



BAY AREA  
AIR QUALITY  
MANAGEMENT  
DISTRICT

**Petroleum Refinery Emissions Reduction  
Strategy:  
Workshop Report**

Prepared by the staff of the  
Bay Area Air Quality Management District  
September 2015

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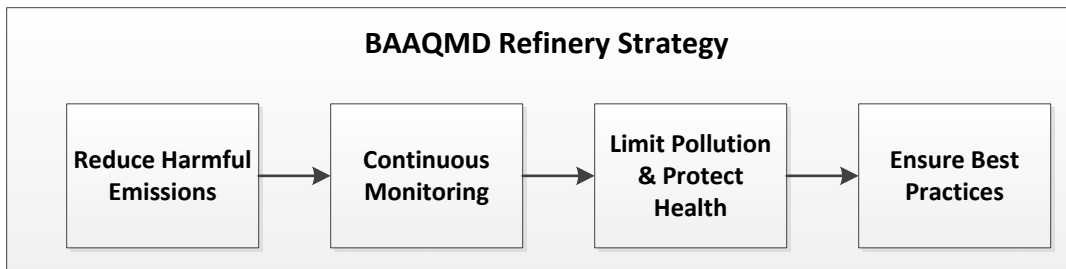
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# Petroleum Refinery Emissions Reduction Strategy: Workshop Report

## I. Refinery Strategy Overview

The Bay Area Air Quality Management District (Air District) has developed a four-part strategy for addressing pollution from Bay Area refineries. An overview of the entire strategy is provided below (Figure 1). The rest of this document provides more detail about the first component –Reduce Harmful Emissions.

Figure 1.



The four elements of the Refinery Strategy are described as follows:

Reduce Harmful Emissions: Air District staff is developing a suite of regulations to reduce smog-forming pollution from Bay Area refineries by 20 percent (or as much as feasible) no later than 2020. The first set of these rules, designed to reduce harmful emissions, will be considered by the Board in December 2015 and is expected to reduce overall emissions from refineries by approximately 15 percent. This first set of rule actions will reduce sulfur dioxide (SO<sub>2</sub>) from coke-calcining and reduce smog-forming and toxic emissions from equipment leaks and cooling towers. These rules also will limit ammonia emissions from fluid catalytic cracking (FCC) units, which will reduce associated formation and emission of fine particulate matter (PM<sub>2.5</sub>).<sup>1</sup> In mid-2016, the second set of regulations will be developed to further reduce PM<sub>2.5</sub> emissions from fluid catalytic cracking units (if needed) and SO<sub>2</sub>. The second set of regulations also will reduce SO<sub>2</sub> from other refinery sources and smog-forming emissions from turbines. The development of these sets of regulations is also known as the Petroleum Refinery Emission Reduction Strategy.

Continuous Monitoring: Draft Regulation 12, Rule 15, Petroleum Refining Emissions Tracking (Rule 12-15), will require that continuously updated, state-of-the art methods be used to calculate and report the total pollution from the refineries every year. It also will require extensive air quality monitoring to validate those pollution calculations and ensure surrounding communities are not subjected to unhealthy levels of pollution. Rule 12-15 also includes other requirements that will enable the Air District to have a more complete understanding of the sources of pollution at the refineries. These requirements include providing information on the physical characteristics of crude oil to determine when significant changes in feedstock occur that might lead to higher emissions. The information also will include energy efficiency data needed to understand opportunities to reduce emissions of climate

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<sup>1</sup> PM<sub>2.5</sub> is the portion of particulate matter with an aerodynamic diameter of less than 2.5 micrometers.

pollutants. Additionally, Rule 12-15 will require new Health Risk Assessments (HRAs) be performed to determine the health risk from toxic air pollutants at the refineries using the best available estimates of pollution emission rates and newer, more protective assumptions about how that pollution impacts nearby communities.

Limit Pollution & Protect Health: Draft Regulation 12, Rule 16, Petroleum Refining Emissions Limits and Risk Thresholds (Rule 12-16), will limit refinery pollution to levels that minimize the health burden for the surrounding communities. The rule will limit toxic emissions by restricting the overall health burden caused by those pollutants, as demonstrated in Health Risk Assessments. This method accounts for relative toxicity of various air contaminants and how they are dispersed across the community. The Health Risk Assessments will be updated by the Air District every year as new emissions data are received.

PM<sub>2.5</sub> and SO<sub>2</sub> are two federally-regulated pollutants that have not been classified as “toxic” but still have negative health impacts on nearby communities. For these pollutants, the rule will impose a limit on emission rates and also will require refineries to demonstrate that emissions of these pollutants will not exceed federal health standards.

Ensure Best Practices: Air District staff is developing changes to the Air District permitting regulations to ensure that when refineries modernize or make significant changes to the type of crude oil they use they will be required to use the best available control technology to reduce smog-forming, toxic, and climate pollutants. Over time, these changes to the permitting regulations will ensure the refineries use best practices and operate as efficiently and cleanly as possible.

## **II. Petroleum Refinery Emissions Reduction Strategy**

The Petroleum Refinery Emissions Reduction Strategy specifically addresses the first part of the overall Refinery Strategy – Reduce Harmful Emissions. It is intended to reduce emissions of criteria pollutants and their precursors (SO<sub>2</sub>, oxides of nitrogen (NO<sub>x</sub>), particulate matter, PM<sub>2.5</sub>, organic gases, and toxic compounds) from the five Bay Area refineries and associated facilities. The Air District plans to accomplish these refinery emissions reductions by amending several Air District rules affecting petroleum refineries and developing additional rules aimed at specific refinery processes.

