BAY AREA AIR QUALITY MANAGEMENT DISTRICT

Regulation 12, Rule 16:
Petroleum Refining Greenhouse Gas Emissions Limits

REVISED FINAL STAFF REPORT

JUNE 2017

(This page was intentionally left blank.)

Table of Contents

I. EXECUTIVE SUMMARY

Petroleum refineries are significant sources of harmful pollutants on both the global (greenhouse gases - GHG) and regional/local scale (toxic air contaminants and criteria pollutants). Many Bay Area residents have expressed concern about the impact of this pollution on the environment and public health. Though refinery emissions have declined over time, it is possible that, as refinery operations change in the future, emissions of these pollutants could increase.

Refineries are the dominant stationary source of GHG emissions, accounting for 16 percent of emissions in the region. They are by far the most significant source within the Air District's jurisdiction. In spite of years of GHG regulations at the state level, emissions from refineries have not significantly decreased. And, in absence of any additional regulation, they may increase.

California refineries' traditional sources of crude oil, California and the Alaska North Slope, are in decline. Replacement feedstocks may require more energy and hydrogen to process, which could lead to significantly increased GHG emissions. These increased GHG emissions would be accompanied by increased emissions of other combustion pollutants (such as fine particulate matter) which have localized and regional public health impacts.

The purpose of Regulation 12, Rule 16: Petroleum Refining Greenhouse Gas Emissions Limits (Rule 12-16) is to limit refining sector GHG emissions to a level consistent with the refineries' current production capacity. This should prevent a switch to more polluting feedstocks. This rule is intended as a backstop to prevent increases while the State of California and the Air District develop a strategy to significantly reduce refinery emissions in order to meet emission reduction goals set by the Legislature.

II. BACKGROUND

Oil Refineries are the largest source of industrial GHG emissions in the Bay Area. Collectively, the refining industry accounts for 16 percent of total GHG emissions in the region. Despite several years of the statewide Cap-and-Trade program, refinery emissions have remained steady and not decreased. As the refineries' traditional sources of crude oil decline, they must find new sources of feedstocks. Some of the replacement feedstocks will require more energy to process into transportation fuels than current sources of crude oil. The purpose of proposed Rule 12-16 is to ensure that GHG emissions from oil refining do not increase as the refining industry transitions to these new sources of feedstock. The Rule will be a backstop to prevent GHG increases while the Air District and California Air Resources Board develop strategies expected to significantly reduce refinery GHG emissions.

Rule 12-16 would cap GHG emissions from oil refineries and closely associated support facilities at a level consistent with current operations with a 3 percent additional buffer to

provide additional operational flexibility considering projected growth in demand for transportation fuels for the next few years.

A. Petroleum Refinery

Currently, the five petroleum refineries located in the Bay Area within the jurisdiction of the Air District that would be affected by the rule are:

1. Chevron Products Company, Richmond (BAAQMD Plant #10)
2. Phillips 66 Company—San Francisco Refinery, Rodeo (BAAQMD Plant #21359)
3. Shell Martinez Refinery, Martinez (BAAQMD Plant #11)
4. Tesoro Refining and Marketing Company, Martinez (BAAQMD Plant #14628)
5. Valero Refining Company—California, Benicia (BAAQMD Plant #12626) and associated Asphalt Plant (BAAQMD Plant #13193)

The three affected, refinery-related facilities are:

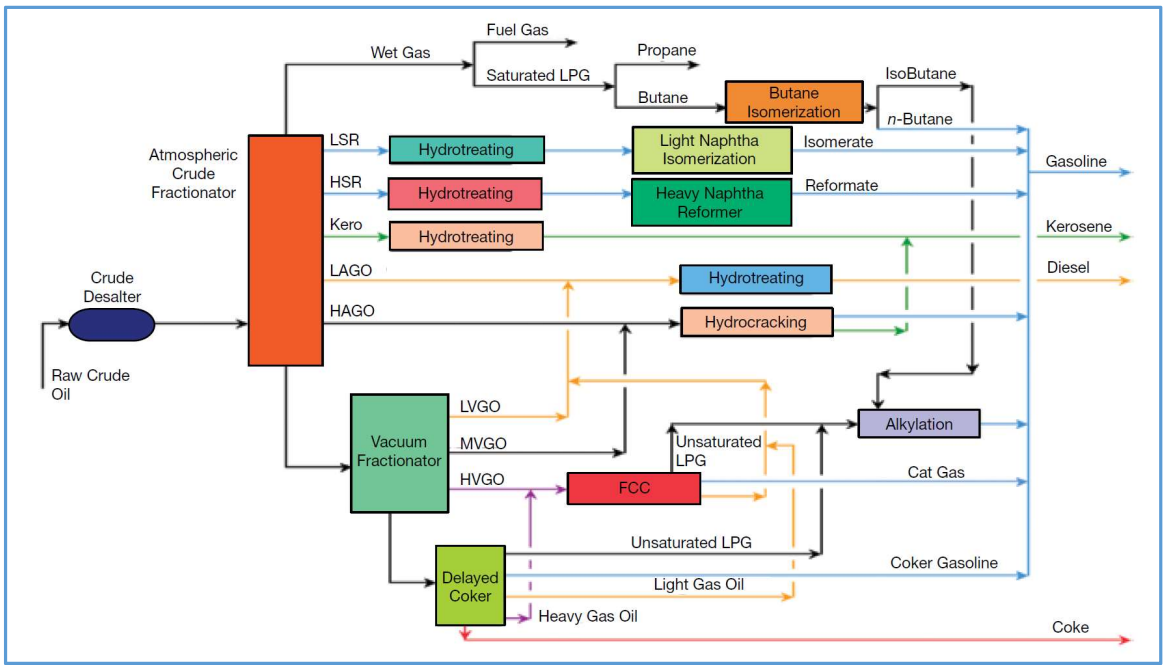
1. Air Products and Chemicals hydrogen plant, Martinez (BAAQMD Plant #10295)
2. Air Liquide hydrogen plant, Rodeo (BAAQMD Plant #17419)
3. Martinez Cogen, L.P. (BAAQMD Plant #1820)

