list of new methane leaks in 2013 by grade.
- A list of open leaks that are being monitored or are scheduled to be repaired.
- A best estimate of gas loss due to leaks.

In addition, current CPUC rulemaking process includes stakeholders from underground natural gas storage facilities and calls for the emissions from this sector to be estimated. However, it is uncertain whether methane emissions from underground storage will be addressed by CPUC's

Gas Leak Abatement rule.³ Phase 1 of the CPUC rulemaking process, on the subject of “Policies and Guidelines”, is currently underway and scheduled to conclude by December 2016. Phase 2, on the subject of “Ratemaking and Performance Based Financial Incentives”, is scheduled for January 2017 through the summer of 2017.

Implementation Actions:

Before embarking on the development of an Air District program to regulate methane emissions from natural gas pipelines, the Air District will:

- Continue to engage with CPUC and ARB staff responsible for developing and implementing the required elements of SB 1371;
- Continue to participate in the CPUC regulatory process;
- Assess the CPUC-developed regulations for areas where Air District efforts may result in additional methane emission reductions and to ensure harmony with the Air District’s Climate Protection Strategy; and
- Review the utility-reported data, when available, to glean additional information on GHG emissions and practices used to prevent and minimize methane emissions.

Listed below are the elements a potential Air District program may contain to address this major source of GHG emissions. The program may require entities responsible for natural gas pipelines to audit and reduce methane emissions in four phases.

Phase 1: Develop:

- Consistent methods for estimating and reporting natural gas/methane losses from natural gas lines, and
- Inventory of the estimated natural gas/methane losses from Bay Area natural gas pipelines sources.

Phase 2: Audit the pipeline system: Identify and map all the natural gas lines in the Air District by:

- Type of piping: transmission lines, distribution mains, or service lines and capacities;
- Material from which it is constructed: cast iron, bare steel, plastic, or protected steel;
- Components: valves, connectors, pumps, compressors, PRDs.
- Prioritize pipe according to leaks, capacity, age, and construction materials.

Phase 3: Develop an LDAR Program plan that would include an audit of the natural gas lines. Also, identify and prioritize piping that should be rehabilitated or replaced and establish a plan for doing so. Plan would be subject to approval by Air District with periodic updates.

³ The current draft of ARB’s Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Facilities rule (Oil & Gas rule), dated May 31st, 2016, includes provisions for natural gas underground storage facilities [95668(i)] which require continuous monitoring and timely leak repairs. ⁴ This can be easily accomplished by segregating a line segment and flooding it with water and capturing the natural gas at an exit point.

Phase 4: Implement the Air District approved LDAR Program plan according to the approved schedule. Ensure that natural gas is captured when evacuating lines for inspection and repair.⁴

Emission Reductions:

Pollutants*	2020	2030
CO _{2e}	283,062	283,062

*CO_{2e} is reported in metric tons/year (100 yr GWP)

If a natural gas LDAR program could reduce line losses by 50 percent, this program would result in an estimated emissions reduction of 715,980 MT of CO_{2e} per year (20 year GWP) or 283,062 MT of CO_{2e} per year (100 year GWP).

Exposure Reductions:

N/A

Emission Reduction Trade-Offs:

None

Costs:

Cost estimates will be developed during rule making. However, the approximate cost of LDAR programs at Bay Area refineries is \$4,100 per 1,000 components. Cost for such a program for natural pipelines could be much higher due to the higher inaccessibility (pipes are buried and may need to be excavated) and much greater geographical expanse of the natural gas distribution network.

Co-Benefits:

A reduction in the amount of natural gas line losses not only reduces GHG emissions, it also reduces VOC emissions. Natural gas contains up to five percent ethane, propane and other VOCs. Thus, this control measure may also result in reductions of VOC emissions associated with natural gas. In addition, methane contributes to background tropospheric ozone levels, and studies consistently show that reducing global methane emissions can lower tropospheric ozone (ARB, 2014). Furthermore, a reduction of methane leaks would result in improved safety of the natural gas line network in the Bay Area and reduce the risk of gas explosions and fires.

Issues/Impediments:

The Air District would have to coordinate with several state and local agencies, including the ARB, the California Energy Commission (CEC), the CPUC, the local Certified Unified Program Agencies (CUPA), the Pipeline and Hazardous Materials Safety Administration (PHMSA) to ensure non-duplicative regulations.

⁴ This can be easily accomplished by segregating a line segment and flooding it with water and capturing the natural gas at an exit point.

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SS16: Basin-Wide Methane Strategy

Brief Summary:

This control measure seeks to better quantify and reduce emissions of methane, and its co-pollutants, from all sources throughout the Air District by implementing a coordinated strategy that combines research, rulemaking, collaborations with state agencies, and other programs.

Purpose:

This control measure seeks to reduce emissions of methane and its co-pollutants, such as nitrous oxide (N₂O) and volatile organic compounds (VOCs), throughout the Air District.

Source Category:

Stationary and area sources.

Regulatory Context and Background:

The latest science has underscored the need to immediately reduce emissions of super-GHGs in order to stabilize global warming below 2°C, a critical threshold to avoid the worse impacts of climate change (IPCC, 2014). Methane (CH₄) is a powerful super-GHG. It is 86 times more potent than carbon dioxide (CO₂) when compared on a 20-year time horizon (or 34 times on a 100-year basis) and it has a much shorter atmospheric lifespan of 12 years (vs. 20 – 200 years) (IPCC, 2014). Due to these factors, actions to reduce methane emissions can provide significant and immediate climate benefits while CO₂ emissions are steadily reduced to achieve long-term climate stability. Curbing methane emissions would also reduce emissions of its co-pollutants, which can include key climate, criteria and toxic pollutants, resulting in public health and (further) climate benefits. For example, finding and reducing methane leaks from oil and gas production facilities would decrease emissions of frequently co-emitted toxic volatile organic compounds (VOCs), such as benzene, toluene, ethylbenzene, and xylenes. Focusing on methane sources in the waste sector would also address emissions of co-pollutants such as nitrous oxide, a potent greenhouse gas (GHG) that warms the atmosphere 298 times faster than CO₂ on a per-molecule basis.

The importance of super-GHGs, and particularly of methane, has been recognized at the international, national, and state levels. There have been many global efforts focused on reducing methane emissions such as the Global Methane Initiative (a partnership of 43 countries comprising over 70 percent of global methane emissions that focuses on methane abatement and recovery), and several methane-specific climate pledges made ahead of the Paris COP21¹. In March 2014, the White House published a Strategy to Reduce Methane Emissions as part of the President's Climate Action Plan. As part of that strategy, the U.S. Environmental Protection Agency (EPA) and other federal agencies have undertaken several actions to reduce methane from the waste, agriculture, coal mining, and oil and natural gas

¹ COP21 stands for the 21st Conference of the Parties of the United Nations Framework Convention on Climate Change, which convened in December 2015. The climate pledges, or Intended Nationally Determined Contributions (INDCs), are non-legally binding emission reduction that countries committed to ahead of the COP21.

sectors. For instance, EPA recently adopted a regulation for new oil and gas production facilities (June 2016) and is currently exploring a regulation for existing oil and gas operations. In the State of California, the Air Resources Board (ARB) released a proposed super-GHG, or short-lived climate pollutant (SLCP) reduction strategy in April 2016 and is expected to present the final SLCP strategy to their Board for approval in late 2016. The proposed strategy addresses emissions of methane (and other super-GHGs) not covered in ARB's Cap-and-Trade program. In the document, ARB emphasizes the critical role that air districts can play in the success of the State's strategy by implementing super-GHG emission reduction strategies in their own jurisdictions.

Methane is the second leading greenhouse gas (GHG) in the Bay Area Air District. In 2015, sources in the district emitted an estimated 10 million metric tons of CO₂ equivalent (MMT CO₂e), about 10 percent of the GHG inventory when calculated on a 20-year basis². According to a recent study commissioned by the Air District to evaluate its methane inventory (Fischer and Jeong, 2016), three source categories represent approximately 84 percent of these emissions. These categories are mainly related to human activities; landfills are the largest source by far, accounting for 53 percent of these emissions, followed by livestock (16 percent) and natural gas production and distribution (15 percent). These emissions estimates carry a large uncertainty (50 percent or more), consistent with a recent study that suggests that methane emissions in the Air District's "bottom-up" inventory³ are 1.5 – 2 times lower than expected from top-down measurements (Fairley and Fischer, 2015). This "methane gap" has been repeatedly observed for the U.S. and California regions, where top-down observations that account for ambient methane concentrations suggest that there are large, unaccounted methane emissions in bottom-up inventories (Brandt et al., 2014; Hsu et al., 2010; Jeong et al., 2013; Cui et al., 2015).

Given the importance and potential co-benefits of controlling methane, the Air District will implement a comprehensive basin-wide methane strategy to reduce the region's methane emissions, in support of ARB's methane reduction goals (40 – 45 percent below current levels by 2030). Elements of this strategy will include: 1) intensifying efforts to improve the Air District's methane emissions inventory, 2) considering amendments to existing Air District Regulation 8, Rule 2 (Rule 8-2) to prohibit significant methane leaks throughout the district, 3) collaborating with state agencies on their methane rules under development, 4) identifying cost effective and technically feasible methane emissions reduction opportunities throughout the Bay Area, and 5) considering the removal of methane exemptions from existing Air District rules when appropriate. These elements are described in more detail below.

- **Improve Methane Emissions Inventory:** The Air District will improve its methane emissions estimates by tracking regional methane emission patterns using a fixed-site GHG monitoring

² Based on the 20-yr global warming potential (GWP) reported for methane in the IPCC Fifth Assessment Report.

³ The Air District traditionally develops its emissions inventory through a bottom-up methodology. In this approach, established emission factors (e.g., methane emitted per unit of natural gas burned) are combined with activity data (e.g., throughput of natural gas) to generate source-specific emissions estimates.

network, and by conducting source-specific measurements of methane throughout the Bay Area. See **SL3: Greenhouse Gas Monitoring and Measurement Network** for more details.

- **Prohibit Significant Methane Leaks:** Currently, there is no Air District rule designed to address large leaks of methane. Air District Rule 8-2 prohibits leaks of organic compounds that exceed 15 pounds per day (and a concentration of 300 ppm) but methane and natural gas are exempted from that prohibition. Thus, the Air District would be limited in its ability to take action should a large natural gas leak similar to the Aliso Canyon storage facility leak occur in the Bay Area. To prevent this potential scenario, the Air District will consider rule amendments to Rule 8-2 that establish a limit above which methane leaks would be prohibited in the region. This leak limit would apply to all stationary sources, including methane leaks from natural gas pipelines, storage tanks, underground storage facilities, refineries, and oil and gas production operations. This rule would serve as a near-term action while additional efforts to address particular sectors are finalized. Such efforts include collaborating with state agencies on their methane rules under development, and seeking cost effective methane reduction opportunities (see items below).
- **Collaboration with State and Other Agencies:** The Air District will continue to collaborate with ARB on their development of an oil and gas production regulation, and with ARB and the California Public Utility Commission (CPUC) on their joint development of a natural gas processing and distribution network regulation, both of which are aimed at reducing methane emissions from these sources. In addition, Air District staff will seek cooperation with other agencies or groups that have similar methane reduction goals, such as the ongoing collaboration with the City of San Francisco’s Department of the Environment on potential emission reduction opportunities for local governments.
- **Methane Reduction Opportunities:** The Air District plans to continually identify cost effective and technically feasible methane emissions reduction opportunities throughout the Bay Area. These opportunities will include, but are not limited to, the following initiatives, identified based on the existing methane emissions inventory:
 - Stationary Sources
 - **Natural Gas & Oil Production:** In addition to collaborating with ARB staff on their oil and gas rule, the Air District will consider amending its existing rule for oil and gas facilities (Rule 8-37) to address methane and VOC emissions from facilities which would otherwise be exempted from ARB’s rule. These include smaller facilities, which are more prevalent in the Bay Area, and capped oil and gas wells, if these facilities prove to be a significant source of emissions. See **SS13: Natural Gas and Crude Oil Production, Processing and Storage** and **SS14: Methane and Other Fugitive Emissions from Capped Oil and Gas Wells** for more details.
 - **Natural Gas Distribution Network:** The Air District will continue participating in CPUC and ARB’s joint development of the Natural Gas Leak Abatement rule, described in detail in **SS15: Natural Gas Processing, Storage and Distribution**.
 - Waste

- **Landfills:** The Air District will propose amendments to the existing Air District landfill rule (Regulation 8, Rule 34) with stricter control and fugitive leak standards, and will evaluate if methane emissions from facilities currently exempt from this rule warrant regulation. See **WA1: Landfills** for more details.
- **Composting and Anaerobic Facilities:** The Air District will consider a rule requiring best practices to reduce methane (and co-pollutant) emissions from composting operations and anaerobic digesters, similar to those adopted in other districts, and will explore further measures to address anaerobic digestion emissions. See **WA2: Composting Operations** for further details.
- Water
 - **Publically Owned Treatment Works (POTWs):** The Air District will seek to better understand and quantify methane and nitrous oxide emissions at POTWs in order to inform potential rulemaking to address these potent greenhouse gases. See **WR1: Limit GHGs from POTWs** for more details.
- Agriculture
 - **Livestock:** The Air District will seek to reduce methane emissions associated with raising livestock by promoting methane capture for on-site energy production, and by engaging with the agriculture community to develop best practices to address enteric fermentation emissions. See **AG2: Dairy Digesters** and **AG3: Enteric Fermentation** for further details.
 - **Confined Animal Facilities:** See **AG4: Livestock Waste/Confined Animal Facilities** for additional information.
- **Remove Methane Exemption from Relevant Rules:** Air District Regulation 8 rules limit the emissions of organic pollutants. In many cases, the specific Reg. 8 rule addresses an industry or source that does not emit methane, such as dry cleaning or architectural coatings. In others, the focus of control may be emissions of smog forming (precursor) compounds, though the industry may also emit methane. Due to that original intent, organic compounds were generally defined in these rules as “any compound of carbon, excluding methane, carbon monoxide, carbonic acid, metallic carbides or carbonates and ammonium carbonate.” Out of the 53 rules that are currently part of Regulation 8, only four rules do not exclude methane as a regulated pollutant. The majority of the rules that exclude methane regulate products like solvents, coatings, and adhesives; in those cases, removal of the methane exemption would not result in reductions of methane emissions. However, there are a few Regulation 8 rules that may benefit from the removal of the methane exclusion. Air District staff will examine emissions and other relevant data to determine if removing the exemption from these rules would result in methane emissions reduction.

Implementation Actions:

The Air District will:

- improve quantification of methane and nitrous oxide in the Air District emissions inventory
- consider amending Regulation 8-2 to prohibit significant leaks of methane throughout the Air District

- address emissions of methane and its co-pollutants from the following sources, prioritizing rule development efforts based on the magnitude of emissions:
 - Natural gas & oil production, natural gas distribution network, natural gas underground storage, and refineries
 - Landfills, composting sites and anaerobic digestion facilities
 - POTWs
 - Livestock and confined animal facilities
- consider removing the methane exemption from existing Air District Regulation 8 rules, when appropriate

Emissions Reductions:

This section presents near-term GHG emission reductions for one element of the strategy, amending Rule 8-2, designed to serve as a stopgap for large methane leaks, while sector-specific regulations are developed. These emissions reductions, estimated to be 0.64 MMT CO₂e per year on a 20-year horizon (or 0.25 MMT CO₂e/yr on a 100-yr basis), are expected to increase once sector specific rules targeting the same GHG emissions in a more comprehensive way are adopted and implemented. Please see GHG reductions from these sector specific rules in their respective control measures (outlined above).

Emissions Methodology:

Oil & Gas Sector: Recent scientific evidence suggests that large leaks (“super emitters”) can account for a large portion of the fugitive emissions from the natural gas distribution network, oil and gas wells, and natural gas storage facilities (Lyon et al., 2016). Given these findings, gross estimations of the potential methane reductions from amending Rule 8-2 for this sector were calculated assuming that 80 percent of emissions are due to 20 percent of the leaks – leaks most likely to be defined as a prohibited leak – and a 50 percent discovery and fixing rate for these leaks.

- Natural Gas Distribution Network: Air District staff estimated that the Bay Area natural gas distribution network emits approximate 1.4 MMT of CO₂e per year (based on a 0.2 percent leak rate and using the 20-year time horizon for methane). Using the methodology outlined above, the potential GHG emission reduction would be 0.57 MMT CO₂e per year.
- Natural Gas & Oil Production: ARB estimated that 68 active crude oil and natural gas facilities in the Air District emit a total of approximate 0.2 MMT CO₂e, using a 20-year time horizon, during 2007. Applying the assumptions given above, GHG emissions would be reduced approximately 72,000 MT CO₂e per year.
- Natural Gas Storage Facilities: Considering the environmental incident at the Aliso Canyon natural gas storage facilities, the Air District would monitor facilities such as this quite closely. Potential emission reductions from these sources will be estimated during rule development.
- Petroleum Refineries: Currently, methane emissions from refineries are estimated to constitute less than 2 percent of the anthropogenic methane emitted in the Bay Area. However, preliminary study findings indicate that fugitive methane emissions from refineries may be significantly higher than bottom-up inventory estimates. Due to the

uncertainty in the fugitive emissions from this sector, emission reductions cannot be estimated at this time.