The Air District is moving these individual actions through the rulemaking process as a package. This enables the Air District to use its staff resources more efficiently, streamlines coordination and consultation with the public and the regulated community and responds to requests by the public. There should be no inference that this approach creates dependencies between these rule actions. Each rulemaking action is independent from the others and will be individually evaluated according to the requirements of the California Health and Safety Code (H&SC).

The purpose of this report and its appendices (individual rule-specific reports and draft rule language) is to inform the public and the regulated community of the Air District’s plans for implementing the Petroleum Refinery Emission Reduction Strategy through rulemaking. In order to develop the best possible rules, Air District staff is soliciting feedback on its interim findings. This report and the draft regulatory language reflect both the input of stakeholders as a result of the Request for Comment on the Initial Report released in May 2015 and internal staff deliberations. Staff will consider the input received in drafting the next iteration of the draft rules and the accompanying workshop report. The revised versions of the rules and associated documentation will then be published and discussed in

public workshops. Air District staff will take the input from this workshop process and further revise the draft rules, as appropriate. The Air District will again publish the draft rules, including changes based on received input, along with a detailed staff report before the public hearing at which the Board of Directors will consider whether to adopt the rules.

**Goals:** On December 17, 2014, the Air District’s Board of Directors approved the following overall goals for the Petroleum Refinery Emission Reduction Strategy:

1. Strive to achieve a 20 percent reduction in emissions of criteria pollutants and precursors in the next five years.
2. Strive to achieve an additional 20 percent reduction in health risk from the emission of toxic compounds.

Criteria pollutants are pollutants for which federal or state air quality standards have been established, such as SO<sub>2</sub>, ozone, and PM<sub>2.5</sub>. Precursors are pollutants that interact in the atmosphere to form criteria pollutants. For example, NO<sub>x</sub>, and reactive organic gases (ROG) when exposed to sunlight combine to form ozone.

## A. Regulatory Context and Background

The Air District is currently engaged in developing regulatory measures to reduce emissions of air pollutants from a wide variety of stationary and area sources. As part of the ongoing development of the Air District’s 2016 Clean Air Plan, staff evaluated many of these sources and determined that some of the largest stationary sources of air pollutants include landfills, refineries, chemical manufacturers, and publically owned treatment works (POTW).

The 2011 Bay Area Emissions Inventory for stationary sources indicates that although landfills are the largest sources of total organic gases (TOG) in tons per day (tpd), refineries are the largest individual stationary source emitters of reactive organic gases (ROG).<sup>2</sup> Refineries are also the predominant source of SO<sub>2</sub> emissions. (See Table 1.)

**Table 1: Criteria Pollutant and Precursor Emissions by Industrial Sector**

Industrial Sector	TOG (tpd)	ROG (tpd)	PM <sub>2.5</sub> (tpd)	NO <sub>x</sub> (tpd)	SO <sub>2</sub> (tpd)	CO (tpd)
Petroleum Refining and Related Facilities	12.1	10.0	2.7	10.0	8.8	5.6
Landfills	191.2	1.7	0.33	0.5	0.3	1.6
POTWs	3.0	0.4	0	0	0	0
Chemical Manufacturing Facilities	1.6	1.6	0.4	0.1	0	0.1

Further, the five Bay Area refineries rank among the top ten facilities in the Bay Area for risk-weighted emissions of toxic air contaminants (TAC), based on an evaluation of emissions from stationary sources in 2012 and using risk factors for cancer and chronic hazard index.

Based on assessments of emissions of criteria pollutants and TAC from refineries, the Air District has made emissions reductions from these facilities a high priority and intends to reduce refinery emissions by 20 percent by 2020, if feasible. To this end, staff is engaged in several rulemaking efforts to further reduce emissions of all air pollutants (including criteria and toxic pollutants) from the five Bay Area

<sup>2</sup> TOG includes methane, while ROG does not.

refineries, plus five associated facilities that either support refinery operation (two sulfuric acid plants and two hydrogen plants), or process a refinery by-product (one coke calcining plant). This emissions reduction effort is part of an overall refinery strategy to address refineries and their impact on neighboring communities. An overview of the rest of this strategy is provided in Section I at the beginning of this document.

## **B. Air District Board Direction**

On October 15, 2014, the Air District Board of Directors adopted Resolution Number 2014-07, instructing staff to develop a strategy based on an evaluation of approaches that would further reduce emissions from petroleum refineries, including:

- The “community-worker” approach outlined in a September 26, 2014 letter;
- Approach(es) proposed by industry;
- Approach(es) to require each refinery to develop a refinery emissions improvement plan to implement a suite of measures to demonstrate compliance with all applicable requirements of the strategy to further reduce emissions from petroleum refineries and to identify any additional feasible measures to achieve best practices with respect to minimizing emission and to assure continuous improvement in minimizing emissions; and
- Other approaches deemed appropriate by Air District staff.

The resolution also instructed Air District staff to prepare and present to the Board of Directors by December 2014, a strategy to achieve further emissions reductions from petroleum refineries that would include as a goal a 20 percent reduction in refinery emissions, or as much emissions reductions as feasible. The resolution also provided that the strategy must include a schedule to implement regulations or other enforceable mechanisms as expeditiously as possible.

On December 17, 2014, the Board of Directors approved the staff-proposed approach that would blend the best of the evaluated approaches the following:

- Identify specific source categories with opportunities for cost-effective controls (this is also known as a Best Available Retrofit Control Technology review, or BARCT review);
- Adopt requirements identified in the U.S. Environmental Protection Agency (EPA) Refinery Risk and Technology Review;
- Include the quantitative goals from the Community-Worker proposal;
- Include continuous improvement as a goal for regulations;
- Retain compliance with the Health and Safety Code and the process transparency advocated by industry.