These three support facilities are subject to provisions of the rule because each is closely linked to the operations of a refinery.

1. Petroleum Refinery Process Description

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 1 illustrates how various process units at petroleum refineries convert raw crude oil (petroleum) into fuels and other products.

Figure 1: 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: Polymers of butane are reformed into isobutane for use in the alkylation process. Alkylates 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_2S) derived from refining crude oil. In the thermal step, H_2S laden gas is combusted to form elemental sulfur and sulfur dioxide (SO_2). In the catalytic step, a catalyst is used to boost the sulfur yield. In this step, H_2S reacts with SO_2 to form elemental sulfur.

a. Separation Processes

Crude oil consists of a complex mixture of hydrocarbon compounds with small amounts of impurities such as sulfur, nitrogen, and metals. The first phase in petroleum refining is the separation of crude oil into its major constituents using distillation and "light ends" recovery (i.e., gas processing) that splits crude oil constituents into component parts known as "boiling-point fractions."

b. Conversion Processes

Crude oil components such as residual oils, fuel oils, and other light fractions are converted to high-octane gasoline, jet fuel, and diesel fuel, gasoline by various processes. These processes, such as cracking, coking, and visbreaking (a form of thermal cracking that breaks the viscosity), are used to break large petroleum molecules into smaller ones. Polymerization and alkylation processes are used to combine small petroleum molecules into larger ones. Isomerization and reforming processes are applied to rearrange the structure of petroleum molecules to produce higher-value molecules using the same atoms.

c. Treating Processes

Petroleum treating processes stabilize and upgrade petroleum products by separating them from less desirable products, and by removing other elements. Treating processes, employed primarily for the separation of petroleum products, include processes such as de-asphalting. Elements such as sulfur, nitrogen, and oxygen are removed by hydrodesulfurization, hydrotreating, chemical sweetening, and acid gas removal.

d. Feedstock and Product Handling

Refinery feedstock and product handling operations consist of unloading, storage, blending, and loading activities.

e. Auxiliary Facilities

A wide assortment of processes and equipment not directly involved in the processing of crude oil are used in functions vital to the operation of the refinery. Examples include steam boilers, wastewater treatment facilities, hydrogen plants, cooling towers, and sulfur recovery units. Products from auxiliary facilities (e.g., clean water, steam, and process heat) are required by most process units throughout a refinery.

f. Emissions from Refinery Processing

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 pollutants (toxic air contaminants), and climate pollutants (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. (A more detailed discussion on refinery emissions is provided below is subsection 3.)

2. PETROLEUM CRUDE OIL

Petroleum crude oil consists of a complex mixture of hydrocarbon compounds with smaller amounts of impurities, including sulfur, nitrogen, oxygen, a variety of toxic compounds, organic acids, and metals (e.g., iron, copper, nickel, and vanadium). Crude oil is most often characterized by the oil's density (light to heavy) and sulfur content (sweet to sour). A more detailed explanation of these terms and others used to describe crude oil follows below.

Each of the properties described below is required to be included in the periodic monthly Crude Slate Report described in Regulation 12, Rule 15 (Rule 12-15) because each relates to emissions of air pollutants. The purpose of the crude slate reporting in Rule 12-15 is to establish a baseline crude slate for each of the refineries and then to track changes in that crude slate, along with improved emissions data, to monitor the relationship between crude slate and emissions from the refineries.

a. API Gravity

The industry standard measure for crude oil density is American Petroleum Institute (API) gravity, which is expressed in units of degrees, and which is inversely related to density (i.e., a lower API gravity indicates higher density; a higher API gravity indicates lower density). Refineries convert crude oils to gaseous products (propane gas for sale and "fuel gas" that is consumed at the refinery), high-value transportation fuels (gasoline, diesel and jet fuel) and lower-value heavy oils (such as "bunker fuel" that is used by ocean-going vessels). Crude oils with higher API gravity can theoretically be converted to higher-value light products with less processing than crude oils with lower API gravity. Refinery operators have asserted that, although this may suggest that a refinery operator would prefer to use high API gravity crudes exclusively, this is not the case because each refinery is designed and equipped to process crude oil with API gravity in a certain range. Processing crude oil outside of the design range—even if it is "light" crude—will result in processing bottlenecks that reduce the overall efficiency of the refinery.

b. Sulfur Content ("Sweet" and "Sour" Crude)

Sulfur is an impurity that occurs in crude oil and arrives in various forms including: elemental sulfur (S), hydrogen sulfide (H_2S), carbonyl sulfide (COS), inorganic forms, and most importantly, organic forms that include: mercaptans, sulfides, and polycyclic sulfides. "Sweet crude" is commonly defined as crude oil with sulfur content less than 0.5 percent, while "sour crude" has sulfur content greater than 0.5 percent. Sweet crude is more desirable because sulfur must be removed from the crude oil to produce more valuable refined products such as gasoline, diesel and aviation fuels.