Waste, Water and Agriculture Sectors: Due to the uncertainty and poor understanding of the emissions from sources in these sectors, such as composting, wastewater treatment, and livestock, emissions reductions from amending Rule 8-2 cannot be estimated at this time.

Emission Reduction Trade-Offs:

None

Costs:

Costs are expected to vary widely depending on the source type and proposed regulation and thus will be developed during rulemaking.

Co-Benefits:

The methane strategy has the potential to reduce other pollutants, such as VOCs and toxic compounds associated with oil and gas production, ammonia (a precursor to secondary PM), and N₂O, a potent GHG frequently co-emitted with methane from sources in the waste sector.

Issues / Impediments:

None

Sources:

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SS17: GHG BACT Threshold

Brief Summary:

This measure would lower the threshold at which facilities subject to the Air District's New Source Review permit program must implement the "Best Available Control Technology" to control their greenhouse gas (GHG) emissions below the current 75,000 tons per year (tpy) CO₂e. In addition, this threshold would apply to all regulated facilities, not just "major" facilities.

Purpose:

The purpose of this control measure is to lower GHG emissions in the Bay Area.

Source Category:

Stationary Source – all regulated facilities

Regulatory Context and Background:

The Air District's New Source Review (NSR) program is a comprehensive air permitting program that applies to a wide-range of stationary source facilities within the Air District's regulatory jurisdiction. The program requires a facility to obtain a permit and implement state-of-the-art air pollution control technology whenever a facility installs a new source of air emissions or makes a modification to an existing source.

The federal NSR program requirements were established in the 1977 federal Clean Air Act (CAA) Amendments. The CAA requires local programs to implement requirements through the CAA's system of "cooperative federalism," under which each state or local agency develops and adopts an NSR program that meets (or exceeds) the minimum requirements of the federal NSR program. These programs are submitted to the United States Environmental Protection Agency (EPA) for review and approval. In 1988, the California legislature enacted the California Clean Air Act, which imposes additional state-law NSR permitting requirements that go beyond the federal NSR program in certain aspects. Each air district in California is required to adopt an NSR program that meets both the additional state-law requirements and the federal NSR program requirements; these programs are subject to review and approval by the California Air Resources Board. The Air District's NSR program operates within the overlay of these state and federal requirements.

The Air District's NSR program is set out in Regulation 2, Rule 2 (Rule 2-2) and is the Air District's fundamental permitting requirement for regulating criteria pollutant emissions. It requires facilities to obtain an NSR permit for any new or "modified" source of air emissions, and to satisfy a number of air pollution control requirements in order to be eligible for the permit.¹

¹ "Modified source" is defined in Regulation 2-1-234 as (i) any physical change, change in the method of operation, increase in throughput or production, or other similar change to a source that will result in an increase in the source's permitted emissions (or for "grandfathered" sources that are not subject to any permit limits, in increase in the source's physical capacity to emit air pollutants); or (ii) for sources at "major" facilities (maximum emissions of any pollutant over 100 tpy or 250 tpy, depending on the facility type), any change that will result in a significant increase in the source's actual emissions as defined in EPA's federal NSR regulations.

These requirements vary somewhat depending on the pollutant involved. For pollutants for which the region is not in attainment of the applicable air quality standards (“non-attainment” pollutants), the NSR requirements are generally more stringent. For pollutants for which the region is in attainment of the applicable air quality standards (“attainment” pollutants), the requirements are generally less stringent. The requirements for attainment pollutants are referred to as “Prevention of Significant Deterioration” (PSD) requirements and include: (i) using the “Best Available Control Technology” (BACT) to limit emissions; and (ii) conducting an air quality impact analysis to ensure that the source being permitted will not jeopardize continued attainment of the applicable air quality standards or cause other adverse air quality impacts.

PSD is the element of the NSR program under which GHGs are regulated. The PSD provisions require new and modified sources at “major” facilities that will increase GHG emissions by 75,000 tpy or more of CO₂e to go through the PSD permitting process and implement BACT to reduce their GHG emissions.² More specifically, if a facility is a “major” facility under the federal CAA, it must comply with the PSD BACT requirement (i) for any new source that will emit 75,000 tpy or more CO₂e, and (ii) for any modification to an existing source that will result in a net increase in emissions of 75,000 tpy or more CO₂e. The District’s NSR program incorporates this 75,000 tpy CO₂e threshold from EPA’s federal NSR regulations, which regulate GHGs at that level.

Since this 75,000 tpy CO₂e threshold was adopted 2012, it has become apparent that a lower threshold may be appropriate for GHG permitting for the Bay Area. Specifically, an evaluation of all permit applications that the Air District has received over the past ten years indicates that reducing the threshold below the current 75,000 tpy CO₂e will subject a substantial additional amount of GHG emissions to the BACT requirement. Staff continues to investigate an appropriate revised threshold.

In addition, Air District staff is proposing to make the revised threshold apply at all facilities, not just facilities that have emissions of regulated air pollutants over the 100/250 tpy federal “major” facility threshold. Staff believes facilities under this latter threshold should be subject to regulation if their GHG emissions are of sufficient magnitude. While the EPA is limited to regulating GHG emissions only from major facilities, the Air District is not precluded from adopting the more stringent approach under its rulemaking authority under the California Health and Safety Code.³

It should be noted that the while a new lower threshold would require more sources to implement BACT to limit their GHG emission, as with the existing BACT requirement, the regulations will not prescribe exactly what technology must be applied in any particular case. Specifically, as with the current regulations, that determination will be made on a case-by-case basis by evaluating the most stringent level of GHG emissions control that can feasibly be

² A “major” facility is one that emits 100 tpy or more of a regulated air pollutant other than GHGs (or 250 tpy or more for certain source categories).

³ The 2014 Supreme Court’s decision in *Utility Air Regulatory Group v. EPA* (134 S.Ct. 2427) held that the EPA cannot regulate GHGs under the CAA from facilities that do not exceed this major facility threshold.

implemented for each individual source being permitted, taking into account considerations such as energy impacts, any ancillary environmental impacts, and economic impacts. Therefore, the BACT requirement for GHGs under a revised CO₂e threshold will work just as it does under the current threshold.

Implementation Actions:

The Air District would create a new subsection in Section 2-2-304, the provision in Rule 2-2 that sets forth the PSD BACT requirement. Section 2-2-304, as enacted in the December 2012 amendments, incorporates the federal PSD BACT requirement by reference, including the 75,000 tpy CO₂e thresholds discussed above. The proposed revisions would create two subsections in Section 2-2-304: (i) Subsection 2-2-304.1, which would continue to incorporate the federal PSD BACT requirement by reference; and (ii) Subsection 2-2-304.2, which would be the new requirement to apply BACT at a lower threshold.

Emission Reductions:

Emission reductions will result from additional sources being required to implement GHG BACT under the lower threshold. However, it is difficult to predict with certainty what the impacts will be for these sources, as the BACT requirement does not prescribe any specific emissions performance level. Generally speaking, however, Air District staff expect that overall GHG emission reductions from a new lower threshold will be modest at first, but will become significant over time as new and more effective GHG emissions control technologies become available.

Exposure Reductions:

None.

Emission Reduction Trade-Offs:

None.

Costs:

This proposed change would be expected to result in cost impacts as additional sources would be required to implement BACT under the lower threshold. However, it is difficult to predict with certainty what the impacts will be for these sources, as the BACT requirement does not prescribe any specific course of action these sources must take to comply and what cost impacts would result.

Overall, additional costs for regulated facilities will most likely be fairly limited in the near term for the same reasons that GHG emission reduction impacts will most likely be limited in this time frame. In the longer term, however, lowering the BACT threshold for GHGs may well involve increased compliance costs as new technologies become more widely used. It is worth noting, however, that the BACT requirement has a built-in cost-effectiveness test, as specified in CAA Section 169's mandate to take into consideration "economic impacts and other costs."

Co-Benefits:

For many facilities, reduction of GHG emissions will likely reduce criteria air pollutants frequently co-emitted in processes that typically generate GHGs (e.g., combustion), particularly if energy efficiency is selected as BACT.

Issue/Impediments:

None

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SS18: Basin-Wide Combustion Strategy

Brief Summary:

This control measure seeks to stabilize and then reduce emissions of greenhouse gas (GHG), criteria air pollutant and toxic emissions from stationary¹ combustion sources throughout the Air District by first establishing carbon intensity caps on major GHG sources, and then adopting new rules to reduce fuel use on a source-type by source-type basis.

Purpose:

Reduce emissions of greenhouse gas, criteria air pollutant and toxic emissions from stationary combustion sources throughout the Air District.

Source Category:

Stationary combustion sources.

Regulatory Context and Background:

Fuel combustion contributes significantly to carbon dioxide (CO₂) emissions, the primary driver of anthropogenic climate change. It is also a significant source of criteria pollutants (including nitrogen dioxide (NO_x), sulfur dioxide (SO₂), and particulate matter (PM) emissions) and toxic air contaminants, which can exacerbate health risks. One way to address these emissions is to find opportunities to increase the efficiency of combustion processes in order to reduce fuel consumption. Fuel use reduction would directly result in emission reductions of these pollutants, and since this approach also leads to fuel cost savings, most if not all of the investment can be recovered over time. Reducing combustion emissions would help the Air District attain and maintain compliance with state and federal air quality standards, reduce local contributions to anthropogenic climate change, and reduce emissions of some toxic pollutants.

Though many stationary sources of combustion emissions are already well-controlled as a result of existing Air District regulation targeting criteria and toxic pollutants, combustion from stationary sources still accounts for over half of all GHG emissions in the Bay Area. Combustion emissions from all stationary sources in the Air District are about 40 million metric tons of carbon dioxide equivalent (MMT CO₂e), including combustion for electricity generation, residential and commercial uses, and combustion at industrial facilities such as oil refineries and cement plants. Residential and commercial fuel usage account for approximately 10 MMT CO₂e of that total, while industrial combustion (including electricity production) generates approximately 30 MMT CO₂e. Typical combustion sources in the industrial and electricity-generation sectors include natural-gas fired turbines, furnaces, boilers, and process heaters, though the top GHG emitting sources will vary by specific facility. For instance, in the refinery sector, the equipment units that comprise the fluid catalytic cracking (FCC) plant, the co-

¹ For the purpose of this control measure, stationary combustion sources include all non-mobile sources, including residential/commercial buildings and electricity generation. In the 2017 Plan, building- and energy-related emission sources are discussed in the Building and Energy sectors.

generation plant, and the hydrogen plant – which include boilers, steam generators, and heaters – are usually the largest sources of these emissions. Building and water heating, which typically involve natural gas combustion, is responsible for the majority of the GHG emitted from the residential and commercial sector.

The Air District will implement a Basin-wide Combustion Strategy to address emissions from stationary combustion, the largest contributor of GHG emissions within the Air District’s direct regulatory jurisdiction.² The first phase of the strategy would evaluate carbon intensity caps as an immediate action to prevent GHG emissions increases at current levels of production. The second phase would involve developing source-specific regulations to reduce combustion emissions through increased efficiency. Both phases of the combustion strategy are described below:

▪ **Phase 1: Carbon Intensity Caps – Stabilize Combustion Efficiency**

The Air District will explore establishing a regulatory cap on the carbon intensity of all major industrial combustion sources in the region, at a level consistent with their current performance. Carbon intensity is the amount of CO₂ emitted for each unit of product or output generated (e.g., pounds of CO₂ emitted per kW of electricity generated for a power plant). In general, the carbon intensity of a facility can be an indication of its efficiency when compared to similar facilities in the same sector.

One advantage of this approach is that since carbon intensity is a rate-based-standard (e.g., CO₂/unit produced) and not an absolute standard (e.g., CO₂ emissions), it does not limit production at particular facilities. Therefore, it would reduce the economic incentive for industry to move outside of the Bay Area due to increased production. Moving outside the Bay Area may result in greater overall emissions due to pollution associated with transporting the product and/or less stringent air pollution regulation.

Nearly 75 percent of CO₂ emissions from industrial combustion in the Bay Area come from the refining of transportation fuels, the generation of electricity and the production of cement. Each of these key industries would be subject to a carbon intensity standard that makes the most sense for that industry. For instance, petroleum refineries use large quantities of energy to convert crude oil into transportation fuels, mainly supplied from the combustion of crude oil and natural gas, and from grid electricity. The methodology to calculate the carbon intensity for the refining sector would need to account for the CO₂ emissions from all of these sources. Since refineries produce several different products (e.g., gasoline, diesel and jet fuel), the standard could be expressed in pounds of CO₂ per gallon of product. A metric such as such as gasoline-equivalent-gallon could be used to aggregate all the products into “gallons of product”.

After defining a carbon intensity calculation standard for each sector, caps would be set on a facility-by-facility basis at a level consistent with current operations, with reasonable allowance for year-to-year variation.

² The California Air Resources Board has primary regulatory jurisdiction over mobile sources.

▪ **Phase 2: Source-by-Source Rulemaking – Increase Combustion Efficiency**

Given the wide variety of combustion emissions sources, regulatory approaches to reduce combustion emissions through increased efficiency will have to be tailored to the specific sector and equipment type. Combustion sources will be evaluated in order to identify cost-effective and technically feasible efficiency improvements that would result in GHG and criteria emission reductions. These evaluations will be prioritized based on two factors: 1) the magnitude of facility GHG and criteria emissions from combustion processes, and 2) the energy efficiency opportunities available for each source-type. Combustion GHG and criteria emissions from Bay Area facilities are comprehensively quantified in the Air District Emissions Inventory and in the California Air Resources Board (ARB) Greenhouse Gas Mandatory Reporting Data. The Air District may rely on the energy efficiency and co-benefits assessment of large industrial sources conducted by ARB, among other resources, to assess the energy efficiency opportunities available for each source-type within each sector. These assessments were completed for the refinery, cement, hydrogen, and electricity generation during the years 2013 through 2015.

Implementation Actions:

Air District Staff will:

- evaluate carbon intensity caps for the refinery, power generation and cement sectors
- promote energy efficiency improvements through new rules on a source-type by source-type basis
- evaluate combustion sources for emissions and efficiency in order to identify cost-effective and technically feasible improvements that would lead to reductions in fuel use
- prioritize the evaluation of combustion sources based on the magnitude of the emissions and the energy efficiency opportunities for each source-type

Emission Reductions:

Pollutants*	2020	2030
PM _{2.5}	604	604
CO _{2e}	1,600,000	1,600,000

**criteria pollutants are reported in lbs/day; CO_{2e} is reported in metric tons/year (100 yr GWP)*

Emission Reductions Methodology:

Implementing a basin-wide combustion strategy is estimated to result in emission reductions, as presented in the table above, assuming a 5 percent emissions reduction across all industrial combustion sources. This value is based on the average GHG emission reductions across all sectors from uncompleted projects, as reported in ARB’s energy efficiency and co-benefits assessment of large industrial sources for the refinery, cement, hydrogen, and electricity generation (ARB, 2013-2015). GHG emission reductions from the residential and commercial fuel usage subsectors are difficult to estimate at this time given the complexity of the regulatory landscape affecting energy efficiency in these categories. Reducing fuel combustion through efficiency will also reduce criteria air pollutants and toxic air contaminant emissions, but anticipated emissions reductions will vary by regulation and source and therefore cannot be

quantified at this point. PM_{2.5} emission reductions can be estimated using the same assumption as for greenhouse gases (5 percent emissions reduction across all industrial combustion sources). NO_x emission reductions are also anticipated, but have not been quantified at this time.

Emission Reduction Trade-Offs:

This control measure is designed to reduce energy or fuel use, so there would be no direct emission trade-offs. There might be an increase of indirect emissions associated with the production and delivery of some energy efficiency technologies.

Costs:

Upfront costs to implement energy efficiency and fuel reduction projects are expected to be borne by the individual facilities. These costs will vary widely depending on the type of project and source-type, but will be partly or entirely offset by savings in electricity or fuel costs.

Issues / Impediments:

Considering the wide variety of sources impacted, specific issues and/or impediments will be identified during rule making.

Source:

1. ARB (2013-2015) Energy Efficiency and Co-Benefits Assessment of Large Industrial Sources Public Reports. Available at:
<http://www.arb.ca.gov/cc/energyaudits/publicreports.htm>.

SS19: Portland Cement

Brief Summary:

Air District Regulation 9, Rule 13 (Rule 9-13) limits the emissions of nitrogen oxides, particulate matter, and toxic air contaminants from the manufacture of Portland cement. This measure proposes to amend sections of the rule pertaining to ammonia and sulfur dioxide (SO₂) emissions, and may reduce GHG emissions.

Purpose:

Air District Rule 9-13 regulates emissions from cement manufacturing. At present, the Lehigh Hanson Cement Plant (Lehigh) in Cupertino is the only operating cement manufacturing plant in the Bay Area. Since the adoption of the rule in September 2012, there have been changes in production processes at Lehigh, changes to the California Office of Environmental Health Hazard Assessment (OEHHA) Health Risk Assessment guidelines, and possible future regulatory changes. This Portland Cement control measure would amend sections of the rule to reflect these changes in processes, guidelines, and the regulatory environment to further reduce emissions from cement manufacturing.