The Board of Directors also approved the following overall goals for the Petroleum Refinery Emissions Reduction Strategy:

1. Strive to achieve a 20 percent reduction in criteria pollutants and precursors within the next five years; and
2. Strive to achieve an additional 20 percent reduction in health risk from toxics.

## **C. Targeted Pollutants**

The Petroleum Refinery Emission Reduction Strategy is intended to reduce emissions from the five Bay Area refineries and the five associated facilities of the following pollutants:

- Particulate matter (PM), including directly emitted filterable PM and condensable PM, as well as precursor compounds that form PM<sub>2.5</sub> as a result of chemical reactions in the atmosphere. Condensable PM is particulate matter that forms after the hot emissions from the stack cool to ambient temperatures. These emissions are not quantified by traditional particulate testing methodologies because the sampling system does not operate at atmospheric temperatures and the condensable PM is a vapor at higher temperatures.
- ROG, a precursor in the formation of ground-level ozone.<sup>3</sup>
- NO<sub>x</sub>, an ozone precursor and a contributor to fine PM formation.
- SO<sub>2</sub>, a contributor to fine PM formation.
- Ammonia (NH<sub>3</sub>), also a contributor to fine PM formation.

Each of the ten facilities mentioned above has high emissions of one or more of these targeted pollutants.

## D. Phased Approach

Air District staff recommends a two-phase approach to complete the rulemaking for the Petroleum Refinery Emission Reduction Strategy:

1. Phase 1 is scheduled to be completed in the fourth quarter of 2015; and
2. Phase 2 is scheduled to be completed in the second quarter 2016.

The first set of proposed regulations, Phase 1, focuses on regulatory efforts for which staff has developed enough background information—such as emissions inventory, emissions reductions, control technology evaluation and cost estimates, cost effectiveness, and preliminary environmental impact review—to draft regulatory language in anticipation of a workshop. Phase 1 includes the following regulatory actions:

- New draft rule, Rule 9-14: Petroleum Coke Calcining, to address emissions of SO<sub>2</sub> and the formation of PM<sub>2.5</sub>;
- New draft rule, Rule 6-5: Fluidized Catalytic Cracking Unit (FCCU), to address emissions of ammonia and also to address condensable PM formation;
- Draft amendments to Rule 8-18: Equipment Leaks, to address fugitive emissions of ROG and toxic compounds from equipment in heavy liquid service; and
- Draft amendments to Rule 11-10: Toxic and ROG emissions from Cooling Towers, to address reactive organic gases (ROG) and toxic compounds from cooling towers.

The second set of proposed regulations, Phase 2, would focus on regulatory development for which staff has developed initial information, such as emissions inventory and cost estimates, but for which staff is currently in the process of gathering additional information needed for the regulatory development process, including environmental and socioeconomic information. Phase 2 would cover the following regulatory actions:

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<sup>3</sup> Methane is not part of ROG because it has a low reactivity for ozone formation, although it is a potent greenhouse gas (GHG). The Air District expects some methane reductions as a co-benefit of ROG reductions. However, methane is not currently a targeted pollutant in this Petroleum Refinery Emission Reduction Strategy. It will be addressed through other measures in the Clean Air Plan.



- Draft amendments to new Rule 6-5: FCCU to address emissions of SO<sub>2</sub> and condensable PM;
- Draft amendments to Regulation 9, Rule 1: Sulfur Dioxide, to further reduce emissions of SO<sub>2</sub> and the formation of PM<sub>2.5</sub> from refinery fuel gas combustion and from sulfuric acid plants, and to address emissions of SO<sub>2</sub> from sulfur plants; and
- Draft amendments to Rule 9-9: Stationary Gas Turbines, to address emissions of NO<sub>x</sub>.

The appendices to this document provide the Air District staff's preliminary findings for all of the Phase 1 rulemaking projects except for Rule 9-14. There is a separate workshop report for this rule, which is also available from the Air District's website.<sup>4</sup> The Air District is soliciting feedback on all four rulemaking projects in Phase 1.

## **E. Affected Facilities**

There are five petroleum refineries in the Bay Area that may be affected:

1. Chevron Products Company (Richmond);
2. Phillips 66 Company – San Francisco Refinery (Rodeo);
3. Shell Martinez Refinery (Martinez);
4. Tesoro Refining and Marketing Company (Martinez); and
5. Valero Refining Company – California (Benicia).

There are also five associated support facilities that may be affected:

1. Chemtrade West (sulfuric acid plant that supports Chevron);
2. Eco Services (formerly called Solvay; sulfuric acid plant that supports Shell and Valero regularly, and Tesoro as needed when its acid plant is down for maintenance);
3. Air Products (hydrogen plant that supports Tesoro);<sup>5</sup>
4. Phillips 66 Carbon Plant; and
5. Air Liquide (hydrogen plant that supports Phillips 66).