c. Vapor Pressure

Vapor pressure is a measure of crude oil volatility. Higher vapor pressure crude oil contains greater amounts of light Volatile Organic Carbon (VOC) compounds.

d. BTEX (Benzene, Toluene, Ethylbenzene, Xylene) Content

BTEX content is a measure of the benzene, toluene, ethylbenzene, and xylene content in crude oil.

e. Metals (Iron, Nickel and Vanadium) Content

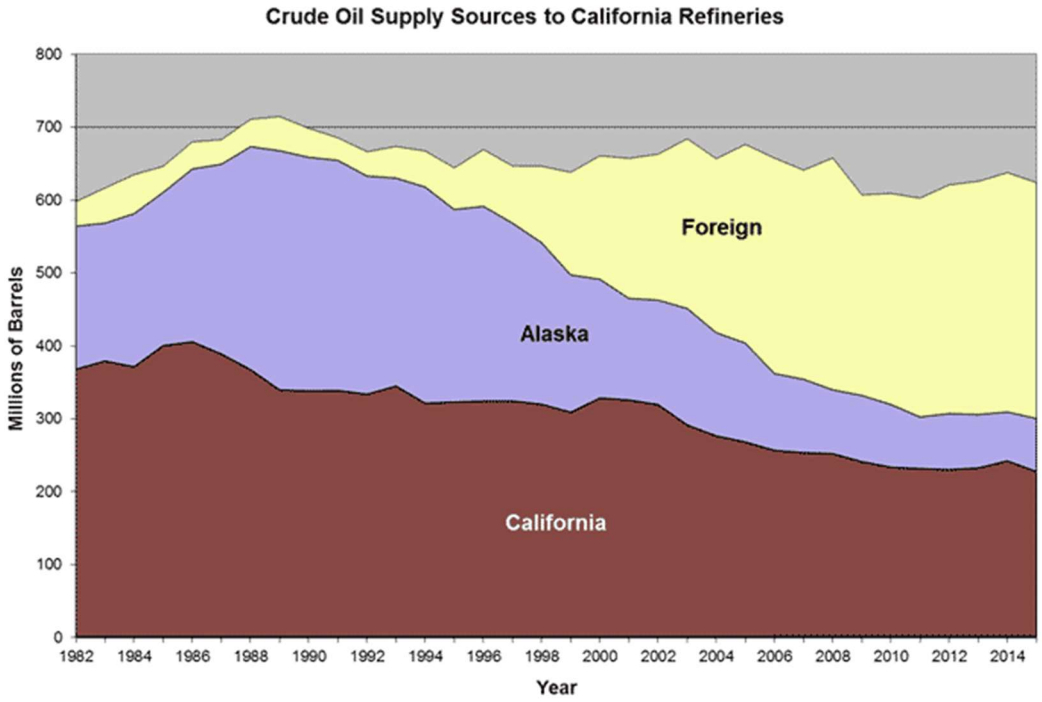
The metals content of crude oil indicates both the solids contamination of crude oil and the potential for organic metals compounds in the heavy gas oil component of crude oil.

f. Possible Changes in Emissions Due to Changes in Crude Oil

In the past several years, new sources of crude oil—including American shale oil and Canadian tar sands-derived oil—have become available to petroleum refineries in North America, including Bay Area refineries. The crude oil derived from shale, now accessible because of technological improvements in hydraulic fracturing ("fracking"), tends to be light and sweet. However, this crude oil has higher VOC and H_2S content than some other crude oils. Crude oil from tar sands, currently under development in the Canadian province of Alberta, tends to be heavy and sour.

To maximize production, refineries are designed to process crude oils within a certain range of compositions—often referred to as “crude window.” For example, a refinery that is designed to process more sour crude must have the capacity to remove large amounts of sulfur from the crude oil, while a refinery designed to process sweet crude does not require as much sulfur processing capacity. Bay Area refineries traditionally process heavier and more sour crude oils because, for many years, much of the crude supply has been heavy sour crude from Kern County and medium sour crude from Alaska. The refineries would likely need to make changes to their facilities to accommodate different sources of crude oil with different compositions to maintain current production levels. Figure 2, shows the trends in crude sources for California refineries.

Figure 2: Crude Oil Supply Sources to California Refineries



Source: California Energy Commission

It is anticipated that refineries will update and/or modify their equipment to meet stricter regulatory fuel requirements and potentially to process crude oil from different sources. Rule 12-15 was adopted to monitor the key data so that staff can determine if emissions changes are potentially driven by changes in crude slate. The intent of Rule 12-16 is to discourage or prevent refineries in the Bay Area from making changes that would lead to increases in emissions of greenhouse gas pollutants.