Source Category:

Stationary source – cement manufacturing

Regulatory Context and Background:

As written, Rule 9-13 assumes consistent levels of ammonia in feedstock. However, since the adoption of the rule, Lehigh has provided ammonia emissions monitoring data documenting the variability in baseline ammonia levels of their feedstock. An amendment of the rule is needed to reflect this variability.

Since adoption of Rule 9-13, OEHHA has updated state guidelines regarding toxicity and cancer potencies. These changes may require changes to Lehigh's existing notification requirements regarding toxic compounds. While this change does not require an amendment to the rule, any rule development effort will need to explain the notification requirements to members of the public.

Air District staff proposes amending Rule 9-13 to include an SO₂ emissions limit for consistency with other Air District rules controlling SO₂ emissions, while accommodating operational changes at the Lehigh facility. Impending Air District rules would impose SO₂ limits on coke calcining and cat cracking units at refineries, and Lehigh, which burns petroleum coke, is the largest uncontrolled source of SO₂ in the Air District. Emissions from Lehigh are considered uncontrolled because the facility does not currently have control devices installed to reduce emissions. While emissions are not "controlled", Lehigh's permit conditions limit SO₂ emissions to 481 pounds per hour (lb/hr) averaged over a 24-hour period. Due to variability in their feedstock, Lehigh has proposed a modified permit limit of 481 lbs/hr averaged over 30 rolling operating days for SO₂ emissions. Federal law determines that this proposed modification to operating conditions would be an increase in emissions and therefore requires new source

review. The averaging periods necessary to allow operational flexibility would be reflected in the rule, so long as emission reductions remain consistent and enforceable.

In addition, Lehigh has a long history of public complaints regarding visible plumes, and the potential for increased emissions of ammonia and SO₂ addressed above may lead to greater potential for detached plume events. A detached plume is a plume that forms above the stack release point.

Production of Portland cement is an energy intensive process that relies on burning petroleum coke. Replacing some of the petroleum coke with biomass such as woodchips (e.g., yard waste, clean construction wood) could reduce emissions, including GHG emissions. Lafarge's cement plant in Bath, Ontario, is aggressively pursuing carbon emission reduction strategies through the planting of multiple energy crops that may eventually replace some of the coal and petroleum coke the plant requires as fuel each year. Recently, Lafarge began a multiyear life-cycle assessment study with Kingston, Ontario-based Queen's University's Energy and Environmental Policy Institute, and has been working closely with researchers on planting trials of perennial crops, utilizing about 2,500 acres of land surrounding the cement plant. Further research is needed to determine if biomass can be viable, cost-effective, and would result in emission reductions. Alternatively, the use of supplementary cementitious materials in place of clinker, such as rice hull ash and fly ash could reduce emissions. Further research is needed to determine how much clinker could be replaced, whether the use of rice hull ash or fly ash could pose a toxic risk, and how the change in cement blends would affect emissions.

Implementation Actions:

The Air District will:

- Consider amending sections of existing Air District Rule 9-13 pertaining to ammonia emissions to allow for replacement of the rolling 24-hour average with a different averaging period for ammonia emissions, and
- Amend Rule 9-13 to impose a standard for SO₂ consistent with other Air District rules; amend the rule as necessary to incorporate language regarding detached plumes, and consider amendments to the rule to reduce GHG emissions.

Emission Reductions:

Pollutants*	2020	2030
SO ₂	4,493	4,493
CO _{2e}	85,055	85,055

**criteria pollutants are reported in lbs/day; CO_{2e} is reported in metric tons/year (100 yr GWP)*

The amendments to Air District Rule 9-13 discussed above are estimated to reduce 4,493 pounds per day of SO₂ emissions based on operating permit conditions potential to emit. As an initial estimate, replacing 10% of the petroleum coke burned with biomass would result in an emission reduction of 85,055 MT CO_{2e}/yr, assuming that such biomass would be carbon neutral.

Exposure Reductions:

TBD

Emission Reduction Trade-Offs:

Stricter emissions standards may require modifications to control equipment increasing the potential for a detached plume.

Costs:

Further study is needed to determine cost information and cost effectiveness.

Co-Benefits:

SO₂ is a PM precursor contributing to the formation of sulfate aerosols which directly and indirectly affect warming and cooling in the earth's atmosphere. Long term exposure to SO₂ can cause breathing difficulties, respiratory illness and aggravate existing heart disease. Reductions in SO₂ emissions will protect public health.

Issue/Impediments:

The cost effectiveness of rule amendments that require further reductions in emissions from Lehigh in Cupertino would need to be investigated.

Sources:

1. Bay Area Air Quality Management District, Regulation 9, Rule 13: Nitrogen Oxides, Particulate Matter, and Toxic Air Contaminants from Portland Cement Manufacturing Scoping Paper, July 2012

SS20: Air Toxics Risk Cap and Reduction from Existing Facilities

Brief Summary:

This control measure seeks to further reduce public exposure to toxic air contaminants (TACs) from existing facilities. New Regulation 11, Rule 18 (Rule 11-18) is expected to substantially reduce health risks from existing facilities that emit TACs, by requiring the implementation of all technically and economically feasible risk reduction measures at significant sources of TACs in these facilities. The rule also incorporates the Office of Environmental Health Hazard Assessment (OEHHA's) recently adopted (2015) Health Risk Assessment Guidelines into its required health risk estimation methodology.

Purpose:

The purpose of this measure is to ensure that existing facilities that emit TACs do not pose an unacceptable health risk to nearby residents, workers, and/or students.

Source Category:

Stationary Sources

Regulatory Context and Background:

Various facilities in the Bay Area region emit toxic air contaminants that can adversely impact public health, including data centers, petroleum refineries, a cement kiln, gasoline dispensing facilities, etc. The Air District's long-standing Air Toxics Program for reducing TAC emissions from stationary sources and statewide programs for reducing emissions from mobile sources have been largely responsible for decreasing these pollutants by at least 87 percent since 1990. However, there is still progress to be made. Many Bay Area residents have expressed concern about the impact of these toxic pollutants on public health.

To directly address concerns about community health risks, Air District staff will propose that the Air District adopt a new Regulation 11, Rule 18 (Rule 11-18): Cap and Reduction of Risk from Air Toxic Emissions at Existing Facilities. Rule 11-18 would enhance the component of the Air District's Air Toxics Program that assesses and reduces health risks from existing facilities. Rule 11-18 would apply to all facilities whose emissions of toxic air contaminants may result in a significant risk to nearby residents and workers, including petroleum refineries.

In order to determine if health risks are significant for each Bay Area facility that emits toxic compounds, Air District staff will first conduct site-specific Health Risk Screening Analysis (HRSA) based on the annual toxic emissions inventories reported to the Air District. The HRSA assesses the potential for adverse health effects from public exposure to routine and predictable emissions of TACs using guidelines adopted by the California Air Resources Board (ARB) and by the California Air Pollution Control Officers Association (CAPCOA). The Air District would determine a priority score (PS) for each facility based on the HRSA results. These scores are influenced by the amount of TACs emitted, the toxicity of these materials, and the proximity of the facility to potential receptors. Site-specific Health Risk Assessments (HRAs) would be conducted and prioritized based on a facility's PS. The results of the HRA would

determine whether a facility would be affected by Rule 11-18. HRAs conducted as part of this process will incorporate the latest science, by using the OEHHA's 2015 HRA Guideline Revisions, a major update to these guidelines that focuses on children's health protection.¹

Rule 11-18 would affect facilities with health risk impact that exceed any of the following risk action level thresholds (risk caps):

- ten per million (10/M) cancer risk
- 1.0 hazard index for chronic risk
- 1.0 hazard index for acute risk

The Air District would notify facilities of their health risk scores. Facilities that pose a health risk in excess of any of these risk caps would be required to reduce that risk below the cap through one of two ways: (1) the implementation of a Risk Reduction Plan approved by the Air District within three years of approval of the plan, or (2) the demonstration that all significant sources of toxic emissions are controlled by Best Available Retrofit Control Technology for Toxics (TBARCT). Risk reduction plans would detail how the facility would reduce its health risk below the risk caps in the specified timeframe and would be expected to include a characterization of each source of toxic emissions, an evaluation of risk reduction measures to be implemented, a schedule for implementing these as quickly as possible, and an estimate of the remaining risk following such implementation. In general, TBARCT is considered to be the most effective or stringent retrofit emission control that is technologically feasible and achieved in practice.

It is anticipated that hundreds of existing facilities may be impacted by Draft Rule 11-18.

Implementation Actions:

Air District staff will:

- Develop Rule 11-18 to include the screening and comprehensive evaluation (if warranted) of health risks from all facilities that emit toxic air contaminants in the Air District, and to require the implementation of all technically and economically feasible risk reduction measures to significant sources of TACs in these facilities.

Emission Reductions:

Specific emission reduction estimates will be estimated during rule development.

Exposure Reductions:

Specific exposure reduction estimates will be estimated during rule development.

Emission Reduction Trade-Offs:

None expected.

Costs:

¹ In March 2015, OEHHA revised the HRA guidelines to include consideration of children's health protection. Advances in science have shown that early-life exposures to air toxics contribute to an increased lifetime risk of developing cancer, and/or other adverse health effects, compared to exposures that occur in adulthood. The revised risk assessment methodology reflects both this greater sensitivity and more refined data in childhood and adult exposure to air toxics.

Specific costs will be developed during rule development.

Co-Benefits:

Reducing TAC emissions will likely result in reduced emissions of TOG, ROG, and particulate matter.

Issue/Impediments:

The regulated community not already subject to the requirements of the Air District Air Toxics “Hot Spots” Program may oppose thresholds that are more stringent. Those already subject to the current Air Toxic ATHS program may oppose increased restrictions as a result of lowering these thresholds.

Sources:

1. Proposed Amendments to Regulation 2, Permits, Rule 5: New Source Review of Toxic Air Contaminants, BAAQMD, Dated December 2009. Available at: http://www.baaqmd.gov/~media/Files/Planning%20and%20Research/Public%20Hearings/2009/0205_RFC_102109/0205_stfrcomplete_121109.ashx?la=en
2. OEHHA Public Notice for Release of Air Toxics Hot Spots Draft Guidance Manual for Public Comment, March 6, 2015. Available at: <http://oehha.ca.gov/air/crnrr/notice-adoption-air-toxics-hot-spots-program-guidance-manual-preparation-health-risk-0>

SS21: New Source Review of Toxic Air Contaminants

Brief Summary:

Air District Regulation 2, Rule 5 (Rule 2-5) requires a health impact review for new and modified sources that emit toxic air contaminants (TACs) in excess of emissions trigger levels. It also establishes risk thresholds for mitigation and permit approval. The Air District conducts the health impact review in accordance with the California Office of Environmental Health Hazard Assessment (OEHHA) Health Risk Assessment Guidelines and the CARB/CAPCOA Risk Management Guidelines. These guidelines were revised in 2015. This measure would update the toxic New Source Review (NSR) program by incorporating the 2015 Health Risk Assessment (HRA) guideline revisions into the Air District's health impact review procedures. The use of the 2015 guidelines will increase the stringency of the toxics NSR program because the new health risk calculation procedures will result in higher cancer risk estimates for the same level of emissions.

Purpose:

This control measure will ensure that the Air District is using the most up to date scientific information and procedures to assess health impacts for new projects. This will also ensure consistency with the related Air Toxics Hot Spots Program that assesses health impacts due to TAC emissions from all sources at a facility.

Source Category:

This rule applies to all new or modified stationary sources that emit toxic air contaminants.

Regulatory Context and Background:

The Air District's Toxics Control Program includes the following three components: Toxics New Source Review, Air Toxics Hot Spots Program and CEQA. The Toxics NSR Program prevents significant increases in health risks resulting from new and modified sources of TACs through the preconstruction permit review process. As part of the engineering evaluation of a permit application, an assessment of health impacts is required. Site-specific health impacts are determined through preparation of an HRA that is performed in accordance with the OEHHA's guidelines. These guidelines are periodically updated to reflect advances in science.

As mandated under the Children's Environmental Health Protection Act of 1999 or SB25, OEHHA revised the HRA guidelines to include consideration of children's health protection. Advances in science have shown that early-life exposures to air toxics contribute to an increased lifetime risk of developing cancer, and/or other adverse health effects, compared to exposures that occur in adulthood. The revised risk assessment methodology reflects both this greater sensitivity and more refined data in childhood and adult exposure to air toxics.

Implementation Actions:

Air District staff will propose revisions to Air District Rule 2-5 to:

- Revise the Air District's Health Risk Assessment Guidelines based on OEHHA's 2015 risk assessment guidelines and CARB/CAPCOA's 2015 risk management guidelines.

- Revise the Air District’s health risk assessment trigger levels for each toxic air contaminant using the 2015 guidelines and most recent health effects values.

Emission Reductions:

This measure will not directly require emission reductions, but the Air District expects it to result in higher level of health protection via evaluations of permit applications. The proposed revisions to the risk calculation procedures will result in higher cancer risk estimates for residential receptors compared to current procedures. As a result, applicants for new or modified sources of TACs will be required to implement risk mitigation measures or limit project risks at lower emission rates compared to current procedures.

Exposure Reductions:

As with emissions, this measure will not directly result in exposure reductions, but new or modified sources of TACs may reduce exposure as one method of meeting the project health risk limits.

Emission Reduction Trade-Offs:

Risk mitigation measures may include lower operating rates, alternative material, and lower emissions for new projects. These mitigation measures may also include abatement devices (afterburners, oxidizers, diesel particulate filters, etc.) and exhaust modifications (stack relocations, taller stacks, flow rate changes, etc.). Small increases in fuel or electricity usage are possible which could increase GHG emissions. However, reductions of black carbon particulate emissions may offset any climate change impacts due to abatement devices or increased electricity use.

Costs:

Specific costs will be developed during rule making.

Co-Benefits:

Risk mitigation measures for new and modified sources will result in reductions of precursor organic compounds and particulate matter emissions and TACs such as benzene and diesel PM. Reductions in diesel PM emissions will also reduce black carbon particulates.

Issue/Impediments:

No major issues have been identified.

Sources:

1. OEHHA 2015 Risk Assessment Guidelines: Guidance Manual for Preparation of Health Risk Assessments
2. CARB/CAPCOA 2015 Risk Management Guidance for Stationary Sources of Air Toxics
3. BAAQMD Regulation 2, Rule 5: New Source Review of Toxic Air Contaminants

SS22: Stationary Gas Turbines

Brief Summary:

In 2006, the Air District amended Regulation 9, Rule 9 (Rule 9-9), *Nitrogen Oxides from Stationary Gas Turbines*, applying the most stringent emission limits for oxides of nitrogen (NO_x) to larger stationary gas turbines. Less stringent limits were applied to small and medium sized units. The Air District is considering whether more stringent limits are warranted for medium-sized gas turbines.

Purpose:

Further reduce NO_x emissions from stationary gas turbines in the Bay Area.

Source Category:

Permitted sources - stationary gas turbines

Regulatory Context and Background:

A gas turbine is an engine that combusts gaseous fuel to generate rotational motion. It consists of three basic parts: a compressor, where air is compressed up to 30 times atmospheric pressure; a combustor, where air and fuel are mixed and burned; and a power turbine, where expanding combustion gases spin rotating blades. The power turbine provides mechanical energy to operate the compressor and to either generate electricity or mechanical energy (e.g. a jet engine or natural gas compressor). To increase efficiency, hot exhaust gases can be used to generate steam to operate a secondary steam turbine and to heat the combustion air so less fuel is needed.

The primary pollutants from gas turbines are the combustion byproducts carbon monoxide and NO_x. Most of the NO_x is emitted as nitrogen monoxide (NO), which oxidizes in air to form nitrogen dioxide (NO₂), a precursor to ozone and fine particulate matter (PM_{2.5}). NO_x emissions can be controlled by enhanced water or steam injection, Ultra Dry Low NO_x (DLN) combustion controls, or Selective Catalytic Reforming (SCR) of NO_x to nitrogen through a reaction with ammonia. SCR is the most effective technology but results in some ammonia emissions (ammonia slip).

In 2006, the Air District amended Rule 9-9, *Nitrogen Oxides from Stationary Gas Turbines*, limiting NO_x emissions depending on turbine size and fuel source (natural gas or other). Gas turbines larger than 250 million British thermal units per hour (MMBtu/hr) are required to install SCR and meet the most stringent limit of 9 ppm. Gas turbines between 50-250 MMBTU/hr in size are required control NO_x by other means, such as water injection or DLN, and meet less stringent limits depending on the size of the turbine, the fuel used, and the type of controls available.

Implementation Actions:

The Air District will:

- Consider amendments to Rule 9-9 that will strengthen the NO_x limits for medium sized gas turbines.

Emission Reductions:

Pollutants*	2020	2030
NO _x	250	250

**criteria pollutants are reported in lbs/day*

Exposure Reductions:

Reducing NO_x emissions will reduce PM_{2.5} and ozone concentrations. While ammonia slip could contribute to additional PM_{2.5} formation, overall PM_{2.5} concentrations are expected to be lower with this control measure.