## **III. Petroleum Refining Processes**

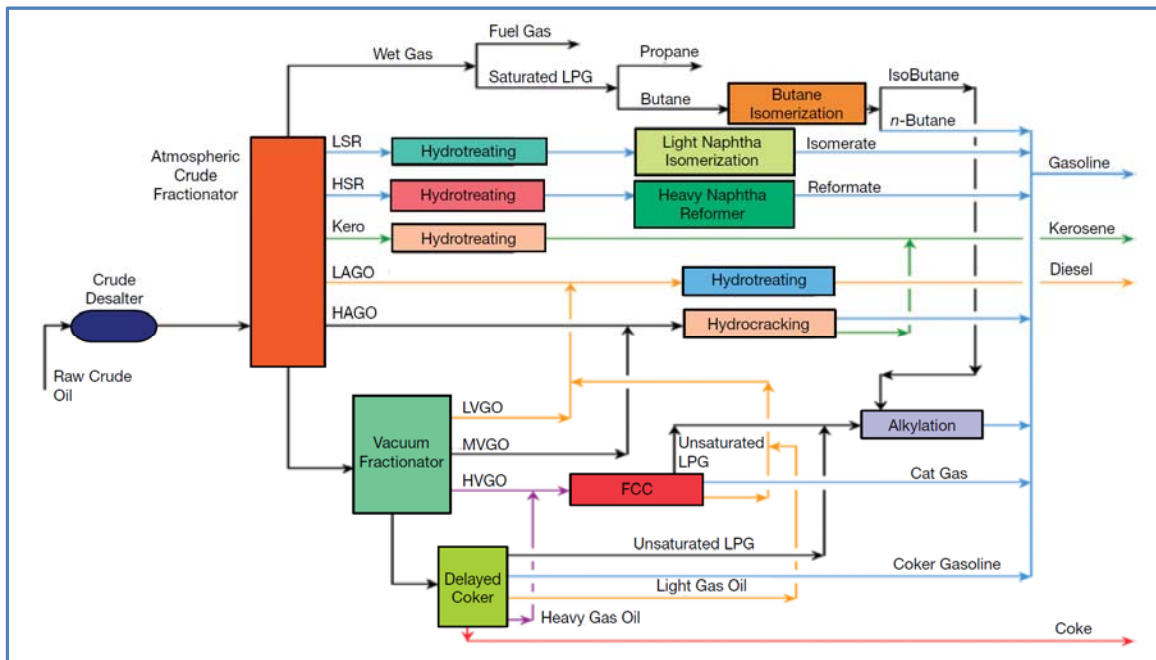
These facilities process crude oil into a variety of products such as gasoline, aviation fuel, diesel and other fuel oils, lubricating oils, and feedstocks for the petrochemical industry. The diagram in Figure 2 illustrates how various process units at petroleum refineries convert raw crude oil (petroleum) into fuels and other products.

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<sup>4</sup> See "2015 Rules Workshops" at the following URL: <http://www.baaqmd.gov/rules-and-compliance/rule-development/meetings-and-public-hearings>

<sup>5</sup> There is also an Air Products plant that supports only the Shell Refinery. The emissions from that plant were included in the baseline inventory.

**Figure 2: Refinery Flow Diagram**



Legend: LSR = light straight-run naphtha; HSR = heavy straight-run naphtha; Kero = kerosene; LAGO = light atmospheric gas oil; HAGO = heavy atmospheric gas oil; LVGO = light vacuum gas oil; MVGO = medium vacuum gas oil; HVGO = heavy vacuum gas oil.

The processing of crude oil occurs in various process units or plants; some of the primary process units include:

- **Crude Desalter:** Crude oil is mixed with water to separate the salt and sediments from the crude.
- **Crude Unit:** The incoming desalted crude oil is heated and distilled into various fractions for further processing in other units.
- **Gas Concentration Unit:** Light hydrocarbons from the top of the crude unit are separated and distributed in the refinery fuel gas (RFG) system for use as fuel for heaters and boilers.
- **Vacuum Distillation Unit:** The residue oil from the bottom of the crude oil distillation unit is further distilled under heavy vacuum.
- **Hydrotreater:** Naphtha, kerosene, and gas oil are desulfurized from the crude unit by using hydrogen and converting the organically bound sulfur into hydrogen sulfide (a toxic compound).
- **Fluidized Catalytic Cracker Unit:** Longer chain, higher boiling hydrocarbons such as heavy oils are broken (or “cracked”) into lighter, shorter molecules at high temperatures and moderate pressure in the presence of a catalyst. This process is so named because the catalyst is so fine that it behaves like a fluid.
- **Butane Isomerization Unit:** Isobutene (a lighter hydrocarbon) is combined with olefins (heavier hydrocarbons) to form larger molecules known as alkylates, which are used in blending gasoline to boost the octane rating. Alkylates are considered one of the highest quality refinery products.
- **Light Naphtha Isomerization Unit:** Benzene is saturated and short, straight-chain hydrocarbons are isomerized into branched-chain hydrocarbons.
- **Heavy Naphtha Reformer and Hydrotreater:** Low-octane linear hydrocarbons (paraffins) are converted into aromatics using a catalyst. The process also forms hydrogen - used in the refinery’s hydrocracking and hydrotreating units - and benzene, toluene, and xylene (BTX) feedstocks, used in other process units.

- Hydrocracker Unit: Hydrogen is used to upgrade heavier fractions into lighter, more valuable products, such as diesel and jet fuel, in a high pressure system.
- Alkylation Unit: Butene and propene are reacted with isobutane into alkylate, a high octane gasoline component.
- Delayed Coker: Very heavy residual oils are converted into end-product petroleum coke as well as naphtha and diesel oil byproducts.
- Claus Sulfur Plant: A two-step (thermal and catalytic) process for recovering sulfur from gaseous hydrogen sulfide (H<sub>2</sub>S) derived from refining crude oil. In the thermal step, H<sub>2</sub>S laden gas is combusted to form elemental sulfur and sulfur dioxide (SO<sub>2</sub>). In the catalytic step, a catalyst is used to boost the sulfur yield. In this step H<sub>2</sub>S reacts with SO<sub>2</sub> to form elemental sulfur.