3. AIR POLLUTANTS EMITTED FROM PETROLEUM REFINERIES

Air pollutants are categorized and regulated based on their properties and there are three primary categories of regulated air pollutants: (1) criteria pollutants; (2) toxic pollutants (toxic air contaminants, which in federal programs are referred to as "hazardous air pollutants"); and (3) climate pollutants (e.g., greenhouse gases). Additional categories of air pollutants include odorous compounds and visible emissions, although these are most often also components of one or more of the three primary categories of regulated air pollutants listed above.

a. Criteria Pollutants

Criteria pollutants have regional or basin-wide impacts and are emissions for which ambient air quality standards (AAQS) have been established, or are atmospheric precursors to such air pollutants (i.e., they participate in photochemical reactions to form a criteria pollutant, such as ozone). The AAQS are air concentration–based standards that are established to protect public health and welfare. The U.S. Environmental Protection Agency (EPA) sets AAQS on a national basis (National Ambient Air Quality Standards, or NAAQS), and CARB sets AAQS for the state of California (California

Ambient Air Quality Standards, or CAAQS). Although there is some variation in the specific pollutants for which NAAQS and CAAQS have been set, the term "criteria pollutants" generally refers to the following:

- Carbon monoxide (CO);
- Nitrogen dioxide (NO_2) and oxides of nitrogen (NO_X);
- Particulate matter (PM) in two size ranges—diameter of 10 micrometers or less (PM_{10}), and diameter of 2.5 micrometers or less ($PM_{2.5}$);
- Precursor Organic Compounds (POCs) for the formation of ozone and $PM_{2.5}$; and
- Sulfur dioxide (SO_2).

Each of these criteria pollutants is emitted by petroleum refineries. Most of these criteria pollutants result from fossil fuel combustion. Typically, these emissions would increase when GHG emissions increase. However, most of the refinery equipment is subject to regulatory and permitting requirements that limit emissions of criteria pollutants. And, any significant equipment change that would lead to increased emissions is subject to the Air District's very strict permitting regulations. So, the extent to which criteria pollutant emissions would increase in tandem with GHG emissions would vary by project and refinery.

b. Toxic Pollutants

Toxic pollutants, also known as toxic air contaminants (TACs), have localized impacts and are emissions for which AAQS generally have not been established, but that nonetheless may result in human health risks. TACs generally are emitted in much lower quantities than criteria pollutants, and may vary markedly in their relative toxicity (i.e., some TACs cause health impacts at lower concentrations than other TACs). The state list of TACs currently includes approximately 190 separate chemical compounds and groups of compounds. TACs emitted from petroleum refineries include volatile organic TACs (e.g., acetaldehyde, benzene, 1,3-butadiene, formaldehyde, and xylenes); semi-volatile and non-volatile organic TACs (e.g., benzo(a)pyrene, chlorinated dioxin/furans, cresols, and naphthalene); metallic TACs (e.g., compounds containing arsenic, cadmium, chromium, mercury, and nickel); and inorganic TACs (e.g., chlorine, hydrogen sulfide, and hydrogen chloride). These pollutants are not addressed by Rule 12-16. The Air District is proposing to address TAC emissions from refineries and other sources through draft Regulation 11, Rule 18: Reduction of Risk from Air Toxic Emissions at Existing Facilities. The TACs that drive health risk from refineries are usually associated with leaks from equipment and tanks, these high risk pollutants, such as benzene, are not correlated to GHG emissions.

c. Climate Pollutants

Climate pollutants (greenhouse gases or GHGs) are emissions that contribute to global anthropogenic climate change. Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and three groups of fluorinated compounds (hydrofluorocarbons, or HFCs; perfluorocarbons, or PFCs; and sulfur hexafluoride, or SF_6) are the major anthropogenic GHGs, and are regulated under the federal Clean Air Act and the California Global Warming Solutions Act (AB 32). The climate pollutants emitted from petroleum refineries include CO_2, CH_4, and N_2O.

d. Refinery Air Pollution in Context

Refineries are a significant source of air pollutants in general. In the counties where the refineries are located, their emissions can be more significant on a percentage basis, especially for SO_2 and $PM_{2.5}$.

The tables below are based on 2012 emissions data and do not account for the benefits of recent Air District rulemaking that are projected to reduce refinery criteria pollutant emissions by approximately 17 percent. They also do not include the benefits of rules under development to reduce SO_2 emissions from refineries. The tables compare refinery emissions of key criteria pollutants to other emissions both in the Bay Area and in Contra Costa and Solano counties where the refineries are located.

Table 1: Bay Area Emissions of Relevant Pollutants by Source Category

Source Category	Emissions							
	$PM_{2.5}$		Anthropogenic ROG		NO_X		SO_2	
	(tons/yr.)	%	(tons/yr.)	%	(tons/yr.)	%	(tons/yr.)	%
Refineries	1,524	9	5,399	6	4,248	4	2,890	41
Coke Calcining	28	0.2	0.2	< 0.1	239	0.2	1,242	17
Cement Plant	23	0.1	40	< 0.1	2,170	2	912	13
Major Industrial	1,839	11	17,639	18	5,765	5	581	8
Residential/Commercial	5,519	34	27,862	28	5,531	5	326	5
Agricultural	471	3	2,049	2	0	0	0	0
Miscellaneous	986	6	116	0.1	10	< 0.1	0	0
Mobile Sources	5,945	36	44,659	46	91,473	83.6	1,168	16
Total Emissions	**16,335**	**100%**	**97,763**	**100%**	**109,436**	**100%**	**7,119**	**100%**

Table 2: Emissions of Relevant Pollutants by Source Category for Contra Costa and Solano Counties