Emission Reduction Trade-Offs:

Ammonia slip from SCR systems can increase secondary PM_{2.5} formation. SCR may result in additional GHG emissions from both the reduction in efficiency of the gas turbine, and the increased energy required to operate the SCR equipment.

Costs:

The estimated annualized costs for the use of SCR technology for medium sized gas turbines (including a 30 percent increase to accommodate retrofit to existing facilities) range from \$0.42 – 1.36 million.

Co-Benefits:

Unknown

Issue/Impediments:

None

Sources:

1. Staff Report, Regulation 9, Rule 9, *Nitrogen Oxides from Stationary Gas Turbines*, November, 2006
2. Regulation 9, Rule 9, *Nitrogen Oxides from Stationary Gas Turbines*, amended: December 6, 2006
3. AP 42, Fifth Edition, Volume I, Chapter 3, Stationary Internal Combustion Sources, Section 3.1, Stationary Gas Turbines, amended: April, 2000.

SS23: Biogas Flares

Brief Summary:

Require that all biogas and non-refinery flares meet lowest available emissions reduction (LAER) level of 0.025 pounds of NO_x per million Btu.

Purpose:

Reduce secondary emissions of NO_x from flares used to abate organic emissions from solid waste landfills and anaerobic digesters.

Source Category:

Stationary Source – landfills and anaerobic digesters

Regulatory Context and Background:

Flares employed at solid waste landfills, publicly owned treatment works, and other anaerobic digesters function as pollution abatement devices and as such are not subject to new source review. Per Air District's permit Regulation 2, Rule 2 (Rule 2-2), section 112, secondary pollutants resulting from abatement devices are exempt from the best available control technology (BACT) requirements of the rule (2-2-301); however, these secondary emissions are still subject to the less stringent reasonable available control technology (RACT) requirements.

BACT is defined (2-2-206) as the most stringent of any control device or technique successfully utilized for that source category, or that is determined to be technically feasible, and it must be at least as stringent as any applicable federal, state or District laws, rules or requirements. Conversely, RACT is defined (2-2-243) as the lowest emission limit that can be achieved taking into account technological feasibility, cost-effectiveness, the specificities of the source in question, or the lowest emission limit achieved by application of control equipment to similar but not necessarily identical categories of sources.

The federal Clean Air Act (section 171(3)) defines the lowest achievable emission rate (LAER) as the most stringent emission limitation achieved in practice for a source category or which is contained in the state implementation plan (SIP) of any state for the same source category. LAER can be equivalent to RACT, but is often equivalent to BACT when stricter standards are required due to nonattainment of national ambient air quality standards for a given jurisdiction. The Air District's definition of BACT is similar to the federal LAER definition; however, BACT is evaluated on a case-by-case basis whereas LAER is uniform for a source category.

Air District staff has determined RACT for enclosed landfill gas flares to be 0.06 pounds of NO_x per million Btu of heat input (lbs/MMBTU), with CO emissions limited to 0.2 lbs/MMBTU. Current LAER for enclosed landfill gas flares achieved in practice is 0.025 lbs/MMBTU for NO_x, and 0.06 lbs/MMBTU for CO.

Implementation Actions:

Given the current exemption in Rule 2-2, imposing LAER level control would require a new rule in Regulation 9 specifically for secondary emissions from non-refinery flares. Air District staff will investigate the potential for more stringent limits on emissions from non-refinery flares.

Emission Reductions:

Pollutants*	2020	2030
NO _x	920	920
CO	2,940	2,940

**criteria pollutants are reported in lbs/day*

Emission Reductions Methodology:

The majority of emissions from biogas and non-refinery flares come from flares subject to RACT level controls. If these flares were subjected to LAER controls, NO_x would be reduced by 58 percent and CO would be reduced by 70 percent. According to the 2011 inventory, landfill flares account for 980 pounds per day of NO_x, and 3,220 pounds per day of CO. Therefore, implementation of this measure would yield potential emission reductions of 920 pounds per day of NO_x, and 2,940 pounds per day of CO.

Exposure Reductions:

None expected.

Emission Reduction Trade-Offs:

None expected.

Costs:

In a 2013 technical support document for a permit for a landfill in Washington state, South West Clean Air Agency staff determined that a 30 MMBTU per hour flare meeting LAER control would result in reduced NO_x emissions at a cost of approximately \$7,000 per ton of NO_x reduced. However, this determination is really a comparison of the installation and maintenance costs of a new LAER compliant flare (\$260,000 capital cost) to a new RACT compliant flare (\$250,000 capital cost). To retrofit existing flares to meet LAER requirements would be somewhere between this delta and the costs of a completely new flare, assuming that not all components would need to be replaced. More research is required to determine the retrofit costs for a LAER compliant flare, and thereby the emission reduction cost in dollars per ton of NO_x reduced.

Co-Benefits:

Reduction in CO emissions as specified in Emission Reductions section above.

Issue/Impediments:

The regulated community would likely oppose the additional costs imposed by retrofitting their existing equipment.

Sources:

1. Bay Area Air Quality Management District, Regulation 2, Permits, Rule 2: New Source Review, June 15, 2005
2. Bay Area Air Quality Management District, Engineering Evaluation Report, Potrero Hills Landfill, Application #210118, October 13, 2013
3. Technical Support Document, Cowlitz County Headquarters Landfill, Air Discharge Permit Application CO-916, Southwest Clean Air Agency, August 8, 2013
4. California Air Pollution Control Officers Association BACT Clearinghouse Resource Manual, CAPCOA, June 21, 2000. <http://www.arb.ca.gov/bact/docs/manual.htm>
5. Specifying a Cost Effective Landfill Flare System, John Zink Company LLC, Brandy Johnson, P.E. March 8, 2005
http://www.johnzink.com/wp-content/uploads/tp_cost_effective_landfill_rev.pdf

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SS24: Sulfur Content Limits of Liquid Fuels

Brief Summary:

This control measure would propose amendments for Air District Regulation 9, Rule 1 to incorporate several fuel-specific sulfur content limits for diesel and other liquid fuels.

Purpose:

Reduce SO₂ emissions, and as a co-benefit, reduce particulate matter (PM) formation as a secondary pollutant.

Source Category:

Stationary sources.

Regulatory Context and Background:

The California Air Resources Board (ARB) currently limits sulfur content in all diesel fuels. SCAQMD Rule 431.2 reflects the same sulfur content limits of 15 ppm for low sulfur fuel used in stationary sources. The SCAQMD 15 ppm sulfur limit is equivalent to the federal ultra-low sulfur diesel fuel limit.

Sulfur emissions lead to the formation of sulfur dioxide (SO₂) which is a criteria pollutant. Although the Air District is in attainment with federal ambient air quality standards for SO₂ concentrations, it is not in attainment for the federal and state PM_{2.5} standards. SO₂ is a precursor of PM_{2.5}. The adoption of low sulfur fuel limits will help make continued progress toward achieving state PM standards and help ensure federal standards are not exceeded.

Currently, Rule 9-1 limits the sulfur content of liquid fuels to 0.5 percent by weight. This standard applies to diesel fuel. The ARB and SCAQMD standards for diesel fuel are more stringent and thus should be evaluated for potential inclusion in Rule 9-1.

Implementation Actions:

The Air District would propose amendments to Rule 9-1 to incorporate a new sulfur content limit for liquid fuels. The terms “liquid fuel” is not currently defined by the rule. In proposing amendments to Rule 9-1, the Air District will be acting pursuant to its authority provided in Health and Safety Code 40447.6 to protect public health by lowering the sulfur content in diesel fuel.

Emission Reductions:

Emission reductions will be estimated during rule amendment process.

Exposure Reductions:

NA

Emission Reduction Trade-Offs:

None.

Costs:

Specific costs will be estimated at time of rule amendment.

Co-Benefits:

Reduction of SO₂ emissions will reduce formation of secondary PM_{2.5} in the form of ammonium sulfate.

Issue/Impediments:

None.

Sources:

1. Bay Area Air Quality Management District, Regulation 9, Rule 1 Inorganic Gaseous Pollutants, Sulfur Dioxide
2. South Coast Air Quality Management District, Rule 431.2 Sulfur Content of Liquid Fuels
3. California Air Resources Board, California Diesel Fuel Regulations

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SS25: Coatings, Solvents, Lubricants, Sealants, and Adhesives

Brief Summary:

This control measure would seek to reduce the VOC emissions from miscellaneous coatings, adhesive, solvent and lubricant categories by lowering certain product VOC limits. Examples of the miscellaneous categories to be considered include coatings used in aerospace; adhesives used in a variety of sealing applications; solvents for cleaning and preservation or graffiti abatement activities; fountain solutions for printing operations; and lubricants used as metalworking fluids to reduce heat and friction to prolong life of tools, improve product quality and carry away debris.

Purpose:

Reduce emissions of VOCs from coatings, solvents, lubricants and adhesives.

Source Category:

Area - coatings and solvents

Regulatory Context and Background:

The following Air District rules contain VOC limits addressing coatings, solvents, lubricants, sealants, or adhesives: Rules 8-4, 8-11, 8-12, 8-13, 8-14, 8-16, 8-19, 8-20, 8-23, 8-26, 8-29, 8-31, 8-32, 8-35, 8-36, 8-38, 8-43, 8-49, and 8-51. Rules 8-3 and 8-45 also have VOC limits for coatings and solvents; but these rules are modeled on suggested control measures (SCM) developed by the ARB in consultation with the state air districts and the California Air Pollution Control Officers Association (CAPCOA). The SCMs are developed to help ensure consistency in the regulation of architectural and automotive coatings and solvents throughout the state. The Air District’s current VOC limits for coatings range from 20 grams per liter (g/l) to 1,800 g/l (Reg. 8-13), 120 to 850 g/l for adhesives, 50 g/l to 880 g/l (Reg. 8-20) for solvents, and, currently, there are not standards for lubricants and vanishing oils. The control measure will examine the potential to reduce the allowable VOC content of coatings, adhesives, and solvents regulated by the above listed Regulation 8 rules. The following table presents a simplified comparison of the potentially affected Air District coatings, adhesives, and solvent rules with comparable rules adopted by the South Coast Air Quality Management District (SCAQMD) and the San Joaquin Valley Air Pollution Control District (SJVAPCD).

**TABLE 1
Comparisons of Air District Coatings, Adhesives, and Solvent VOC Limits to Comparable, SCAQMD, and SJVAPCD Rules**

Bay Area Rules VOC Limit Range	South Coast Rules VOC Limit Range	San Joaquin Valley VOC Limit Range
8-4: General Solvent and Surface Coating Operations 4,533 kg/yr emission rate or 85 to 90% control or 420 g/l VOC content and 50 g/l solvent limit	Rule 1122: Solvent Degreasers & Rule 1171: Solvent Cleaning Operations 25-50 g/l or 90% and other controls	Rule 4661: Organic Solvents 2,489 kg/yr or 85% control

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Bay Area Rules VOC Limit Range	South Coast Rules VOC Limit Range	San Joaquin Valley VOC Limit Range
8-11: Metal Container, Closure and Coil Coating 20 to 600 g/l	Rule 1125: Metal Container, Closure, and Coil Coating Operations 0 to 800 g/l	Rule 4604: Can and Coil Coating Operations 20 to 750 g/l
8-12: Paper, Fabric and Film Coating 265 g/l or effective 120 g/l control	Rule 1128: Paper, Fabric, and Film Coating Operations 265 g/l or effective 120 g/l control (20 g/l for plastisol)	Rule 4607: Graphic Arts and Paper, Film, Foil and Fabric Coatings 20 to 600 g/l
8-13: Light and Medium Duty Motor Vehicle Assembly Plants 450 to 1,800 g/l or 90% control	Rule 1115: Motor Vehicle Assembly Line Coating Operations 145 to 1,800 g/l	Rule 4602: Motor Vehicle Assembly Coatings 250 to 1,440 g/l or 90% control
8-14: Surface Coating of Large Appliances and Metal Furniture 275 to 420 g/l	Rule 1107: Coating of Metal Parts and Products 275 to 420 g/l	Rule 4603: Surface Coating of Metal Parts and Products, Plastic Parts and Products, and Pleasure Crafts 275 to 420 g/l
8-16: Solvent Cleaning Operations 50 g/l or 90% and other controls	Rule 1122: Solvent Degreasers & Rule 1171: Solvent Cleaning Operations 25-50 g/l or 90% and other controls	Rule 4662 Organic Solvent Degreasing Operations & Rule 4663: Organic Solvent Cleaning, Storage, and Disposal 25 to 800 g/l or 85% control
8-19: Surface Coating of Miscellaneous Metal Parts and Products 275 to 420 g/l or 85% control 50 g/l for surface prep solvent	N/A	N/A
8-20: Graphic Arts Printing and Coating Operations 25 to 400 g/l	Rule 1130: Graphic Arts 16 to 300 g/l	Rule 4607: Graphic Arts and Paper, Film, Foil and Fabric Coatings 20 to 600 g/l
8-23: Coating of Flat Wood Paneling and Wood Flat Stock 250 g/l or 90% control	Rule 1104: Wood Flat Stock Coating Operations 250 g/l or 90% capture /95% control (85% overall) control & 50 ppm emission limit	Rule 4606 Wood Products and Flat Wood Paneling Products Coating Operations 120 to 750 g/l or 15 lbs/day pre controls
8-26: Magnet Wire Coating Operations 200 g/l or 90% control	Rule 1126: Magnet Wire Coating Operations 200 g/l or 90% control	N/A
8-29: Aerospace Assembly and Component Coating Operations 250 to 850 g/l or 85% control	Rule 1124: Aerospace Assembly and Component Manufacturing Operations 120 to 1000 g/l or 90% capture /95% control (85% overall control)	Rule 4605: Aerospace Assembly and Component Coating Operations 120 to 1000 g/l or 90% capture /95% control (85% overall control)
8-31: Surface Coating of Plastic Parts and Products 420 to 800 g/l coatings and 50 g/l solvent or 85% control	Rule 1145: Plastic, Rubber, and Glass Coatings 50 to 800 g/l or 90% capture /95% control (85% overall control) & 50 ppm emission limit	Rule 4603: Surface Coating of Metal Parts and Products, Plastic Parts and Products, and Pleasure Crafts 275 to 880 g/l

Bay Area Rules VOC Limit Range	South Coast Rules VOC Limit Range	San Joaquin Valley VOC Limit Range
8-32: Wood Products Coatings 150 to 550 g/l & 50 g/l solvent limit	Rule 1136: Wood Products Coatings 120 to 750 g/l	Rule 4606 Wood Products and Flat Wood Paneling Products Coating Operations 120 to 750 g/l or 15 lbs/day pre controls
8-35: Coating, Ink and Adhesive Manufacturing 200 g/l solvent limit	Rule 1141.1. Coatings and Ink Manufacturing No VOC limits	Rule 4652: Coatings and Ink Manufacturing No VOC limits
8-36: Resin Manufacturing 95% control or 4.5 kg/day VOC emissions limit	Rule 1141: Control of Volatile Organic Compound Emissions From Resin Manufacturing 95-98% control or 0.12 to 0.5 lb VOC emitted per 1000 lbs resin produced.	Rule 4684: Polyester Resin Operations 10 to 48 wt% VOC content & 25 g/l cleaning solvent
8-38: Flexible and Rigid Disc Manufacturing 85% control	N/A	N/A
8-43: Surface Coating of Marine Vessels 275 to 610 g/l	Rule 1106: Marine Coating Operations 275 to 780 g/l	Rule 4603: Surface Coating of Metal Parts and Products, Plastic Parts and Products, and Pleasure Crafts 275 to 880 g/l
8-49: Aerosol Paint Products 60 to 95 g/l	ARB Aerosol Coating Products Regulation 60 to 95 g/l	ARB Aerosol Coating Products Regulation 60 to 95 g/l
8-51: Adhesive and Sealant Products 30 to 850 g/l	Rule 1168: Adhesive and Sealant Applications 30 to 850 g/l	Rule 4653: Adhesive and Sealants 25 to 850 g/l

Implementation Actions:

The Air District will:

- Review applicable Air District rules for coatings, solvents, and adhesives and compare the VOC limits with limits in other Bay Area Air District rules and comparable VOC limits in other California air districts rules, such as the SCAQMD and SJVAPCD, and propose revised limits as appropriate. The table above is a cursory comparison of coating, adhesive, and solvent rules from the Air District to similar rules from the SCAQMD and SJVAPCD.
- A more comprehensive comparison of VOC limits for specific coating, adhesive, and solvent categories would be undertaken to determine which areas are most likely to present opportunities for additional emission reductions.

Emission Reductions:

Emission reductions will be calculated at time of rule-making.

Exposure Reductions:

N/A

Emission Reduction Trade-Offs:

N/A

Costs:

Specific costs will be estimated at time of rule-making.

Co-Benefits:

N/A

Issue/Impediments:

None.

Source:

1. South Coast Air Quality Management District, 2012 Air Quality Management Plan

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SS26: Surface Preparation, Cleanup, and Equipment Cleaning Solvents

Brief Summary:

Lower the VOC limits for solvents used for surface preparation, cleanup, and equipment cleaning in Air District Rules 8-24, 8-29, 8-30, 8-35 and 8-38.