These primary process units, minor process units, auxiliary equipment (boilers, turbines, heat exchangers, etc.), and other refinery activities (such as truck and loader traffic) emit a variety of criteria pollutants, toxic air contaminants, and greenhouse gases. Other sources of emissions include waste water treatment, tanks, leaking equipment, pressure release devices, flares, marine terminals, and product loading, which are collectively subject to at least ten different Air District regulations.

#### IV. Rule Change Descriptions

Air District staff has begun developing the following control measures that would comprise the Petroleum Refinery Emissions Reduction Strategy. Table 2 lists these individual control measures and rule development efforts.

**Table 2: Description of Rule Changes**

Title	Proposal Description
<b>PHASE 1</b>	
Rule 6-5: FCCU (Part 1)	Consider emission limits on fluid catalytic cracking units in oil refineries for ammonia, which is a PM <sub>2.5</sub> precursor. It is expected that limiting ammonia from the FCCU would also reduce emissions of condensable PM.
Rule 8-18: Equipment Leaks	Reduce fugitive emission of organic gases and toxic compounds through the following: <ul style="list-style-type: none"> <li>• Include identification and monitoring of heavy liquid service equipment;</li> <li>• Amend the non-repairable equipment standard to reduce the allowable amount of equipment placed on non-repairable list;</li> <li>• Require quantification of leaks for all equipment placed on the non-repairable list;</li> <li>• Add a maximum leak concentration (10,000 ppm) that would apply to all equipment placed on the non-repairable list; and</li> <li>• Add a maximum mass emissions rate (five pounds per day) that would apply to any individual piece of equipment subject to monitoring by Rule 8-18.</li> </ul> Administrative changes to rule language will be drafted to clarify and enhance enforceability of the rule.
Rule 9-14: Petroleum Coke Calcining	Reduce SO <sub>2</sub> emissions from the coke calcining facility through improvements to the emission control system.
Rule 11-10: Toxic and ROG Emissions from Cooling Towers	Reduce emissions of toxic organic gases and ROG from cooling towers by testing for and repairing heat exchanger leaks.
<b>PHASE 2</b>	
Rule 6-5: FCCU (Part 2)	Reduce SO <sub>2</sub> and condensable PM emissions.
Rule 9-1: Sulfur Dioxide (Part 1)	Reduce SO <sub>2</sub> emissions by the following: <ol style="list-style-type: none"> <li>1. Limit the sulfur content of refinery fuel gas to no more than 40 ppm;</li> </ol>

Title	Proposal Description
	2. Limit SO <sub>2</sub> emissions from sulfuric acid plants to no more than 0.20 lb. SO <sub>2</sub> per ton of acid produced; and 3. Reduce SO <sub>2</sub> emissions from refinery sulfur plants to the extent that it is feasible.
9-9: Stationary Gas Turbines	Require the installation of selective catalytic reduction control on turbines with heat input greater than 100 MM BTU/hr. (The scope of this change may be expanded to include smaller turbines, if staff finds that there may be cost-effective opportunities for emission reductions on these smaller turbines.)
<b>FURTHER STUDY MEASURES</b>	
Rule 8-8: Industrial Wastewater	Review industrial wastewater collection, separation, and treatment system operations to develop an overall strategy to reduce air toxics and TOCs.
8-44: Marine Vessel Operations	Reduce organic gas emissions from marine loading operations that are within the Air District's authority in consideration of overlapping authority of the Coast Guard and other agencies.
9-10: Refinery Boilers, Steam Generators and Process Heaters	The majority of NO <sub>x</sub> emissions at the refineries come from these sources. Recent updates to Rule 9-10 have tightened standards, but those reductions have not yet been reflected in the emissions inventory. Substantial work will be required to determine whether there are opportunities for additional controls.

## A. Baseline Emissions and Estimated Reduction from Proposed Rules

The Air District has established a baseline emissions inventory for estimating emissions reductions from the new rules and draft amendments to current rules in the Petroleum Refinery Emission Reduction Strategy. This inventory shows baseline emissions for pollutants targeted by the proposed regulations: PM (including directly-emitted filterable PM and condensable PM), TOG,<sup>6</sup> NO<sub>x</sub>, and SO<sub>2</sub>. It includes emissions from petroleum refinery processes (e.g., feedstock and product handling, petroleum separation, and conversion and treating processes) as well as from auxiliary facilities such as hydrogen production, sulfur recovery, and power plants. Reporting year 2013<sup>7</sup> was chosen as the baseline year because it is the most recent year for which the Air District has complete emissions data. However, fugitive TOG emissions are based on reporting year 2014 because the calculation methodology for these components has been significantly improved in this reporting cycle.

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<sup>6</sup> The Air District's emissions reporting system does not consistently differentiate between TOG and ROG emissions. Because TOG is the more inclusive category, it is being used for the development of the baseline.

<sup>7</sup> The 2013 reporting year emissions correspond to emissions from calendar year 2012.

**Table 3: Baseline Emissions from the Refineries and Associated Facilities**

Facility Name	Average Annual Emissions (tons/year)				
	PM (filterable)	PM (condensable) <sup>8</sup>	TOG	NO <sub>x</sub>	SO <sub>2</sub>
Chevron	173	255	2,122	910	339
Phillips 66	53	—	338	266	409
Shell	409	98	1,812	971	1,084
Tesoro	80	91	887	763	572
Valero	123	—	420	1,205	111
Chemtrade West	4	—	55	2	127
Eco Services	18	—	1	13	362
Air Products	10	—	9	3	2
Phillips 66 (Carbon Plant)	29	—	0	239	1,242
Air Liquide	16	—	29	2	2
<b>Total Emissions</b>	<b>915</b>	<b>444</b>	<b>5,675</b>	<b>4,375</b>	<b>4,250</b>

The baseline emissions inventory shown in Table 3 will be replaced with the Petroleum Refinery Emissions Profile (PREP), an emissions inventory that would be required from relevant facilities by draft Rule 12-15. The PREP will be used as a reference with which to compare ongoing emissions inventories to monitor emissions changes. It will have a breadth similar to the baseline inventory provided in Table 3 because it will include emissions from both refineries and their auxiliary facilities. However, it will not include emissions that exceeded regulatory or permitted limits, or emissions from accidental air releases.