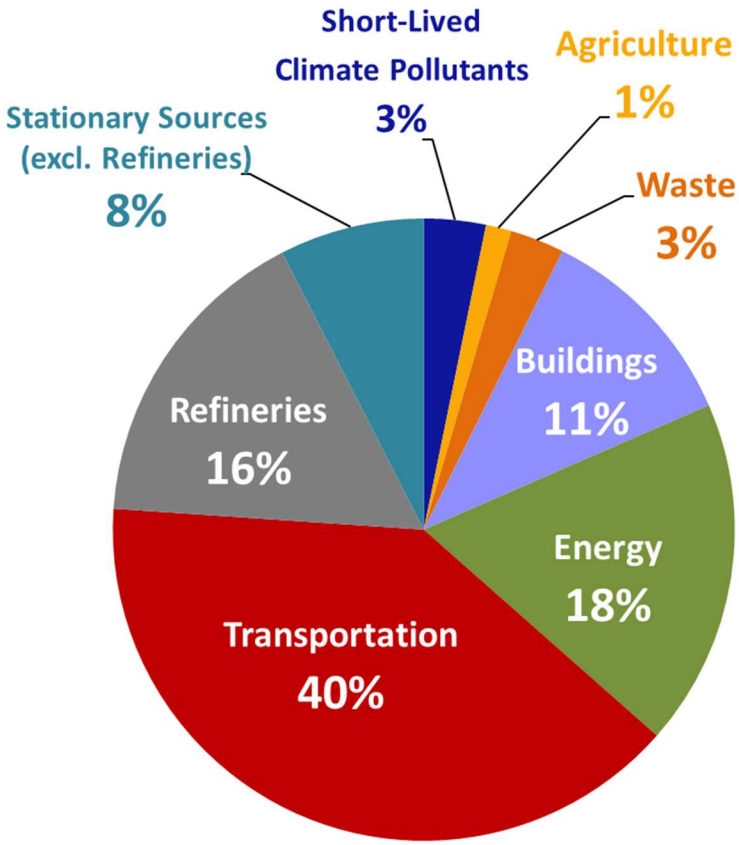
Source Category	Emissions							
	$PM_{2.5}$		Anthropogenic ROG		NO_X		SO_2	
	(tons/yr.)	%	(tons/y.r)	%	(tons/yr.)	%	(tons/yr.)	%
Refineries	1,524	29	5,399	23	4,248	17	2,890	63
Coke Calcining	28	1	0.2	0.001	239	1	1,242	27
Cement Plant	0	0	0	0	0	0	0	0
Major Industrial	569	11	3,383	14	2,131	8	85	2
Residential/Commercial	1,548	29	5,649	24	1,122	4	49	1

Source Category	Emissions							
	$PM_{2.5}$		Anthropogenic ROG		NO_X		SO_2	
	(tons/yr.)	%	(tons/y.r)	%	(tons/yr.)	%	(tons/yr.)	%
Agricultural	97	2	369	2	0	0	0	0
Miscellaneous	294	6	20	0.1	2	0	0	0
Mobile Sources	1,212	23	9,041	38	17,703	70	296	6
Total	**5,272**	**100%**	**23,859**	**100%**	**25,445**	**100%**	**4,563**	**100%**

1. Emissions from biogenic sources and accidental fires are not included in this inventory. Mobile emissions include shipping emissions within 3 nautical miles of the Bay Area coastline.
2. $PM_{2.5}$ emissions for the Refineries category include condensable and filterable PM. Condensable PM data are not available for other source categories at this time.

Refineries are also a significant source of GHG emissions. They produce about two-thirds of the industrial GHG emissions in the Bay Area. Mobile sources are the largest source of GHG emissions overall. Refining and use of transportation fuels together account for 56 percent of GHG emissions in the Bay Area.

Figure 2: Bay Area GHG Emissions by Economic Sector for Year 2013



1. Emissions for the energy sector include electricity generation and co-generation for the Bay Area region, including imported electricity.
2. Emissions associated with fuel usage (solid, liquid and gas) are apportioned according to its use; residential and commercial fuel usage is attributed to the buildings sector while industrial fuel usage is accounted for in the stationary sources or refinery sectors.

B. Regulation of Air Pollutants from Petroleum Refineries

1. Criteria Pollutants

Bay Area refineries are subject to various air quality regulations that have been adopted by the Air District, CARB, and the EPA. These regulations contain standards that ensure emissions are effectively controlled, including:

- Requiring the use of specific emission control strategies or equipment (e.g., the use of floating roofs on tanks for VOC emissions);
- Requiring that emissions generated by a source be controlled by at least a specified percentage (e.g., 95 percent control of VOC emissions from pressure relief devices);
- Requiring that emissions from a source not exceed specific concentration levels (e.g., 100 parts per million [ppm] by volume of VOC for equipment leaks unless those leaks are repaired within a specific timeframe; 250 ppm by volume SO_2 in exhaust gases from sulfur recovery units; 1,000 ppm by volume SO_2 in exhaust

gases from catalytic cracking units);
- Requiring that emissions not exceed certain quantities for a given amount of material processed or fuel used at a source (e.g., 0.033 pounds NO_X per million BTU of heat input, on a refinery-wide basis, for boilers, process heaters, and steam generators);
- Requiring that emissions be controlled sufficiently so that concentrations beyond the facility's property are below specified levels (e.g., 0.03 ppm by volume of hydrogen sulfide [H_2S] in the ambient air);
- Requiring that emissions from a source not exceed specified opacity levels based on visible emissions observations (e.g., no more than 3 minutes in any hour in which emissions are as dark or darker than No. 1 on the Ringelmann Smoke Chart); and
- Requiring that emissions be minimized by the use of all feasible prevention measures (e.g., flaring prohibited unless it is in accordance with an approved Flare Minimization Plan).