Purpose:

Reduce emissions of VOC from various surface preparation, cleanup, and equipment cleaning activities.

Source Category:

Stationary Source and Area Source: Evaporative emissions

Regulatory Context and Background:

Most Air District rules addressing surface preparation and cleanup and equipment cleaning solvents include a VOC limit for these materials. Air District Rules 8-4: General Solvent and Surface Coating Operations, 8-19: Surface Coating of Miscellaneous Metal Parts and Products, 8-31: Surface Coating of Plastic Parts and Products all have a VOC limit of 50 grams per liter (g/l) for surface preparation and cleanup, which is the most stringent in the Air District. However, there are several other Air District rules addressing solvent use that either do not contain solvent limits for surface preparation, cleanup, and equipment cleaning or have solvent limits in excess of 50 g/l. These Air District rules are Rules 8-24, 8-29, 8-30, and 8-35, and 8-38.

Air District Rule 8-24: Pharmaceutical and Cosmetic Manufacturing Operations only includes evaporation minimization measures. In comparison, South Coast AQMD Rule 1171, Sacramento Metropolitan AQMD Rule 466: Solvent Cleaning, and San Joaquin Valley APCD Rule 4663 include a VOC limit of 800 g/l for addressing surface preparation and cleanup for pharmaceutical production. Both Sacramento Metropolitan AQMD Rule 466 and San Joaquin Valley Rule 4663 include a 600 g/l limit for equipment cleaning for pharmaceutical production. Because Feather River APCD Rule 3-14: Surface Preparation and Clean-up does not have an explicit limit or exemption for cosmetic manufacturing, the default of 50 g/l limit would apply.

Air District Rule 8-29: Aerospace Assembly and Component Coating Operations contains no VOC limit for surface preparation and cleanup. South Coast AQMD Rule 1124: Aerospace Assembly and Component Manufacturing Operations and San Joaquin Valley APCD Rule 4605 Aerospace Assembly and Component Coating Operations both have VOC limits of 200 g/l for cleaning solvents and 300 g/l for stripping solvents.

Air District Rule 8-30: Semiconductor Wafer Fabrication Operations includes a VOC limit of 10 percent by weight for wipe cleaning in semiconductor manufacturing. This limit was established in 1998 and is higher than the Air District's most stringent solvent limit of 50 g/l VOC. South Coast AQMD Rule 1164: Semiconductor Manufacturing contains a 200 g/l limit for equipment cleaning. Sacramento Metropolitan AQMD, Rule 466 contains a 100 g/l limit for electronic

components manufacturing, which could be interpreted to include semiconductor wafer fabrication.

Air District Rule 8-35: Coating, Ink and Adhesive Manufacturing includes a VOC limit of 200 g/l for equipment cleaning solvent. This limit was established in 1994 and is higher than the most stringent solvent limit of 50 g/l VOC found in many district regulations in other regions. San Joaquin Valley APCD Rule 4663 Organic Solvent Cleaning, Storage, and Disposal and South Coast AQMD Rule 1171 have a VOC limit of 25 g/l for general product cleaning and surface preparation and cleaning of coating or adhesive application equipment.

Most District rules addressing cleanup solvent include a VOC limit for these materials. Air District Rule 8-38: Flexible and Rigid Disc Manufacturing, Section 8-38-116 provides a blanket exemption for VOC emissions from "cleaning of disc coating or polishing equipment." Further, Air District Rule 8-4 also exempts surface preparation operations for flexible and rigid disc manufacturing operations subject to Rule 8-38. A review of Air District permit records indicates that there is only one operation that may be subject to this rule.

Implementation Actions:

The Air District will:

- Draft amendments to Rules 8-29, 8-30, and 8-35 that would reduce the VOC limit for general product cleaning, surface preparation, and equipment cleaning solvents to no more than 50 g/l or, if compliant products are suitably available, no more than 25 g/l.
- Consider possible removal of VOC emission exemptions from Rule 8-38.

Emission Reductions:

The four source categories addressed by these rules emit approximately 2.4 tons of VOCs per day (2.2 tons attributable to wipe cleaning); however, it is unknown what fraction of these emissions would be available to be reduced through the implementation of this control measure.

Exposure Reductions:

N/A.

Emission Reduction Trade-Offs:

None.

Costs:

Specific costs will be estimated during rule amendments.

Co-Benefits:

N/A.

Issue/Impediments:

Training of workers in the use of alternative solvents. Undetermined health or odor issues associated with potential alternatives.

Sources:

1. Bay Area Air Quality Management District, Rule 8-4: General Solvent and Surface Coating Operations.
2. Bay Area Air Quality Management District, Rule 8-16: Solvent Cleaning Operations.
3. Bay Area Air Quality Management District, Rule 8-19: Surface Coating of Miscellaneous Metal Parts and Products.
4. Bay Area Air Quality Management District, Rule 8-24: Pharmaceutical and Cosmetic Manufacturing Operations.
5. Bay Area Air Quality Management District, Rule 8-31: Surface Coating of Plastic Parts and Products.
6. Bay Area Air Quality Management District, Rule 8-35: Coating, Ink and Adhesive Manufacturing.
7. Bay Area Air Quality Management District, Rule 8-38: Flexible and Rigid Disc Manufacturing.
8. Feather River Air Quality Management District, Rule 3-14: Surface Preparation and Clean-Up.
9. San Joaquin Valley Air Pollution Control District, Rule 4663: Organic Solvent Cleaning, Storage, and Disposal.
10. South Coast Air Quality Management District, Rule 1171: Solvent Cleaning Operations.

SS27: Digital Printing Operations

Brief Summary:

This control measure would reduce VOC emissions from digital printing operations, most likely by one of two approaches:

- Adopting VOC limits on inks and solvents used, or
- Adopting control technology requirements.

Purpose:

Reduce emissions of VOC from digital printing operations.

Source Category:

Area Source-digital printing operations

Regulatory Context and Background:

District Regulation 8, Rule 20 (Rule 8-20): Graphics Arts Printing and Coating Operations limits organic emissions from traditional graphic arts operations during printing, coating, adhesive, and cleaning activities. Traditional printing technologies include lithographic, letterpress, gravure, flexographic, and screen printing. VOC emissions from such operations are reduced by the rule via VOC limits on various inks, coatings and solvents.

Maryland's Code of Regulations (Section 26.11.19.18F), for example, addresses VOC emissions from screen printing and digital printing. The regulation applies to persons, owners, or operators that perform screen printing, manufactures plastic cards, coats plywood used for signs, or digital imaging and causes VOC emissions of 20 pounds or more per day. The regulation sets requirements on the maximum VOC content of inks used for screen printing. As a general requirement, persons, owners, or operators of digital imaging subject to the regulation may not cause VOC emissions exceeding 100 pounds per day from all digital printing at the premises. Those subject to the regulation must maintain records for not less than 3 years on the use of inks, and VOC content of each type of ink.

Digital printing (DP) is a fairly new, non-traditional printing process that is emerging in virtually every segment of the graphic arts industry as well as other industries. In traditional printing and graphic arts, images are transferred from a press to a paper or paper-like product. In a small percentage of operations, images are applied to limited types of textiles. In the DP process a digital image that is stored on a computer is converted into an image that can be printed on a wide variety of substrates besides paper, such as many types of textiles, and three dimensional objects. This differs from traditional graphic arts printing, which uses fixed-image masters or "plates." One primary reason DP is gaining greater acceptance is that DP has a faster turnaround time because it requires considerably less setup time for each job compared to other printing processes. Furthermore, last minute revisions are easily carried out without having to make significant changes, and may have environmental advantages, such as reduced waste. The nine basic types of digital printing technology include liquid inkjet printing; thermal transfer printing; laser printing, liquid electrophotographic printing; electrostatic printing; solid

ink printing; magnetographic printing; ionographic printing; and dye sublimation printing. Some digital printing operations utilize hydrocarbon mediums and some do not. Of all the digital printing operations, inkjet printing and electrophotographic printing appear to have the largest market share in the graphic arts industry on a world-wide basis. Although DP accounted for only about three percent of the total U.S. printing industry output in 1991, it is forecast to have at least a 20 percent market share by 2018.

A newer type of non-traditional printing process, known as 3D printing, is also emerging. 3D printing (or additive manufacturing) is a process of making three dimensional solid objects from a digital file. The creation of a 3D printed object is achieved using additive processes. In an additive process an object is created by laying down successive layers of material until the entire object is created. Each of these layers can be seen as a thinly sliced horizontal cross-section of the eventual object. There are many variations of 3D printing technologies. It is yet to be determined whether 3D printing should be classified as a digital printing category. The prevalence of 3D printing in the Bay Area is not yet known. The extent of organic vapor emissions from this industry is not known. However, some of the resin materials used to create 3D images is known to contain monomers which release organic vapors when polymerized.

Emissions from the DP industry are not regulated by the Air District's rule to control emissions from printing presses, Rule 8-20. However, the 2008 amendments to Rule 8-20 require certain large commercial digital printing operations to keep records of the usage of ink and other VOC-containing materials. Staff has identified two DP technologies that are believed to have significant emissions, Air District-wide: liquid electrophotographic printing and solvent-based inkjet printing. Solvent-based inkjet printers can produce images on the widest formats in the printing industry and use inks with high VOC contents. Inkjet printing and electrophotographic printing appear to be the most likely DP processes to emit significant ROG emissions.

Implementation Actions:

The Air District will:

- Determine VOC emission rates from various DP technologies in order to establish a DP emissions inventory. Determine the feasibility to control such emissions and whether the controls should be incorporated into the current graphic arts rule or a new DP rule.
- Consider establishing a limit for VOC emissions from DP facilities, such as Maryland's 100 pounds per day limit for example. Consider add-on controls or equipment requirements to control emissions.
- Consider establishing emission limits for each DP technology, allowing a combination of low-VOC materials and add-on controls, as necessary.

Emission Reductions:

It is estimated that 40 to 50 large, liquid electrophotographic presses may exist in the Bay Area. The number of large, commercial inkjet printers as well as other commercial DP operations is not known.

Exposure Reductions:

N/A

Emission Reduction Trade-Offs:

N/A

Costs:

Costs are unknown at this time. Some DP operations may reduce emissions through internal controls of ink usage, making ink and/or solvents available for re-use.

Co-Benefits:

- Reduction in ROG emissions may reduce emissions of toxic organic compounds.

Issue/Impediments:

Unlike traditional printing, technical barriers to the development of low-VOC inks may exist due to the nature of how the DP creates images. Inkjet printing relies on ink with a very low viscosity to be sprayed through tiny nozzles. Electrophotographic printing relies on the polarity of ink molecules to be attracted to charged plates.

Sources:

1. EPA Office of Compliance Sector Notebook Project: Profile of the Printing & Publishing Industry, 1995
<http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/printpt1.pdf>
1. EPA Design for the Environment Printing Industry Profile,
<http://www.p2pays.org/ref/01/00936/execsum.htm>
2. Digital Printing: The Reference Handbook, 2004, Uri Levy & Gilles Biscos
3. Today's Digital Imaging: Version 5.0, 2005, Smart Papers
4. Conference call with Sandra Lowe-Leseth, Rule Developer, San Joaquin Valley Air Pollution Control District, 5/2/07
5. Code of Maryland Regulations: 26.11.19.18. 18 Control of Volatile Organic Compound Emissions from Screen Printing and Digital Imaging
6. Digital Printing Market Forecast to 2018: Smithers Pira
<https://www.smitherspira.com/market-reports/news/printing/digital-printing-trends-market-analysis-2018.aspx>

SS28: LPG, Propane, Butane

Brief Summary:

Investigate potential ROG reductions by regulating filling of, and leakage from LPG, propane and butane tanks.

Purpose:

Reduce ROG emissions that occur when venting LPG, propane, and butane storage vessels during the filling process.

Source Category:

Area Source

Regulatory Context and Background:

The Air District already enforces tight gas requirements at stationary sources for a variety of operations, including refineries and bulk terminals. This control measure would set leakage allowance standards for Liquid Petroleum Gases (LPG), propane and butane tanks and connections, as well as prohibit or control venting during filling of such tanks.

Typically, LPG should occupy no more than 80 to 85 percent of the volume of a tank to allow for liquid expansion if a tank gets heated (such as by sunlight). These tanks have a bleed valve that indicates to the person filling the container when the level of liquid in the tank is at the “full” level (80 to 85 percent by volume). The current standard practice is to bleed LPG vapor from the tank while filling, and then stop filling when liquid LPG “spits” from the bleed valve. However, these tanks can be safely refilled without venting by filling to a final weight or by filling to a final liquid volume using a tank gage. A research project at CARB in 2009 indicated that technological solutions were available and cost effective.

California LPG demand is 652 million gallons per year. Bay Area demand is approximately 20 percent, based on population. Approximately 40 percent of the LPG is used for residential heating and cooking, 40 percent industrial, 13 percent commercial, and 7 percent transportation uses. ROG fugitive emissions from LPG in the Bay Area are estimated to be 7,200 pounds per day.

South Coast Air Quality Management District (SCAQMD) adopted a rule (Rule 1177) in June 2012 that requires:

- A vapor tight vapor recovery system for LPG bulk loading facilities,
- Use of new filling technology, or a low emission Fixed Liquid Level Gauge (FLLG) at LPG transfer and dispensing facilities.
- New cargo tanks manufactured after 7/1/2013 must be fitted with a low emission FLLG.
- A cylinder or portable storage tank must be fitted with a low emission FLLG by 7/1/2017.
- The owner/operator must develop and implement and Leak Detection and Repair (LDAR) program.
- Appropriate record keeping.

Provisions do not apply to any container less than 4 gallons, or LPG cylinders used with recreational vehicles.

Implementation Actions:

The Air District will:

- Investigate the potential for a new rule to regulate VOC emissions from LPG storage facilities, equivalent to SCAQMD Rule 1177.

Emission Reductions:

Pollutants*	2020	2030
ROG	5,000	5,000

**criteria pollutants are reported in lbs/day*

Emissions Reduction Methodology:

ROG emission reductions are estimated to be 5,000 pounds per day, based on expected reduction of about 70 percent fugitive LPG emissions with the proposals in Rule 1177.

Exposure Reductions:

None

Emission Reduction Trade-Offs:

None

Costs:

Costs for vapor tight vapor recovery system for LPG bulk loading facilities, low emissions connectors, and low emissions Fixed Liquid Level Gauge (FLLG) will total about \$9.1M capital, amortized to \$1.4M annually, and \$0.4M annually for operating costs.

Co-Benefits:

None

Issue/Impediments:

None.

Sources:

1. South Coast Air Quality Management District Rule 1177, and Staff Report, June 1, 2012
2. Maximus™ SFI – Measurement and Reduction of Gas Outage Gauge Emissions, the ADEPT Group, Inc. California Air Resources Board, Chair’s Air Pollution Seminar, March 19, 2009

SS29: Asphaltic Concrete

Brief Summary:

Cutback and emulsified asphalts are used to seal and repair roads, parking lots, walkways and airport runways. Other locations in the US have more restrictive petroleum distillate (solvent) limits for these liquid asphalt products than is currently required in the Bay Area. Some locations have limits for emulsified or cutback asphalt set at no more than 0.1 wt. percent ROG. This measure is intended to reduce ROG emissions from asphalt.

Purpose:

Reduce reactive organic emissions that are precursors to ozone formation

Source Category:

Area source – emulsified asphalt

Regulatory Context and Background:

The 2008 Massachusetts State Implementation Plan (SIP) identified Asphalt Paving as an area of opportunity to reduce ROG, however it does not appear that Massachusetts took any action on that initiative. The current Massachusetts limit for ROG in cutback asphalt is 5 weight percent. Maine established a requirement in 2010 limiting ROG content during summer months for both cutback and emulsified asphalt to no more than 0.1 wt. percent ROG. South Coast and San Joaquin Valley air districts limit ROG content of cutback asphalt to 0.5 volume percent, and limit ROG content of cutback asphalt to 3 volume percent. Similarly, Air District Regulation 8, Rule 15 currently allows 0.5 volume percent distillates (described as petroleum solvents) in Slow-Cure Liquid Asphalt, and 3.0 volume percent distillates in emulsified asphalt.

In a related issue, a recent study by the Institute for Research and Technical Assistance (IRTA) determined that asphalt contractors were using diesel fuel to clean their equipment.¹ IRTA found that recycled vegetable oil worked just as well with reduced concerns about toxicity.

Implementation Actions:

Air District staff will:

- Evaluate the cost effectiveness, and feasibility of limiting solvent content of emulsified asphalt.
- Evaluate the availability of substitutes to diesel to clean asphalt related equipment.

Emission Reductions:

Pollutants*	2020	2030
ROG	400	400

*criteria pollutants are reported in lbs/day

¹ "Alternative Low-VOC Release Agents and Mold Cleaners for Industrial Molding, Concrete Stamping and Asphalt Applications", IRTA, October 2013.

Emissions Reduction Methodology:

Current emissions estimated for emulsified asphalt is 600 pounds of ROG per day. Emissions can be reduced by 400 pounds per day by limiting ROG content of these emulsified asphalts.