At this point, the Air District has estimated the following emission reductions and costs for the regulatory actions under consideration (Table 4). More details may be found in the appendices to this document. The Air District is seeking ongoing input on the accuracy of these estimates throughout its rule making process.

**Table 4: Estimated Emissions Reductions and Costs for Rule Changes in Phase One**

Title	PM (tons/year)	TOG (tons/year)	NO <sub>x</sub> (tons/year)	SO <sub>2</sub> (tons/year)	Costs (million \$/yr)
Rule 9-14: Petroleum Coke Calcining				645	\$6.0
Rule 6-5: FCCU (Part 1) <sup>9</sup>	TBD				\$0
Rule 8-18: Equipment Leaks		1,227			\$6.8
Rule 11-10: Toxic and VOC Emissions from Cooling Towers		514			\$0.3
<b>Totals for Phase 1</b>	<b>TBD</b>	<b>1,741</b>	<b>0</b>	<b>645</b>	<b>\$13.1</b>

<sup>8</sup> Condensable PM emissions are estimated based on a very small number of non-standard tests on FCCUs. These numbers will change as more testing is completed at the refineries.

<sup>9</sup> Part 1 of this rule change would reduce ammonia emissions. There is reason to believe that this would also reduce emissions of condensable PM, but it is not possible to quantify condensable PM reductions at this time. Therefore, the estimated PM reduction is listed as “to be determined” or TBD.

Table 4 shows that the Air District has identified significant opportunities for SO<sub>2</sub> and TOG reductions. As sources of filterable PM at the refineries are already cost-effectively controlled, the key opportunity for emissions reductions is from condensable PM. The Air District plans to address condensable PM by regulating emissions from FCCUs.

The total combined baseline emissions from the refineries are 15,659 tons per year. The emissions reductions from Phase 1 of the Petroleum Refinery Emission Reduction Strategy are estimated to be 2,386 tons per year, which means this initial phase is projected to reduce emissions from these sources by 15 percent. Air District staff is still developing emissions reductions estimates for Phase 2, but expects the combined emission reductions to meet or exceed the 20 percent goal set by the Board.

## **B. Twenty Percent Reduction in Risk from Toxic Emissions**

Another of the goal of the Petroleum Refinery Emission Reduction Strategy is to reduce the risk from emissions of toxic compounds by at least 20 percent. Several of the rule development efforts undertaken in the strategy would reduce toxic emissions and risk. Specifically, amendments to Rule 8-18 would reduce VOCs, including toxic compounds, from leaking components, and amendments to Rule 11-10 would expand the scope of this airborne toxic control measure to included toxic organic gases from refinery cooling towers (see Table 2).

The “Limit Pollution and Protect Health” components of the overall Refinery Strategy (Draft Rules 12-15 and 12-16) will specifically address the risk from toxic emissions. Staff expects that the revised requirement for Health Risk Assessments in 12-15 and the stringent Action Levels in 12-16 will significantly impact the risk from toxic emissions. Once the impact of these rules is fully understood, Air District staff will determine whether additional toxic emission reductions are feasible.

## **V. Other Regulatory Development – Further Study Measures**

Staff is also engaged in developing information that would assist in the potential development of additional rulemaking. This information development would take the form of further study measures for two refinery processes: industrial wastewater collection, separation, and treatment, which is currently addressed by Air District Rule 8-8: Waste Water Collection and Separations Systems; and marine operations, addressed by Rule 8-44: Marine Tank Vessel Operations. Staff will determine whether there are cost-effective opportunities for TOG and NO<sub>x</sub> reductions from these sources as well as the potential for reduction of TACs as a co-benefit.

## **VI. Rule Development and Public Consultation Process**

During this multi-phased rule development effort staff will continue to engage all interested stakeholders, including affected industry, nearby community members, environmental organizations, other governmental agencies, the media, and other interested parties. There are several aspects to this public engagement, including:

- Development of conceptual versions of draft rules with discussions of those concepts;
- Scheduling and siting of public workshops (which will be held in and around communities impacted by refinery emissions) with the timely release of associated draft regulatory language, preliminary reports, and support documents;
- Meetings and consultations (community meetings, phone conversations, emails, letters) with interested stakeholders in less formal settings to discuss concerns and issues;
- Preparation of a regulatory package for the consideration of the Air District Board of Directors, including:

- Proposed regulatory language;
- A Staff Report presenting the staff’s findings, such as descriptions of the refining industry, regulatory history, summary and explanation of the proposal, emissions and emission reductions estimates, costs, cost effectiveness and incremental cost effectiveness, environmental and socioeconomic impacts, a schedule of implementation (when the provisions of the rule become effective if adopted), and staff recommendations to the Board of Directors;
- An environmental analysis report;
- A socioeconomic analysis report;
- A discussion of and responses to comments received on the proposed rule, staff report, and environmental and socioeconomic analyses; and
- Public Hearing, where the staff’s presentation is made and stakeholders may provide testimony to the Board of Directors on the staff proposal and at which the Board would consider the adoption of the proposal.