Air quality rules generally do not expressly limit mass emissions (e.g., pounds per year of any specific air pollutant) from affected equipment unless that equipment was constructed or modified after March 7, 1979, and was subject to the Air District's New Source Review (NSR) rule. All Bay Area refineries have "grandfathered" emission sources that were not subject to NSR but are generally regulated by equipment-specific Air District regulations or operational conditions contained in Air District permits. As a result, none of the Bay Area refineries have overall mass emission limits that apply to the entire refinery as they are defined in Rule 12-16. Nonetheless, mass emissions of regulated air pollutants from Bay Area refineries are tracked at the source level, and these mass emissions generally have been substantially reduced over the past several decades.

Air pollutant emissions from Bay Area petroleum refineries have been regulated for more than 50 years, with most of the rules and regulations adopted following enactment of the 1970 Clean Air Act amendments. The Air District has the primary responsibility to regulate "stationary sources" of air pollution in the Bay Area, and the Air District has adopted many rules and regulations that apply to petroleum refineries.

2. TOXIC POLLUTANTS

The Air District uses three approaches to reduce TAC emissions and to reduce the health impacts resulting from TAC emissions: (1) Specific rules and regulations, including federal, state, and Air District regulation; (2) Preconstruction review; and (3) the AB 2588 Air Toxics "Hot Spots" Program. Rule 12-16 would not impact existing regulations of these pollutants as it does not directly address them.

3. ACCIDENTAL RELEASE REGULATION

In addition to Air District regulations, petroleum refineries are also subject to regulatory programs that are intended to prevent accidental releases of regulated substances. Accidental release prevention programs in California are implemented and enforced by

local administering agencies, which, in the case of the Bay Area refineries, are Solano County (for the Valero Refining Company) and Contra Costa County (for Chevron Products Company, Phillips 66 Company, Shell Martinez Refinery, and Tesoro Refining and Marketing Company).

The primary regulatory programs of this type are based on requirements in the amendments to the1990 Clean Air Act as follows: (1) the Process Safety Management (PSM) program, which focuses on protecting workers, and which is administered by the U.S. Occupational Safety & Health Administration (OSHA); and (2) the Accidental Release Prevention program (commonly referred to as the Risk Management Program, or RMP), which focuses on protecting the public and the environment, and which is administered by EPA. Bay Area refineries are subject to Cal/OSHA's PSM program, which is very similar to the federal OSHA program focusing on worker safety, but with certain more stringent state provisions. Bay Area refineries are subject to the California Accidental Release Prevention (CalARP) Program, which is very similar to EPA's RMP program to limit exposure of the public, but with certain more stringent State provisions. In addition, Contra Costa County and the City of Richmond have both adopted an Industrial Safety Ordinance (ISO). These ISOs are very similar to CalARP requirements, but with certain more stringent local provisions.

4. AIR DISTRICT RULES AFFECTING REFINERIES

The following is a partial list of the air pollution rules and regulations that the Air District implements and enforces at Bay Area refineries:

- Regulation 1: General Provisions and Definitions
- Regulation 2, Rule 1: Permits, General Requirements
- Regulation 2, Rule 2: New Source Review
- Regulation 2, Rule 5: New Source Review of Toxic Air Contaminants
- Regulation 2, Rule 6: Major Facility Review (Title V)
- Regulation 6, Rule 1: Particulate Matter, General Requirements
- Regulation 6, Rule 5: Particulate Emissions from Refinery Fluidized Catalytic Cracking Units
- Regulation 8, Rule 1: Organic Compounds, General Provisions
- Regulation 8, Rule 2: Organic Compounds, Miscellaneous Operations
- Regulation 8, Rule 5: Storage of Organic Liquids
- Regulation 8, Rule 6: Terminals and Bulk Plants
- Regulation 8, Rule 8: Wastewater (Oil-Water) Separators
- Regulation 8, Rule 9: Vacuum Producing Systems
- Regulation 8, Rule 10: Process Vessel Depressurization
- Regulation 8, Rule 18: Equipment Leaks
- Regulation 8, Rule 28: Episodic Releases from Pressure Relief Devices at Petroleum Refineries and Chemical Plants
- Regulation 8, Rule 44: Marine Vessel Loading Terminals
- Regulation 9, Rule 1: Sulfur Dioxide

- Regulation 9, Rule 2: Hydrogen Sulfide
- Regulation 9, Rule 8: Nitrogen Oxides and Carbon Monoxide from Stationary Internal Combustion Engines
- Regulation 9, Rule 9: Nitrogen Oxides and Carbon Monoxide from Stationary Gas Turbines
- Regulation 9, Rule 10: Nitrogen Oxides and Carbon Monoxide from Boilers, Steam Generators and Process Heaters in Petroleum Refineries
- Regulation 9, Rule 14: Petroleum Coke Calcining Operations
- Regulation 11, Rule 10: Cooling Towers
- Regulation 12, Rule 11: Flare Monitoring at Petroleum Refineries
- Regulation 12, Rule 12: Flares at Petroleum Refineries
- Regulation 12, Rule 15: Petroleum Refinery Emissions Tracking
- 40 CFR Part 60, Subpart J: Standards of Performance for Petroleum Refineries (NSPS)
- 40 CFR Part 61, Subpart FF: Benzene Waste Operations (NESHAP)
- 40 CFR Part 63, Subpart CC: Petroleum Refineries (NESHAP)
- 40 CFR Part 63, Subpart UUU: Petroleum Refineries: Catalytic Cracking, Catalytic Reforming, and Sulfur Plant Units (NESHAP)
- State Airborne Toxic Control Measure for Stationary Compression Ignition (Diesel) Engines (ATCM).