Exposure Reductions:

None

Emission Reduction Trade-Offs:

None

Costs:

Solvents / distillates are generally the most expensive component of emulsified asphalt, except for the emulsifying agent. Reducing ROG content may reduce the costs to manufacture. These costs may be offset by higher product testing and quality assurance costs during the transition to the lower ROG content materials.

Co-Benefits:

None

Issue/Impediments:

None

Sources:

1. EPA AP-42: Emission factors for Asphalt Paving Operations, Chapter 4.5
2. CARB Attachment C: Asphalt Paving and Roofing, from STI's Area Source Emissions Updates, March 2003.
3. Rita Leahy, Consultant for California Asphalt Pavement Association
4. Massachusetts Department of Environmental Protection, 310 CMR 7.18
5. Maine Department of Environmental Protection, Chapter 131, Cutback Asphalt and Emulsified Asphalt
6. South Coast Air Quality Management District, Rule 1108, 1108.1
7. San Joaquin Valley Air Pollution Control District, Rule 4641

SS30: Residential Fan-Type Furnaces

Brief Summary:

This control measure would reduce oxides of nitrogen (NO_x) emissions from fan type central furnaces by reducing allowable NO_x emission limits on new furnace installations in Regulation 9, Rule 4 (Rule 9-4). Also, Rule 9-4 would be amended to apply to non-residential furnaces in the same size range.

Purpose:

Reduce emissions of NO_x from fan-type central furnaces.

Source Category:

Combustion

Regulatory Context and Background:

The Air District's Rule 9-4 is a "point-of-sale" type regulation, requiring that any new residential furnace rated up to 175,000 BTU/hr be certified to meet 40 nanograms (ng) of NO_x per joule of delivered heat, which is equivalent to an emission concentration of about 55 ppmv at 3 percent oxygen. Rule 9-4 was adopted and last amended in 1983. In 2009, the South Coast Air Quality Management District (SCAQMD), which previously imposed the same 40 ng/joule NO_x limit as Rule 9-4 in their Rule 1111, adopted a future NO_x limit of 14 ng/joule for most categories of central furnace rated up to 175,000 BTU/hr (conventional units, high-efficiency condensing units, mobile-home units), with the first category subject to the reduced limit in October 2014. As of the beginning of 2014, SCAQMD staff reported to their governing board that manufacturers had developed and tested prototype furnaces in each device category that comply with the 14 ng/joule NO_x limit, but that commercial versions of these devices were not yet available, and that Rule 1111 might be amended in 2014 to address this timing issue. In September 2014, Rule 1111 was indeed amended to delay the compliance date for condensing (high efficiency) units until April 1, 2015, and to allow up to three years' delay for residential furnace manufacturers to meet the 14 ng/joule emission limit with payment of a mitigation fee.

The intent of this control measure is to reduce NO_x and CO emissions. In a broader context, the Air District is working with local governments and others to phase out the use of fossil fuel-based technologies in buildings, as part of the Air District's large-scale effort to reduce greenhouse gas emissions (see BL2: Decarbonize Buildings). When it is not feasible to install a non-fossil fuel-based furnace, this control measure ensures that the furnace installed uses best available retrofit control technology (BARCT). This control measure establishes maximum allowable NO_x and CO emission levels for a specified type and size range of furnace. Any future greenhouse gas reduction rules the Air District may develop as part of its climate protection strategy may restrict commerce in or use of certain types of fossil fuel combustion devices, including devices addressed in NO_x and CO BARCT rules.

Implementation Actions:

The Air District will:

- Develop amendments to Rule 9-4 to include the 14 ng/joule NO_x limit that appears in SCAQMD Rule 1111 and extend the rule to non-residential applications.
- Explore opportunities regarding the use of fossil fuel-based technologies in residential and non-residential space heating (see BL2: Decarbonize Buildings).

Emission Reductions:

Pollutants*	2020	2030
NO _x	13,200	13,200

**criteria pollutants are reported in lbs/day*

Emission Reductions Methodology:

Because the amended rule will apply only to new devices and because central furnaces have an average life of about 20 years, the emission reductions from this measure will be phased in as existing furnaces are replaced. Emissions reductions will be 12,000 to 14,400 pounds per day after the measure is fully implemented (emission reductions in the table above represent an average of these two estimates). This estimate is based on a 65 percent reduction (14 ng/joule versus 40 ng/joule) of the 2011 NO_x inventory for domestic space heating using natural gas fuel (17,220 pounds/day), plus some portion of commercial natural gas use (4,820 pounds/day). The inventory also includes industrial natural gas use (5,880 pounds/day), but this is assumed to not be used for space heating.

Exposure Reductions:

Not applicable to NO_x emissions.

Emission Reduction Trade-Offs:

Depending on the technology selected, NO_x reductions may increase GHG emissions, specifically CO₂, by reducing efficiency of the combustion process. This trade-off is unlikely for this control measure, however, because efficient low-NO_x burners have been developed for similar types of appliances. New forced air heaters will probably be more efficient than the ones they replace, reducing GHG emissions.

Costs:

In the staff report for Rule 1111, South Coast AQMD estimated that compliance with a 14 ng/joule NO_x limit would cost from \$9,400 to \$20,750 per ton of NO_x reduced and would result in an additional consumer cost of \$118 to \$223 per furnace, all in 2014 dollars.

Co-Benefits:

Because NO_x compounds in the atmosphere contribute to the formation of secondary particulate matter (PM), any NO_x emission reduction will also result in a reduction of PM_{2.5}. Secondary PM is formed from the conversion of NO_x to ammonium nitrate (NH₄NO₃). District staff has estimated the ratio between NH₄NO₃ formation to NO_x emissions to range between 1:6 and 1:10. Assuming a NO_x emission reduction of 12,000 to 14,400 pounds/day, and a

particulate formation factor of 1:8, secondary particulate matter will be reduced by 1,600 to 1,800 pounds/day by the control measure.

Issue/Impediments:

No specific issues or impediments have been identified.

Sources:

1. South Coast Air Quality Management District, Rule 1111
2. Bay Area Air Quality Management District (BAAQMD), Regulation 9, Rule 4

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SS31: General Particulate Matter Emission Limitation

Brief Summary:

Reduce the Air District's emissions limits for particulate matter.

Purpose:

Reduce particulates, especially PM_{2.5}.

Source Category:

Permitted stationary sources

Regulatory Context and Background:

There are currently seven Air District rules directly addressing particulate matter (PM) emissions:

- Regulation 5: Open Burning
- Regulation 6, Particulate Matter, Rule 1: General Requirements
- Regulation 6, Particulate Matter, Rule 2: Commercial Cooking Equipment
- Regulation 6, Particulate Matter, Rule 3: Wood Burning Devices
- Regulation 6, Particulate Matter, Rule 4: Metal Recycling and Shredding Operations
- Regulation 9, Inorganic Gaseous Pollutants, Rule 13: Nitrogen Oxides, Particulate Matter, and Toxic Air Contaminants from Portland Cement Manufacturing
- Regulation 12, Miscellaneous Standards of Performance, Rule 4: Sand Blasting
- Regulation 12, Miscellaneous Standards of Performance, Rule 13: Foundry and Forging Operations

Regulation 6: Particulate Matter was originally adopted by the Air District on October 18, 1973, and then amended on December 17, 1975 to allow enforcement of limits on smoking motor vehicles. Regulation 6 was amended on January 5, 1983, and again on July 11, 1990 to be consistent with the California Health and Safety Code regarding emissions from pile driving equipment. On December 19, 1990, Regulation 5: Open Burning was amended, and minor adjustments were made to Reg. 6 for consistency. On December 5, 2007, Regulation 6: Particulate Matter was renumbered and retitled to Regulation 6, Particulate Matter, Rule 1: General Requirements. This was done to accommodate a new rule for commercial charbroilers, titled Regulation 6: Particulate Matter, Rule 2: Commercial Cooking Equipment. Regulation 6, Particulate Matter, Rule 3: Wood Burning Devices was adopted on July 9, 2008 to address PM_{2.5} from wood stoves and fireplaces during the winter. On September 19, 2012 the District adopted Regulation 9, Rule 13, which controls nitrogen oxides, particulate matter, and toxic air contaminants from Portland cement manufacturing. On May 1, 2013, the District adopted two rules: Regulation 6, Rule 4: Metal Recycling and Shredding Operations, and Regulation 12, Rule 13: Foundry and Forging Operations. Both of these rules require plans to control fugitive emissions of particulate matter. Regulation 5 Open Burning was amended on June 19, 2013.

The general requirement limits for particulate matter emissions in Rule 6-1 are:

- Particulate emissions (TSP) must be less than 343 milligrams per dry standard cubic meter (mg/dscm), or 0.15 grains per dry standard cubic foot (gr/dscf); and
- No more than 20 percent opacity for stack emissions (or no more than Ringelmann 1.0 for uncontained plumes) for no more than 3 minutes in any hour.

Many existing stationary sources with PM emissions have been modified over the years. Permit conditions have been established to require Best Available Control Technology (BACT) when these sources were installed, modified, or replaced, requiring more stringent levels of control than required by Rule 6-1. These permit conditions often also define testing, monitoring, reporting and recordkeeping requirements.

Comparison of Air District PM Regulations to other air districts

Air District rules controlling particulate matter are less stringent in certain respects than similar rules in other urban air districts in the state. Rule 6-1 limits PM to 0.15 gr/dscf, where the limit is 0.10 gr/dscf in several other air districts. Rule 6-1 limits based on “process weight” are less restrictive than in South Coast, San Joaquin Valley and Sacramento air districts. In addition, South Coast also establishes a PM concentration limit, in both milligrams per dry cubic meter (mg/dscm), and grains per dry standard cubic foot (gr/dscf) based on volumetric flow rate, culminating in a limit of 0.01 gr/dscf for volume flows exceeding 70,000 cubic meters per minute (~ 2.5 million standard cubic feet per minute).

Requirements for visible emissions are very similar throughout California’s air districts. Most visible emissions are limited based on the Ringelmann scale or within a specific opacity limit using an opacity sensing device. Visible limits are often based on a “not to exceed” limit of three or four minutes within any 60-minute period. Visible emissions are also sometimes limited to remaining within the source’s property boundaries.

One difference among local air district rules for PM is that the Bay Area Air District has just a few all-inclusive PM rules, where other air districts have recognized several specific industries or categories of PM sources, and have developed specific PM rules for each industry or category. As the Air District moves forward in further controlling PM emissions, staff will consider the largest source categories of PM emissions and determine the best approach to control each category.

The 2017 Plan control strategy will also have control measures that limit PM emissions through its source specific proposed rules and control measures, e.g. enforce ARB regulations to reduce PM emissions from diesel engines in the Bay Area communities most impacted by PM emissions (SS39: Enhanced Air Quality Monitoring); continue and enhance its program to reduce residential wood-burning (SS34: Wood Smoke); and provide grants and incentives to reduce emissions of particulate matter and BC from heavy-duty vehicles (TR19); PM from trackout (SS36); and PM from asphalt operations (SS37).

State and Federal PM Requirements

California air pollution control laws address particulate matter from stationary sources in several specific ways. They set standards for diesel pile-driving hammers, and for sandblasting so that they are consistent throughout the state. State law also addresses requirements on portable equipment for consistency. State law provides guidelines for the local air districts to regulate agricultural burning. Almost all other state PM related regulations are directed at mobile sources – primarily diesel engines.

Federal regulations from the United States Environmental Protection Agency limiting particulate matter encompass a wide variety of stationary sources. The Air District enforces these federal requirements. Air District requirements can be more stringent, as needed, to achieve National and California Ambient Air Quality Standards.

Implementation Actions:

The Air District will

- Investigate the potential for a new or amended rule that considers application of available control technology to reduce or revise allowable weight rate limitations on existing PM emissions sources.

Emission Reductions:

Pollutants*	2020	2030
PM _{2.5}	340	340
PM ₁₀	640	640

**criteria pollutants are reported in lbs/day)*

Emission Reductions Methodology:

Reductions are expected to be relatively modest, because most permitted sources have been modified over the years, triggering BACT and permit conditions that are far more stringent than 6-1.

Exposure Reductions:

Particulate matter from stationary sources can also contain toxics, depending on the specific source.

Emission Reduction Trade-Offs:

Minor – some additional energy required to operate cyclones/baghouses, or roto-clones/ESP's due to increase in pressure drop across these devices.

Costs:

Both initial capital cost and annual cost (based on EPA Cost Models, in 2012 dollars) can vary depending on control technology and size. A wet scrubber can cost between \$85,000 to \$488,000, with annualized costs ranging from \$25,000 to \$146,000. Cyclones range from \$64,000 to over \$600,000, and have varying annual costs. Baghouses range from \$278,000 to

just over \$900,000; while ESPs are the most expensive and cost anywhere from 1.8 million to nearly \$4.4 million.

Cost effectiveness is dependent on the loading of particulates at the inlet.

Co-Benefits:

None identified.

Issue/Impediments:

None Identified.

Source:

1. Bay Area Air Quality Management District, 2014 amendments to Rule 6-1, workshop report.

DRAFT

SS32: Emergency Back-up Generators

Brief Summary:

Emergency back-up generators (BUGs) provide power when primary sources are unavailable (e.g. during blackouts or brownouts). Most BUGs are powered by diesel fired engines that emit diesel particulate matter (DPM), a toxic air contaminant (TAC), and black carbon which contributes to climate change. Beginning with the year 2000, the federal government and the State of California have enacted progressively stricter emissions standards for diesel engines that power BUGs, but thousands of BUGs that do not meet current standards remain in operation. Draft Regulation 11, Rule 18 (Rule 11-18) will address health risks resulting from all significant sources of TAC emissions, including emergency BUGs.

Purpose:

This measure will reduce emissions of DPM and black carbon from BUGs through Draft Rule 11-18, resulting in reduced health risks to impacted individuals, and in climate protection benefits. Black carbon's short atmospheric lifetime, combined with its strong warming potential, means that targeted strategies to reduce black carbon emissions can provide climate benefits within the next several decades.

Source Category:

Stationary sources – emergency back-up generators

Regulatory Context and Background:

Stationary diesel engines are regulated at the federal, state and local level. DPM is not classified as a hazardous air pollutant by US EPA, but many components of diesel emissions are identified as such. Federal requirements for diesel engines are contained in the National Emission Standard for Hazardous Pollutants (NESHAP) from Stationary Reciprocating Internal Combustion Engines and the New Source Performance Standards (NSPS) for stationary diesel engines. The NESHAP issued in 2004 targets toxic emissions (formaldehyde, acrolein, methanol, acetaldehyde, among others) from stationary compression and spark ignited engines located at major facilities and area sources of hazardous air pollutants. In 2006, US EPA promulgated the NSPS establishing emission standards for criteria pollutants from new engines, modeled after US EPA standards for non-road and marine diesel engines. These included progressively more stringent emissions standards phased in over several years (tiers one through three), with the most stringent tier (tier four) for prime (non-emergency) engines requiring add-on controls such as selective catalytic reduction (SCR) for NO_x and diesel particulate filters (DPF) for PM.

State requirements for diesel engines stem from identification of DPM as a TAC by the California Air Resources Board (CARB) in 1998. In 2000, CARB approved a risk reduction plan to reduce PM emissions from diesel fueled engines and vehicles with a recommendation for an 85 percent reduction in cancer risk from these sources by 2020. In 2004, the stationary compression ignition engine Air Toxics Control Measure (ATCM) was adopted to limit public exposure to diesel PM, establishing emission limits for new and in-use stationary diesel engines. Emissions standards are linked to state off-road compression ignition engine standards and implementation schedules based on model year and size of the engine. Emissions certification

standards are phased in as tiers one through four becoming more stringent and coming into effect in 4 to 5 year increments, similar to federal standards. In 2007, the ATCM was amended to establish standards for in-use stationary diesel engines used in agricultural applications. The ATCM was further amended in 2011 to eliminate the need for new emergency standby engines to meet the tier four standards which require add-on controls and align direct drive fire pump engines with NSPS standards.

In response to CARB’s identification of DPM as a TAC in conjunction with problems with the California energy grid, the Air District amended Regulation 2, Rule 1 in 2001 to eliminate a permit exemption for engines used for stand-by power. In addition, as part of that rulemaking, Regulation 9, Rule 8 (Rule 9-8) was amended to clarify the conditions under which standby engines may be operated during emergencies. In 2007, Rule 9-8 was further amended to regulate emissions of NO_x from diesel engines along with other amendments for internal combustion engines fired by gaseous fuels and liquid fuels other than diesel.

No air district has implemented add-on controls or emission standards (aside from limiting hours for maintenance and testing) to reduce emissions from existing BUGs, and most air districts implement the ATCM adopted in 2004 by CARB for controls on new engines. South Coast Air Quality Management District places slightly more stringent requirements on new engines located near sensitive receptors.

Over 6,700 diesel fired engines are permitted in the Air District for emergency standby power (electrical power generation and pumps). This represents over one quarter of all permitted sources in the Air District. Of the 6,700 permitted BUGs in the Bay Area, 40 percent predate US EPA emissions standards as well as emissions certification by CARB, and so they are known as tier zero engines. Less than 15 percent of the permitted BUGs meet the current level of control required for new engines (tier 4), and approximately 400 engines have installed add on emission controls.