## VII. Request for Comments

On May 26, 2015, Air District staff published a Request for Comments to solicit input on the initial regulatory concepts that comprise Phase 1 of the Petroleum Refinery Emission Reduction Strategy. This package contained concept papers addressing the following regulatory developments:

- a. New Rule 6-5: Fluidized Catalytic Cracking Units (FCCU);
- b. Changes to Rule 8-18: Equipment Leaks;
- c. Changes to Rule 9-1: Refinery Fuel Gas Sulfur Limits;
- d. Changes to Rule 9-1: Limiting SO<sub>2</sub> Emissions from Acid Plants;
- e. Changes to Rule 11-10: Toxic and ROG emissions from Cooling Towers; and
- f. Changes to Rule 9-9: Stationary Gas Turbines.

Staff received three comment letters dated June 19, 2015, on the Initial Report and the associated concept papers. The commenters were:

1. Greg Karras, et al, Citizens for a Better Environment (CBE);
2. Matthew Buell, Tesoro Refining and Marketing Company (Tesoro); and
3. Guy Bjerke, Western States Petroleum Association (WSPA).

Staff’s responses to the general comments are shown below. Comments on particular regulatory actions may be found in the appendix for that rule. Because changes to Rule 9-1 and Rule 9-9 have been deferred to Phase 2 of the Petroleum Refinery Emission Reduction Strategy, our responses to comments on those draft rules and concept papers will be shown in the workshop report for Phase 2.

Comment: *[Need for action:] Air quality, environmental health, and climate impacts of existing and potential refinery emissions are not discussed. Please include this information. As you know, we believe that these already harmful impacts could become more severe. (CBE)*

Staff Response: The Initial Report was a preliminary discussion of the development of the Petroleum Refinery Emission Reduction Strategy; therefore, it was focused on the regulatory actions that comprise the emission reduction portion of the strategy. Existing and potential refinery emissions will be addressed by draft Rules 12-15 and 12-16, which comprise the “Limit Pollution and Protect Health” portion of the overall Refinery Strategy.

Comment: [Goals:] *Please include the goal to reduce refinery emissions as much as feasible through enforceable mechanisms to be implemented as quickly as possible. This goal is stated in the 15 October 2014 resolution of your Board that is referenced in the Report.* (CBE)

Staff Response: The goals expressed in the Initial Report clearly reflect the intent of the Air District Board of Directors' Resolution Number 2014-07, adopted on October 15, 2014, which states:

"...Air District staff shall prepare a strategy to achieve further emissions reductions from petroleum refineries which shall include as a goal a 20 percent reduction in refinery emissions, or as much emissions reduction as are feasible, and shall include a schedule to implement the strategy through regulation or other enforceable mechanisms as expeditiously as possible."

As a result of the Board Resolution and its expressed goal, the Air District staff developed a Petroleum Refinery Emission Reduction Strategy as directed and presented it to the Board of Directors for their consideration at a public hearing on December 17, 2014. At that hearing, the Board of Directors approved the strategy with the following stated goals:

1. Strive to achieve a 20 percent reduction in emissions of criteria pollutants and precursors in the next five years; and
2. Strive to achieve an additional 20 percent reduction in health risk from the emission of toxic compounds.

Comment: [Targeted pollutants:] *Sources targeted by the Strategy emit multiple pollutants. Please expand the scope of air pollutants to be targeted, analyzed, and controlled to all pollutants emitted from the refinery sources targeted that could potentially be controlled—including criteria and toxic pollutants as well as greenhouse gases (GHGs). The adverse impacts of emissions from each source include those from all the pollutants it emits. A feasible measure that more effectively reduces these adverse impacts from multiple pollutants could be excluded erroneously, or could erroneously be deemed "infeasible," if its benefits associated with reducing emissions of some of the harmful pollutants it would address are ignored.* (CBE)

Staff Response: While it is correct that refineries emit a multitude of pollutants, staff believes that the approach outlined in the Petroleum Refinery Emission Reduction Strategy will be effective in reducing not only the criteria pollutants listed in the Initial Reports, but a wide range of pollutants, including toxic and climate pollutants, such as methane. The regulatory actions identified in the two phases of the Petroleum Refinery Emission Reduction Strategy address the feasible emission reduction measures that the Air District has currently identified for criteria pollutants. Emissions of toxic pollutants will be addressed in other components of the broader strategy, primarily through draft Rules 12-15 and 12-16. Climate pollutants, other than methane, are currently addressed through a statewide Cap and Trade system that requires substantial emission reductions from the refining sector.

Comment: [Further study of marine operations:] *Refiners could supply electric power (even grid-purchased renewable power) to reduce emissions when oil tankers call at their wharves. This "cold ironing" is required when some other cargo ships call at state ports. The District Staff's reliance on an EIR that required cold ironing as a contingency to offset potentially increasing emissions from Chevron's Modernization Project suggests that District Staff believes this measure is feasible at refineries. Please explain why the District appears to have rejected or deferred this emissions reduction measure to further study.* (CBE)



Staff Response: While “cold ironing” at marine terminals is a much desired goal, the Air District does not have the regulatory authority to require electrification at marine terminals. This falls under the purview of the California Air Resources Board – Executive Order AB-15-01 – Clean Air Engineering-Maritime, Inc.

Comment: *[Rule development / public consultation process:] Please consider holding the adoption hearings for new and revised refinery rules in refinery fence line communities. The District’s refinery rule workshops in our communities allowed for more equitable and meaningful public participation in these decisions about our communities’ health. The same need, to support more equitable and meaningful participation by people and communities whose environmental health is most affected by the District’s actions, applies even more strongly to the agency’s decision-making hearings. (CBE)*

Staff Response: The Air District will consider this request when scheduling and siting the public hearing(s) for these rule development efforts.