III. REQUIREMENTS

Explanations of the various provisions of Rule 12-16 are provided below.

A. Applicability and Exemptions

Rule 12-16 would apply to the five large refineries in the Bay Area:

1. Chevron Products Company, Richmond (BAAQMD Plant #10)
2. Phillips 66 Company—San Francisco Refinery, Rodeo (BAAQMD Plant #21359)
3. Shell Martinez Refinery, Martinez (BAAQMD Plant #11)
4. Tesoro Refining and Marketing Company, Martinez (BAAQMD Plant #14628)
5. Valero Refining Company—California, Benicia (BAAQMD Plant #12626) and associated Asphalt Plant (BAAQMD Plant #13193)

The rule would also apply to three support facilities:

1. Air Products and Chemicals hydrogen plant, Martinez (BAAQMD Plant #10295)
2. Air Liquide hydrogen plant, Rodeo (BAAQMD Plant #17419)
3. Martinez Cogen, L.P. (BAAQMD Plant #1820)

Small oil refineries less than 5,000 bpd capacity would be exempt from the requirements of this rule.

B. Definitions

The definitions section defines key terms and phrases used in the proposed rule. Other relevant definition can be found in Rule 12-15.

C. Standards

Rule 12-16 sets GHG emission limits for each affected facility. These limits were established by analyzing emissions to establish a baseline five-year period. GHG emissions were analyzed for calendar years 2011, 2012, 2013, 2014, and 2015, as this was the most recent five-year period for which CARB has released GHG emissions data. CARB GHG data prior to 2011 used a different methodology to calculate emissions.

GREENHOUSE GAS EMISSION LIMITS

- Each facility must provide GHG emissions to CARB as part of CARB's Mandatory Reporting of Greenhouse Gas Emissions Requirements (MRR). GHG Emissions Inventory information for each year was obtained from an Excel spreadsheet available on the CARB website,[1] using the entries under "Calculated Covered Emissions, metric tons CO2e."
- The intent of the rule is to set emissions limits at a level consistent with full production operation of the refineries, with an allowance to provide for additional operational flexibility and buffer for potential increases in demand for transportation fuels.
- The staff calculated the mean and standard deviation for the baseline emissions for each of the facilities. Years 2012 and 2013 were excluded for Chevron, because they were operating at significantly reduced capacity those years due to a fire that impacted their crude unit.
- Limits are calculated by adding three standard deviations to the mean emission rate for each refinery and support facility during the baseline period. This will be sufficient to allow for anticipated normal variation in operations. An additional 3 percent buffer was added to allow for possible near-term growth in demand for transportation fuels. The EIA projects that overall demand for transportation fuels in the Western United States will peak at a level 2.7 percent higher than the demand in 2015. After that projected peak, the improved mileage of the fleet overcomes increased vehicle miles traveled and overall demand is projected to decline over the long term.
- Annual emission limits for each facility are shown below.

[1] https://www.arb.ca.gov/cc/reporting/ghg-rep/reported-data/ghg-reports.htm

Table 12-16-301: GHG Emission Limits

Facility	**Maximum Emissions in 2011–2015 Baseline**[1] (metric tons CO_2e/yr.)	**Mean Emissions in 2011-2015 Baseline** (metric tons CO_2e/yr.)	**Standard Deviation in 2011-2015 Baseline** (metric tons CO_2e/yr.)	**Emissions Limits** (metric tons CO_2e/yr.)
Chevron Refinery A-0010	4.46 M	4.33 M	152 K	4.93 M
Shell Refinery A-0011	4.26 M	4.12 M	102 K	4.56 M
Phillips 66 Refinery A-0016	1.50 M	1.36 M	77.8 K	1.64 M
Tesoro Refinery B-2758/2759	2.44 M	2.27 M	161 K	2.83 M
Valero Refinery, B-2626 & Asphalt Plant, B-3193	2.94 M	2.77 M	105 K	3.18 M
Martinez Cogen LP A-1820	421 K	407 K	12.0 K	456 K
Air Liquide H2 Plant B7419	885 K	787 K	79.8 K	1.06 M
Air Products H2 Plant B-0295	271 K	240 K	28.0 K	333 K

M = Million, K = Thousand

[1]Maximum annual emissions from 2011 – 2015 baseline years, California Air Resources Board Emissions Inventory: Mandatory GHG Reporting - Reported Emissions, ARB Calculated Covered Emissions (metric tons CO_2e)

ADJUSTMENT OF REPORTED GHG EMISSIONS

Reported Greenhouse Gas Emissions may be adjusted for two reasons:

1. Emissions from sources operated solely to comply with District, State or federal air pollution control regulation. These sources must be built and operated after the adoption of this Rule, as designated by an Authority to Construct dated after the date of adoption of this Rule. An example would be a thermal oxidizer installed to control criteria pollutants but that increases GHG emissions by virtue of its energy consumption.
2. Emissions from sources that are authorized by an Air District Authority to Construct dated prior to January 1, 2017, but were not fully utilized or not in operation during the baseline period. If the APCO makes a Determination of Carbon Intensity Neutrality for the entire facility, the emissions attributed to increased utilization of these Permitted Future-Operational Sources will be subtracted from the Reported GHG Emissions. The intent of this provision is to allow refineries to follow through with projects that have been permitted. The Determination of Carbon Intensity Neutrality is intended as a safeguard against the possibility that these new projects would be employed to enable the refinery to process heavier, more polluting

crudes. This ensures that operation of these sources, though they may entail emissions in excess of the Rule 12-16 limits, is nevertheless consistent with the underlying purposes of the Rule to prevent increases due to changes in feedstocks.