Annual DPM emissions from all permitted BUGs are relatively small in total mass. According to the 2011 inventory, BUGs operating in the Air District account for 18 tons per year of total particulate. Annual black carbon emissions from BUGs account for less than 14 tons per year district-wide. Some older, higher-emitting BUGs may present health risks if they are used in proximity to residential or other sensitive receptors.

Implementation Actions:

Air District staff will implement Rule 11-18, once adopted. See SS20: Air Toxics Risk Cap and Reduction from Existing Facilities for more detail on this rule and its implementation.

Emission Reductions:

Pollutants*	2020	2030
CO _{2e}	0	1.8

*CO_{2e} is reported in metric tons/year (100 yr GWP)

Emission Reduction Trade-Offs:

None

Costs:

The cost to replace a back-up generator is roughly \$121 dollars per horsepower (\$121/hp), or \$30,250 to replace a 250 hp engine (Source #1 adjusted from 2003 to 2015 dollars). Costs for a diesel particulate filter (DPF) vary, averaging about \$67/hp, so for the same 250 hp engine this would be \$16,750 (Source #5 adjusted from 2012 to 2015 dollars). Because CARB has yet to certify any control device for use with tier zero engines, application of these devices would require some sort of additional verification. In most cases, replacement of the engine would be a more likely outcome considering years of service and the additional costs of source testing for compliance verification. Air District staff will refine cost estimates as this measure is developed further.

Co-Benefits:

In addition to having lower emission rates of DPM, newer engines emit less carbon monoxide (CO), reactive organic gases (ROG), and oxides of nitrogen (NOx). Back-up generators do not represent a large percentage of the Air District inventory for these pollutants, however. Some operators may choose to replace older BUGs with cleaner technologies, such as fuel cells or propane-fired engines instead of purchasing new diesel-fired units.

Issues/Impediments:

There is a large inventory of permitted tier zero BUGs, and there may be additional unpermitted BUGs. In developing and implementing Rule 11-18, the Air District will conduct extensive outreach to communicate all regulatory changes to the large number of affected stakeholders, which span many different industries.

Sources:

1. CARB; Staff Report; Initial Statement of Reasons for Adoption of the Proposed Airborne Toxic Control Measure for Stationary Compression-Ignition Engines, Emissions Assessment Branch, Stationary Source Division, CARB; September 2003
2. California Air Resources Board; Staff Report; Final Statement of Reasons for Rulemaking: Proposed Amendments to the Airborne Toxic Control Measure for Stationary Compression-Ignition Engines; October 2010
3. Regulatory Impact Analysis for Existing Stationary Reciprocating Internal Combustion Engines (RICE) NESHAP, Final Report; US EPA Office of Air Quality Planning and Standards, Air Benefit and Cost Group; February 2009
4. Regulatory Impact Analysis for Reconsideration of Existing Stationary Reciprocating Internal Combustion Engines (RICE) NESHAP; US EPA Office of Air Quality Planning and Standards, Health and Environmental Impact Division, Air Economics Group and Risk and Benefits Group; January 2013
5. South Coast Air Quality Management District; Revised Staff Report; Proposed Amended Rule 1110.2 –Emissions from Gaseous- and Liquid- Fueled Engines; August 2012
6. Bay Area Air Quality Management District; HRSA Streamlining Policy Report for Stationary Emergency Standby and Fire Pump Diesel Engines; May 2015
7. Bay Area Air Quality Management District; Backup Generator Emission Factor Study; January 2015

SS33: Commercial Cooking Equipment

Brief Summary:

Air District Regulation 6, Rule 2 (Rule 6-2) requires installation of certified control devices for chain driven and underfired charbroilers (grills). At this time, no control devices have been certified for underfired charbroilers. This measure would amend Rule 6-2 so that the Air District can approve control devices for underfire charbroilers.

Purpose:

To further reduce particulate matter (PM) emissions from commercial cooking operations.

Source Category:

Stationary Sources

Regulatory Context and Background:

In 2007, the Air District passed Rule 6-2, which limits PM emissions when cooking beef at chain driven charbroilers and underfired charbroilers. Chain driven charbroilers are semi-enclosed, mechanically driven cookers commonly used at fast food establishments. Underfire charbroilers are generally recognized as grills. Food preparation contributes a significant proportion to the PM inventory in the Bay Area.

Because chain driven charbroilers can be delivered with ready-made control devices, many units in the Bay Area are controlled. To date, however, there are no approved control devices for underfired charbroilers. The current version of Rule 6-2 establishes an emission limit of 1.0 lbs PM/1000 pounds of meat cooked. Recent evidence from the University of California, Riverside shows that this limit is not attainable because the original emission factors were not realistic (too low). In order to certify control equipment for underfire charbroilers, another certifying criterion, such as percent control efficiency, will be required.

Implementation Actions:

The Air District will determine adequate criteria for approving add-on equipment to control PM emissions from underfire charbroilers, amend Rule 6-2, and develop an implementation plan for the amended rule.

Emission Reductions:

Pollutants*	2020	2030
ROG	n/a	340

*criteria pollutants are reported in lbs/day

Exposure Reductions:

Restaurants often operate in or near residential and commercial areas. Reductions in PM and associated air toxics will occur near peoples' homes and in or near shopping and recreation areas.

Emission Reduction Trade-Offs:

Modest additional electricity required to operate the control devices.

Costs:

Specific costs will be estimated during rule amendment.

Co-Benefits:

Related reductions in organic compounds and air toxics.

Issue/Impediments:

None identified.

Sources:

1. Bay Area Air Quality Management District, Regulation 6, Rule 2, *Commercial Cooking Equipment*, December 5, 2007
2. Bay Area Air Quality Management District, Draft Staff Report, Regulation 6, Rule 2, *Commercial Cooking Equipment*, November, 2007
3. University of California, Riverside, College of Engineering-Center for Environmental Research and Technology, "Comparison of Particulate Matter Emissions Measurement for a Commercial Charbroiling Process with and without Controls," Final Draft Report, prepared for Bay Area Air Quality Management District

SS34: Wood Smoke

Brief Summary:

The Air District amended Regulation 6 Particulate Matter and Visible Emissions, Rule 3: Wood-Burning Devices in late 2015 to impose additional significant restrictions on wood burning. However, wood smoke continues to be a significant contributor to PM_{2.5} exceedances during the winter, when low winds can result in the formation of an inversion layer over the Bay Area. Exemptions currently in place in Rule 6-3 allow homes without any other form of permanent heat to burn wood in an EPA certified wood burning device. This control measure considers banning wood burning completely during Spare the Air episodes.

Purpose:

Reduce wood smoke during Winter Spare the Air alerts

Source Category:

Area Source – wood burning devices

Regulatory Context and Background:

The Air District adopted Rule 6-3 in 2008, and later amended it on October 21, 2015. This rule has been very effective at reducing wood smoke emissions. During the winter season from November through February, PM_{2.5} emissions from wood smoke are estimated to average 34,000 pounds per day. When the Air District calls a Winter Spare the Air Alert, PM_{2.5} emissions from wood smoke are estimated to be reduced to approximately 720 pounds per day. The Bay Area still periodically exceeds air quality standards for fine particulates. Therefore, staff is identifying further opportunities to reduce PM_{2.5} emissions, including considering a complete ban of wood burning during Winter Spare the Air Alerts.

Implementation Actions:

Air District staff will:

- Investigate further limits on wood burning, including additional limits to exemptions from existing Rule 6-3, Wood Burning Devices.

Emission Reductions:

Pollutants*	2020	2030
PM _{2.5}	60	60

*criteria pollutants are reported in lbs/day

Emission Reductions Methodology:

PM_{2.5} emissions from wood smoke are estimated to average 34,000 pounds per day during the winter season. During Winter Spare the Air Alerts, when Rule 6-3 restrictions are in effect, PM_{2.5} emissions from wood smoke are approximately 720 pounds per day. Complete ban of wood burning during Winter Spare the Air Alerts will reduce PM_{2.5} emissions by 60 pounds per day for each Winter Spare the Air Alerts are in effect (typically 15 – 25 nights each winter), or approximately 72,000 pounds per year.

Exposure Reductions:

Rule 6-3 reduces PM_{2.5} exposure, especially in certain locations where wood smoke may accumulate. A large and growing body of scientific evidence indicates that both short-term and long-term exposure to fine particles can cause a wide range of health effects, including: aggravated asthma and bronchitis; hospital visits for respiratory and cardiovascular symptoms; and contributes to strokes and heart attacks, some of which result in premature deaths. The evidence also shows that reducing PM emissions can reduce mortality and increase average life span. Therefore, measures that reduce PM emissions may have a significant impact on public health.

Emission Reduction Trade Offs:

None, although some perceive wood as a renewable source of energy. The Environmental Impact Report (EIR) completed in 2008 during the development of the original Rule 6-3 indicated that most firewood comes from old-growth trees and land clearing, not from managed tree farms.

Costs:

Individuals with homes without an alternative permanent source of heat may need to install one. Many of these homes are in rural areas, so natural gas is not available. The simplest approach is to add electric space heaters. Electric heat is quite expensive, but would be required only during Winter Spare the Air Alerts. Other forms of permanent alternative heat, such as a heat pump and associated air ducts are much more expensive, estimated at \$10,000 capital. Heating costs are dependent on the type of alternate heat. Heat pumps are very efficient, so electric heat pump on-going costs are comparable with natural gas costs. Propane heat is efficient, but propane is expensive. Further cost impacts would be evaluated during rule development.

Co-Benefits:

Wood smoke contains some black carbon, which is a short-lived climate pollutant; further reduction of wood burning would decrease black carbon emissions.

Issue/Impediments:

Some members of the public are strongly in support of a complete ban on wood burning, while other members of the public may not support further limits on wood burning.

Sources:

1. Bay Area Air Quality Management District, staff report for amendments to Rule 6-3, 2015
2. US Environmental Protection Agency, Report to Congress on Black Carbon, 2012. Available at: <http://www3.epa.gov/blackcarbon/2012report/fullreport.pdf>

SS35: Particulate Matter from Bulk Material Storage, Handling and Transport, Including Coke and Coal

Brief Summary:

The Air District has been receiving complaints about black dust from petroleum coke and coal storage and transfer operations. This dust is leaving black residue on residential property and business equipment. South Coast AQMD Rule 1158 addresses coke, coal (and elemental sulfur) storage and handling. The intent of this measure is to develop a new regulation to control fugitive dust from bulk material operations throughout the Bay Area, including petroleum coke and coal storage and handling operations.

Purpose:

Reduce public nuisance complaints and PM_{2.5} emissions from storage, handling and transport of all bulk materials with potential to create fugitive dust, particularly petroleum coke and coal storage and handling operations.

Source Category:

Point Sources – bulk material handling including petroleum coke and coal storage and transfer operations

Regulatory Context and Background:

Regulation 6, Particulate Matter, Rule 1: General Requirements (Rule 6-1) currently has a provision that does not allow particulates from a source to cross the property line and impact neighbors. Enforcement of this provision of Rule 6-1 is difficult when trying to identify the specific source of excessive dust. Bulk materials including petroleum coke and coal dust are easier to trace, but more explicit requirements and performance standards are needed to reduce impacts from bulk material storage and handling operations.

Implementation Actions:

Air District staff will develop a new rule, Regulation 6, Particulate Matter, Rule 8: Bulk Material Storage, Handling and Transport to prevent and control wind-blown fugitive dust from these types of storage and handling operations. Establish enforceable visible emission limits to support preventive measures such as water sprays, enclosures to surround the bulk materials, and wind barriers. Consider enhanced controls where sources are located near sensitive populations or areas currently impacted by cumulative sources of air pollution.

Emission Reductions:

Pollutants*	2020	2030
PM _{2.5}	4	4
PM ₁₀	32	32

**criteria pollutants are reported in lbs/day*

Emission Reduction Methodology

PM emissions of fugitive dust from coke and coal storage and handling operations are currently estimated to be 0.21 tpd TSP, 0.064 tpd PM10, and 0.007 tpd PM2.5. Controls for fugitive dust include enclosures or wind brakes to reduce wind-blown dust, and water sprays or wetting agents to improve moisture content and bind silt to the bulk coke or coal. Enclosures with secondary controls (baghouses) of dust emissions are 95 percent effective. Wind screens and water sprays may be more practical for existing facilities, and are expected to be 50 – 75 percent effective. Based on conservative assumption that control requirements are applied to 50 percent of sources, emission reductions are estimated to be 32 pounds/day PM10, and 4 pounds per day PM2.5.

Exposure Reductions:

The main threat to urban populations near bulk material storage facilities is the very small particles from dust that may develop from wind erosion or through handling of these solid materials. Particles from coal and petroleum coke piles are highly visible and the source of many complaints from the surrounding community. Small particles (less than 2.5 microns) have been found to cause a wide range of health impacts. In addition, coke oven workers have been found to have higher incidents of lung cancer, bronchitis, and chronic obstructive pulmonary disease (COPD).

Petroleum coke is known to contain polycyclic aromatic hydrocarbons (PAH's), and high levels of nickel and vanadium. The nickel and vanadium were found in water runoff, but further study is needed to identify risks to aquatic life. Plants using water with high metals are found to also contain high metals. Toxicity studies relevant to human health found PAH's do not leach into the water streams. Petroleum coke exposure does not lead to higher incidents of types of cancer, and showed low reproductive and developmental toxicity. Coal is lower in silt content, as well as lower in PAH's, but metals levels in coal can be higher.

Emission Reduction Trade-Offs:

Enclosures and wind screens are one-time projects, so the only emissions impacts occur during construction. If secondary controls (baghouses) are required for the enclosures, they require energy but typically not more than 100 HP. Water consumption is a concern during drought periods, however many facilities can recycle water used for wetting the storage piles and transfer systems. Occasionally reclaimed water may be available.

Costs:

Enclosures can cost as much as \$500,000 in capital expenses, depending on difficulty of retrofit with the existing facilities. Secondary controls on the enclosures, like baghouses can cost an additional \$250,000 in capital. Wind screens are much lower cost – typically no more than \$50,000 for a large facility. Transfer systems (conveyors) need wind screens and spillage control added, usually less than \$20,000 per conveyor. Water spray systems can be quite inexpensive – less than \$10,000 each. If water spray mist is needed, an air compressor to generate the mist can cost an additional \$10,000. Water control and recycle systems can be significant, as much as \$250,000.

Co-Benefits:

Fugitive dust control will help reduce regional haze, and can also help reduce black carbon particulate matter that contributes to climate change.

Issue/Impediments:

None identified.

Sources:

1. BAAQMD proposed amendments to 6-1, and new 6-8 associated workshop reports.
2. “Petroleum Coke in the Urban Environment: A Review of Potential Health Effects”, International Journal of Environmental Research and Public Health, 29May2015

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SS36: Particulate Matter from Trackout

Brief Summary:

The intent of this measure is to develop a new regulation, Regulation 6, Particulate Matter; Rule 6: Trackout (Rule 6-6), to address mud and dirt that can be “tracked out” from construction sites, bulk material storage, and disturbed surfaces onto public paved roads where vehicle traffic will pulverize the mud and dirt into fine particles and entrain them into the air.

Purpose:

Reduce PM_{2.5} emissions from trackout of mud and dirt onto paved public roadways.

Source Category:

Area Sources – construction sites, bulk material storage

Regulatory Context and Background:

Particulate matter emissions due to trackout at construction sites is not currently subject to Air District regulations. However, PM from trackout is subject to state requirements for large construction sites. These requirements mandate the preparation of a Storm Water Pollution Prevention Plan; the plan includes provisions for reducing trackout.

Trackout dust can contain much higher levels of fine particulate matter – because mud and dirt that are tracked out onto paved roads can be subsequently pulverized by passing vehicles into silt, then entrained into the air as fine particulate by the wind currents from the passing vehicles.

Implementation Actions:

The Air District will:

- Develop a new rule to prevent trackout onto paved roads, establish visible emission limits to prevent trackout, require cleanup if the trackout is significant, and limit visible emissions of dust during cleanup of any material that is tracked out.

Emission Reductions:

Pollutants*	2020	2030
PM _{2.5}	93	93

**criteria pollutants are reported in lbs/day*

Emission Reductions Methodology:

Particulate matter (PM) emissions of fugitive dust from construction sites, bulk material storage sites, and from disturbed surfaces are estimated to be 11,800 pounds per day TSP, 5,600 pounds per day PM₁₀, and 680 pounds per day PM_{2.5}. Controls for trackout are already required to meet Storm Water Pollution Prevention Plans, so the proposed new rule will improve enforcement of existing requirements. Staff estimates fine particle emission reductions of 140 pounds per day for the 8 months of the dry season (34,000 pounds per year).

Exposure Reductions:

A large and growing body of scientific evidence indicates that both short-term and long-term exposure to fine particles can cause a wide range of health effects, including: aggravated asthma and bronchitis; hospital visits for respiratory and cardiovascular symptoms; and contributes to strokes and heart attacks, some of which result in premature deaths. The evidence also shows that reducing PM emissions can reduce mortality and increase average life span. Therefore, measures that reduce PM emissions may have a significant impact on public health.