Comment: *[Fossil-fueled power generation (Rules 9-9 and 9-10):] Please consider developing and proposing requirements to partially re-power refineries with renewable electricity. (CBE)*

Staff Response: The AB 32 Cap and Trade Program includes refineries as one of its industrial sectors. Staff believes it would be premature to attempt to impose climate pollutant regulations on this industrial sector before any results from this program are realized. Staff intends to closely monitor the implementation and progress of the Cap and Trade program and if, in the Air District’s opinion, reductions in climate pollutants from Bay Area refineries are not achieving state and regional goals, the Air District would then consider regulatory development for climate pollutants emitted from this sector.

Comment: *There is concern that the district has not followed its typical and statutory rule making process. The District has provided no identification of an air pollution problem (nor a review of options for addressing the problem), given that:*

- (a) The District currently attains all of the National Ambient Air Quality Standards (NAAQS);*
- (b) The District’s monitoring data have reflected a declining trend in ambient concentrations for decades; and*
- (c) The District’s CARE program identified that the most significant toxics impacts are not in the vicinity of the refineries, but are instead in the vicinity of “the maze” of highways across from the Bay Bridge. (WSPA)*

Staff Response: The Initial Report clearly indicates the problem this effort would address. Refineries are the largest individual sources of sulfur dioxide (SO<sub>2</sub>), reactive organic gases, and PM<sub>2.5</sub>. Further, the five refineries rank among the top facilities in the Bay Area for risk-weighted emissions. The Air District is pursuing all feasible measures to reduce criteria and toxic pollutants in an effort to maintain and attain compliance with federal and state ambient air quality standards; our preliminary analysis indicates that the measures discussed in the Initial Report and concept papers are feasible. However, we are open to reconsidering this assessment in light of technical information provided by the refineries.

Comment: *Of the six rules that are identified in the District’s strategy, three address ozone precursors, ROG and NO<sub>x</sub>: i.e., Rule 8-18 (ROG and TACs from equipment in heavy liquid service), Rule 11-10 (ROG and TACs from cooling towers), and Rule 9-9 (NO<sub>x</sub> from Stationary Gas Turbines). In accordance with H&SC 40914(b), the District’s 2010 Clean Air Plan (CAP) for ozone was required to include “every feasible measure” to control ozone, and ARB had to concur with that assessment. We are not aware of any new*

information since the time of the 2010 CAP that indicates that the feasibility of these controls has changed, nor does the District’s strategy present such information. (WSPA)

Staff Response: While the Air District is required to consider “every feasible measure” in the Clean Air Plan, there is no prohibition against addition rule development efforts that have not been vetted in the Plan.

Comment: *The District is rushing this rule development effort. The 24 days that the District allowed for comments on its refinery emissions reduction strategy and draft language for six new or modified rules is far shorter than what it has used for individual rulemakings in the past, and is far too short for a complete review of the draft language; as a result our comments here are only preliminary.* (WSPA)

Staff Response: While 24 days is almost a week shorter than what is normally a 30-day comment period, this Initial Report is a preliminary publishing of staff initial concept for which stakeholder input was solicited. Following this initial release, staff will develop and publish a workshop report and revise the draft regulatory language based on stakeholder input and internal deliberations.

Further, as is always the case, stakeholders are always welcome either to request an extension of the comment period or to engage staff to further discuss concerns and share information via phone calls, emails, and meetings.

Comment: *[Stakeholders:] Some of the draft proposed rule changes—including Rule 8-18 (Equipment Leaks), possibly Rule 9-1 (for any sulfuric acid plants separate from refineries), and Rule 9-9 (Stationary Gas Turbines)—affect more entities than just refineries, and that by burying these draft proposed rule changes within the “Petroleum Refinery Emissions Reduction Strategy” the District may not be including and engaging all stakeholders.* (WSPA)

Staff Response: Air District staff has attempted to identify and notice all potentially affected stakeholders. If WSPA is aware of any stakeholders that we may have unintentionally overlooked, please identify them so they can participate in this rule development effort.

## **VIII. Revised Schedule of the Petroleum Refinery Emission Reduction Strategy Regulatory Development**

Table 5 provides a preliminary schedule for the development of each of the two phases of the regulatory effort. It should be noted that these are only rough estimates of the schedule and the dates may change as the effort proceeds.

**Table 5: Revised Schedule of the Petroleum Refinery Emission Reduction Strategy Regulatory Development**

<b>Milestone</b>	<b>Phase 1</b>	<b>Phase 2</b>
Concepts	April 2015	April 2015
Workshops	3 <sup>rd</sup> Quarter 2015	1 <sup>st</sup> Quarter 2016
Public Hearing	4 <sup>th</sup> Quarter 2015	2 <sup>nd</sup> Quarter 2016

## **IX. Cost Recovery**

The Air District has the authority to assess fees to regulated entities for the purpose of recovering the reasonable costs of implementing and enforcing applicable regulatory requirements. On March 7, 2012, the Air District's Board of Directors adopted a Cost Recovery Policy that specifies that newly adopted regulatory measures should include fees that are designed to recover increased regulatory program activity costs associated with the measure (unless the Board of Directors determines that a portion of those costs should be covered by tax revenue).

In accordance with the adopted Cost Recovery Policy, Air District staff is developing a new fee schedule to be included in Regulation 3, Fees.

## **Appendices**

Appendix A: Concept Paper for Rule 6-5: Fluidized Catalytic Cracking Units (FCCU)

Appendix B: Concept Paper for Changes to Rule 8-18: Equipment Leaks

Appendix C: Concept Paper for Changes to Rule 11-10: Toxic and ROG emissions from Cooling Towers