Emission Reduction Trade-Offs:

Possible exhaust emissions and dust from street sweepers during the cleanup of trackout materials. Cleanup by hand, or using a PM₁₀ efficient regenerative street sweeper, can minimize this dust during cleanup.

Costs:

Trackout prevention typically consists of using grizzly bars or rumble grates, or a truck wheel wash system. Most facilities are currently equipped with grizzly bars, but the bars often fill with mud and stop working effectively. Truck wheel wash systems can cost \$150,000 in capital, and \$1,000 per month in operating costs. Cleanup can typically be completed with two workers and hand tools.

Co-Benefits:

Fugitive dust control will help reduce regional haze.

Issue/Impediments:

None identified.

Source:

1. Bay Area Air Quality Management District, proposed amendments to 6-1, and new Regulation 6-6 workshop reports

SS37: Particulate Matter from Asphalt Operations

Brief Summary:

This measure would develop a new regulation, Regulation 6, Particulate Matter, Rule 7: Asphalt Operations (Rule 6-7), to prevent condensable particulate matter when paving asphalt is loaded into storage bins on a delivery truck. Similarly, this measure would prevent condensable particulate matter when chip seal asphalt is sprayed onto a roadway. These particulate matter (PM) emissions are condensed asphalt aerosols known as “blue smoke”. This regulation will require blue smoke abatement, and establish visible emissions limits for these operations. In addition, this measure would establish a requirement to use low fuming asphalt for all roofing asphalt operations.

Purpose:

Reduce PM_{2.5} emissions from paving asphalt, chip seal asphalt, and roofing asphalt.

Source Category:

Point Sources – Particulate Matter for Asphalt Plants

Area Sources – Particulate Matter for Chip Seal Paving and Roofing Asphalt operations

Regulatory Context and Background:

Visits to asphalt plants identified vapors coming from paving asphalt as it is loaded into delivery trucks as significant sources of visible smoke. This smoke consists of small condensed aerosols from asphalt vapors, commonly referred to as “blue smoke”. Chip seal operations are also large sources of “blue smoke”. In addition, roofing asphalt is heated to application temperatures in a heating device known as an asphalt kettle. Hot roofing asphalt and asphalt kettles also produce smoke, and since application is usually in populated areas, odors are also a concern.

Implementation Actions:

The Air District will:

- Develop a new rule to prevent blue smoke emissions from paving asphalt and chip seal operations and to require “low fuming” roofing asphalt for roofing asphalt operations.
- Investigate whether more use of Warm Mix Asphalt rather than Hot Mix Asphalt is a viable method to reduce PM emissions.

Emission Reductions:

Pollutants*	2020	2030
PM _{2.5}	175	175

*criteria pollutants are reported in lbs/day

PM emissions of blue smoke from paving asphalt operations are estimated to be 240 pounds per day PM_{2.5} (50 pounds per day from each of three large paving asphalt plants) for approximately eight months of the year (during the paving season). Similarly, PM emissions of blue smoke from chip seal operations are estimated to be 120 pounds per day of PM_{2.5} for six months of the year. Controls for blue smoke emissions from these sources are expected to be

75 percent effective, resulting in emission reductions of 270 pounds per day of PM_{2.5} or 30 tons per year (tpy). PM emissions of smoke and fumes from roofing asphalt is estimated to be 250 pounds per day, and control from the polymer in low fuming asphalt is conservatively expected to be 70 percent, resulting in emission reductions of 175 pounds per day of PM_{2.5} for approximately 8 months each year (21 tpy).

Exposure Reductions:

A large and growing body of scientific evidence indicates that both short-term and long-term exposure to fine particles can cause a wide range of health effects, including: aggravated asthma and bronchitis; hospital visits for respiratory and cardiovascular symptoms; and contributes to strokes and heart attacks, some of which result in premature deaths. The evidence also shows that reducing PM emissions can reduce mortality and increase average life span. Therefore, measures that reduce PM emissions may have a significant impact on public health.

Emission Reduction Trade-Offs:

Operations of blue smoke abatement will require some energy use, estimated to be less than 50 horsepower for each abatement device. No trade-offs for the polymer used in low fuming roofing asphalt.

Costs:

Blue smoke abatement facilities are estimated to cost \$200,000 capital, amortized to \$30,000 per year plus \$10,000 per year operating costs. Low fuming asphalt raises the cost of roofing asphalt approximately \$1.00 above the base of \$40 - \$45 per 100 lb. plug.

Co-Benefits:

Low fuming roofing asphalt for asphalt operations is approximately 75 percent less odorous than regular roofing asphalt.

Issue/Impediments:

None.

Source:

1. Bay Area Air Quality Management District, proposed amendments to Regulation 6-1, and proposed Regulation 6-7, workshop reports

SS38: Fugitive Dust

Brief Summary:

Air District staff are currently developing amendments for Regulation 6, Particulate Matter, and Rule 1: General Requirements (Rule 6-1). In addition, Air District staff are developing specific targeted fugitive dust and particulate matter controls for proposed Rule 6-6: Trackout; proposed Rule 6-7: Asphalt Operations, and proposed Rule 6-8: Bulk Material Storage, Handling and Transport, Including Coke and Coal. This control measure proposes that Air District staff review and recommend controls for a broader range of more general sources of fugitive dust, such as large construction sites, and disturbed surfaces larger than 1 acre.

Purpose:

Reduce particulate matter (PM₁₀ & PM_{2.5}) fugitive dust emissions from traffic and other operations on construction sites, large disturbed surfaces, and other sources of fugitive PM emissions.

Source Category:

Area Sources

Regulatory Context and Background:

Air District staff are developing amendments to Rule 6-1, and developing new rules for three sources of fugitive dust: trackout of mud and dirt onto paved public roads; smoke and fumes from paving and roofing asphalt operations; and dust from petroleum coke and coal storage and handling.

Fugitive dust from construction sites and bulk material handling operations are sources of PM₁₀, and to a lesser extent sources of PM_{2.5}. In addition, control of fugitive dust from these sources will reduce regional haze. This measure will evaluate potential control strategies in preparation of future rulemaking opportunities.

Implementation Actions:

Air District staff will:

- Evaluate the availability of cost-effective control strategies for these sources of particulate matter and consider future rulemaking.
- Consider applying the proposed fugitive dust visible emissions limits to a wider array of sources.
- Consider enhanced controls where sources are located near sensitive populations or areas currently impacted by cumulative sources of air pollution.

Emission Reductions:

Pollutants*	2020	2030
PM _{2.5}	400	400
PM ₁₀	2,800	2,800

**criteria pollutants are reported in lbs/day*

Total current PM emissions of fugitive dust from construction sites, bulk material storage sites, and from disturbed surfaces are estimated to be 11,800 pounds per day TSP, 5,600 pounds per day PM₁₀, and 680 pounds per day PM_{2.5}. Controls for fugitive dust from large sources are estimated to result in a 50 percent reduction in PM emissions, resulting in 5,800 pounds per day TSP, 2,800 pounds per day PM₁₀, and 400 pounds per day PM_{2.5}.

Exposure Reductions:

None

Emission Reduction Trade-Offs:

None, although concern about additional water usage to control fugitive dust may raise questions about the priority of air quality versus water conservation. These concerns are valid if water sources used for fugitive dust control are mostly potable water rather than reclaimed water.

Costs:

Fugitive dust control costs are typically minor. In many cases, these resources / costs are already in place to comply with existing Storm Water Pollution Prevention Plan requirements. Incremental costs to comply with proposed fugitive dust requirements are very low. Costs for application of fugitive dust requirements to sources that are not currently controlled are dependent of the size and nature of the source, but can be as high as \$100,000 capital and total \$30,000 per year amortized and operating costs to reduce 3 tons per year of PM.

Co-Benefits:

Fugitive dust control will help reduce regional haze.

Issue/Impediments:

Concern that additional source will require additional water resources during severe drought seasons.

Source:

1. Bay Area Air Quality Management District, proposed amendments to Regulation 6-1, and proposed Regulations 6-6, 6-7, and 6-8 associated workshop reports.

SS39: Enhanced Air Quality Monitoring

Brief Summary:

The Air District will evaluate and enhance its capabilities, as resources permit, to monitor air quality on a region-wide basis, as well as on a localized basis in the impacted communities identified under the Air District's Community Air Risk Evaluation (CARE) program.

Purpose:

The purpose of this measure is to provide the Air District with sufficient ambient air quality monitoring data needed to inform: 1) its efforts to improve air quality in impacted communities and 2) its air quality planning and modeling programs.

Source Category:

Not applicable.

Regulatory Context and Background:

In 2015, the Air District had 32 air monitoring stations operating in the Bay Area. An additional air monitoring station (Point Reyes) is operated by the California Air Resources Board. The air monitoring network is designed to: 1) provide the data required to determine the Bay Area's attainment status for both National and State ambient air quality standards; 2) provide air quality data to the public in a timely manner; and 3) support air pollution research and modeling studies. Additionally, a network of air toxic monitors collects data to ensure permit conditions are met at stationary sources and for State and National regulatory programs. The Air District's 2014 Air Monitoring Network Plan describes recent and planned changes and improvements to the Air District's air monitoring network.

In recent years, the Air District has undertaken initiatives, such as the Community Air Risk Evaluation (CARE) program and the Clean Air Communities Initiative, to analyze pollution exposure at a more localized level and identify communities that are disproportionately impacted by air pollution. In many cases, these communities correspond to areas identified as priority development areas (PDAs) under Plan Bay Area - the region's Sustainable Communities Strategy. Plan Bay Area encourages infill development in PDAs to promote smart growth and reduce sprawl, thus reducing automobile use and emissions. The data and information generated from these initiatives allows the Air District to implement more targeted policies and programs to reduce emissions and exposures in these communities.

The Air District has developed limited enhanced monitoring capabilities of key pollutants to gather more complete data to better assess local air quality conditions based upon the resources available. As an example, the Air District has conducted special air monitoring studies in areas impacted by wood smoke, deployed air toxics monitoring at a proposed school site in Newark, and in past years has implemented similar monitoring sites in Berkeley, Cupertino, and Benicia to address local air quality concerns. Such efforts generally require a minimum of one year of data collection to effectively characterize an area's air quality, but can require longer periods to properly assess local air quality trends. These efforts are resource intensive,

requiring expensive instrumentation, specialized operators, coordination among many Air District staff, and long site-development and set-up times.

Additionally, as part of the implementation of Regulation 12-15 (See SS10: Petroleum Refining Emissions Tracking), the Air District will require enhanced fenceline air monitoring at refineries. Rule 12-15 requires refinery owner/operators to prepare and submit to the Air District an air monitoring plan for establishing an air monitoring system and, upon Air District approval of the plan, to install and operate fenceline monitors.

The Air District will also site and operate additional community air monitors via a Community Monitoring Program. The goal of the community monitoring program is to establish air monitoring stations in areas where major stationary sources may contribute to impacts in local communities. Data from these newly established monitoring locations would be used to compare air quality in potentially impacted communities with air quality measurements at other Air District sites. While it is important to recognize that sampling results from ambient air monitoring stations cannot usually be attributed to air pollutants from specific sources, monitoring in areas with large stationary sources will allow residents to determine if air quality in their neighborhoods is significantly different than other Bay Area locations. The first communities to have monitoring stations established will be those with refineries and other significant sources in their vicinity.

Implementation Actions:

Air District will:

- Ensure representative air quality data is being collected in the impacted communities identified under the CARE program. This effort would require review of the existing monitoring network with respect to the impacted communities to ensure that appropriate long term air quality data is being collected.
- Enhance monitoring of local air quality by collecting more information about pollutant concentrations and exposure at localized levels. This effort would be focused around microenvironments that may have significant local emission sources that could be assessed through the use of temporary monitors.
- Partner with County Health Departments to identify areas of poor air quality and collaborate with the community on ways to potentially measure and reduce exposure and emissions from local and regional sources.
- Require petroleum refineries to prepare and submit to the Air District an air monitoring plan for establishing an air monitoring system. Upon plan approval, require installation and operation of fenceline monitors.
- Implement the Community Monitoring Program.

Emission Reductions:

Control measure does not directly reduce emission; however, it does support emissions reduction programs.

Emission Reduction Methodology:

Not applicable.

Exposure Reduction:

Control measure does not directly reduce exposure but supports exposure reduction efforts.

Emission Reduction Trade-offs:

None identified.

Cost:

Costs would vary depending on the extent of enhanced monitoring implemented. Available resources would be determined through the Air District's budget process.

Co-benefits:

Not applicable.

Issues/Impediments:

Enhanced air quality modeling will require additional resources, including purchase of new instrumentation, equipment maintenance, and additional staff with technical expertise in atmospheric chemistry, and background and familiarity with monitoring equipment.

Sources:

1. Bay Area Air Quality Management District, *2014 Air Monitoring Network Plan*, July 2015, http://www.baaqmd.gov/~media/files/technical-services/2014_network_plan.pdf?la=en
2. [Bay Area Air Quality Management District, Staff Report, Proposed Air District Regulation 12, RULE 15: Petroleum Refining Emissions Tracking, April 2016](#)
[Bay Area Air Quality Management District, Staff Report, Proposed Amendments to District Regulation 3: Fees, April 2016](#)

SS40: Odors

Brief Summary:

This control measure would revise Air District Regulation 7 to reduce emissions of odorous substances and place emission limits on odor compounds. Revisions to Regulation 7 would also incorporate industry requirements to develop and identify odor management practices and control measures, and integrate odor detection technologies and evaluation methods. The rule amendment process would include reviewing the effectiveness of the current standards and consider best available technologies to reduce odors.

Purpose:

Reduce emissions from odorous compounds and improve enforceability of Regulation 7.

Source Category:

Stationary source and area source: industrial and commercial operations

Regulatory Context and Background:

In 1970, the Air District was directed by the State Legislature to establish standards for the emission of identifiable odorous substances. On August 2, 1972, the Air District adopted Regulation 2, Division 15 - Odorous Substances, which set emissions limits for five odorous compounds. The rule was originally intended to reduce odorous emissions from operations such as refineries, sewage treatment plants, and rendering plants. In 1976, the regulation was amended to alter the applicability to sources that generated citizen odor complaints, to establish general limitations on odorous substances to be evaluated by an odor panel, and to set limitations on total reduced sulfur (TRS) from kraft pulp mills.

Later the rule was renamed Regulation 7 – Odorous Substances. Between 1976 and 1982, the Air District restructured the regulations which resulted in two substantive amendments to Regulation 7 including, removing the sampling and analysis procedures for odorous substances and including those in a Manual of Procedures, and removing kraft pulp mill requirements and creating a new regulation entitled TRS from Kraft Pulp Mills. Through the Air District's Compliance and Enforcement Program odorous facilities are identified and those facilities are placed on a list of plants subject to Regulation 7.

Since adoption of Regulation 7 in 1972, changes in the Bay Area's population density and the closer proximity of industrial and manufacturing processes to residential areas and public spaces has resulted in significant odor impacts in certain communities. In 2015, the Air District received and responded to 4,946 odor complaints. Seventy-three percent of those odor complaints came from a single community in the Bay Area, alleging odors from solid waste and other organic waste related facilities in the area.

In 2011, in response to the California Legislature's goal of reducing solid waste going to landfills by 75 percent, CalRecycle recommended a statewide strategy to divert organic wastes from landfills. As a result, cities and counties across the Bay Area began utilizing old and new

technologies to divert organic wastes and to convert organic wastes to energy and reusable materials. The decomposition of organic waste, once almost exclusively occurring at landfills and sewage treatment plants, is now creating odors at diverse operations of all sizes. These process changes to existing operations and addition of new types of operations have the potential to cause significant increases and changes in odors throughout nearby communities.

Strengthening the requirements and odor standards of the rule will help further reduce odor nuisances and allow the Air District to enforce limits on odorous compounds that negatively impact air quality in the Bay Area.

Implementation Actions:

The Air District will:

- Propose amendments to Regulation 7 to strengthen odor standards and enhance enforceability. An evaluation of newer air monitoring technologies will be aimed at increasing enforceability of the rule with respect to a wider range of odorous compounds and sources.

Amending Regulation 7 will include the following emission reduction strategies and objectives:

- Evaluate the complaint threshold that triggers applicability of the regulation.
- Evaluate and identify source types that can attribute to odor complaints.
- Identify odorous compounds that are associated to industrial and commercial operations.
- Review the effectiveness of existing odor thresholds and emissions limits.
- Evaluate methods of detection and monitoring practices of odorous compounds.
- Amend regulatory requirements to ensure best management practices for the control of odorous emissions, such as the requirement of odor mitigation plans.

Emission Reductions:

N/A

Emission Reduction Methodology:

N/A

Costs:

N/A

Co-Benefits:

There are a wide range of chemical compounds that are odorous, some of which are toxic air contaminants (TAC), and others which are non-methane organic compounds (NMOC) that contribute to the creation of ground level ozone. Beyond reducing odor nuisances and impacts to surrounding communities, reducing odorous compounds reduces the emission of TACs and NMOCs.

Issue/Impediments:

There may be opposition from industries that have odorous sources of operations that have received a substantial number of odor complaints and are subject to the rule.

Source:

1. California Department of Resources Recycling and Recovery (CalRecycle). August 2015. *AB341 Report to the Legislature*. Publication # DRRR-2015-1538.

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