The rule provides a process for making Reported GHG Emissions, and Adjusted GHG Emissions available for review by each Affected Facility and any members of the public who have requested notification. Each Affected Facility and members of the public have 14 days to comment, and the APCO may issue a final Adjusted GHG Emission determination as soon as 21 days from notification, including publication of the information on the District website, and notification to those interested.

EXCEEDANCE OF EMISSIONS LIMITS

If the Affected Facility's Adjusted GHG Emissions exceed the limit, the owner/operator must investigate to determine the primary cause and contributing factors for the exceedance. The exceedance will be a violation unless the APCO determines:

1. The necessary corrective action would result in adverse air quality impacts that exceed the air quality benefits of compliance, or
2. That conditions that caused the exceedance could not feasibly be addressed prior to the next major maintenance shutdown.

DETERMINATION OF CARBON INTENSITY NEUTRALITY

An Affected Facility may experience increases in GHG Emissions if Permitted Future-Operational Sources are more fully utilized, but within permitted limits, and generate increased GHG's. These are sources that were fully permitted or fully entitled before January 1, 2017, but may not have been operating at full capacity during the baseline period. The owner/operator may request the APCO to make a Determination of Carbon Intensity Neutrality so that any increased GHG emissions from these sources may be subtracted from the Reported GHG Emissions during the adjustment process, as described in Section 12-16-302.2. The owner/operator must provide all data needed to make the determination.

Baseline Carbon Intensity is representative for the Affected Facility operation during the baseline period, and normal variation of carbon intensity is determined for the baseline period. Carbon Intensity is calculated for the year with increased GHG Emissions. If the Carbon Intensity for the year in question is within the range of normal variation during the baseline period, the increase emissions from these sources may be subtracted from the Reported GHG Emissions during the adjustment process described in Section 12-16-302.

ADMINISTRATIVE REQUIREMENTS

If the Affected Facility's Adjusted GHG Emissions exceed the limit, Section 12-16-401 requires the owner/operator to investigate to determine the primary cause and contributing factors for the exceedance. When the APCO notifies the Affected Facility of a GHG Emissions Limit exceedance, the owner/operator has 60 days to submit a report describing the primary cause and contributing factors for the exceedance, and corrective measures that will be implemented to prevent recurrence as well as justification for any

corrective measures that were rejected. The report may include an explanation of why corrective measures would result in adverse air quality impacts, or could not feasibly be addressed prior to a next scheduled major maintenance shutdown.

Quarterly reports from each refinery are required, beginning May 1, 2018 to ensure each Affected Facility has a monitoring system in place to measure GHG emissions, and that each facility is on-track to achieve compliance at the end of the year.

Section 12-16-403 of proposed Rule 12-16 specifies that a refinery owner/operator may designate as confidential any information required to be submitted under the rule that is claimed to be exempt from public disclosure under the California Government Code. The owner/operator is required to provide a justification for this designation, and must submit a separate public copy of the document with the information that is designated "trade secret" redacted. These provisions are intended to facilitate processing of trade secret information by expediting release of related public information while helping ensure that trade secret portions are not inadvertently released. The purpose of Section 407 is purely administrative. Actual trade secret protections derive from the Government Code. The Air District's Administrative Code sets forth procedures for how the Air District will handle trade secret information that is responsive to Public Records Act requests.

COMPLIANCE DETERMINATION

Each Affected Facility will report emissions based on the requirements in Rule 12-15, Section 401. The APCO will review and approve the annual emissions inventory per Rule 12-15, Section 402. Compliance with Rule 12-16 is determined by comparing each facility's GHG emissions as set forth in the facility's inventory with the emissions limits in Section 12-16-300. If the inventory emissions, as adjusted are less than the limit, the facility complies. If the inventory emissions exceed the limit, the facility is out of compliance for the entire year and would be liable for a violation of the pollutant limit for each day of the calendar year.

The emissions limits shown for GHG Emissions in Rule 12-16, Section 300 may need to be adjusted for a variety of reasons:

- as GHG emissions measurement methods improve, especially for methane,
- as GHG emissions estimates for various process operations, startups, shutdowns, and malfunctions improve,
- as new regulations establish more restrictive limits on specific emissions sources, any resulting GHG emission reductions (or increases) will be subtracted from (or added to) the GHG emissions limits,
- to account for any other improvements in emissions inventory methods and reporting that are not yet anticipated.

Staff considered building an emissions limit adjustment process into the Administrative Requirements section of Rule 12-16, but decided that beyond the adjustments proposed for new sources required for compliance with new air quality regulations, and Carbon Intensity Neutrality, all other adjustments should require Board of Director's approval.

Rule 12-16 may need to be amended in the future to include a variety of adjustments in the emissions limits.

IV. ECONOMIC IMPACTS

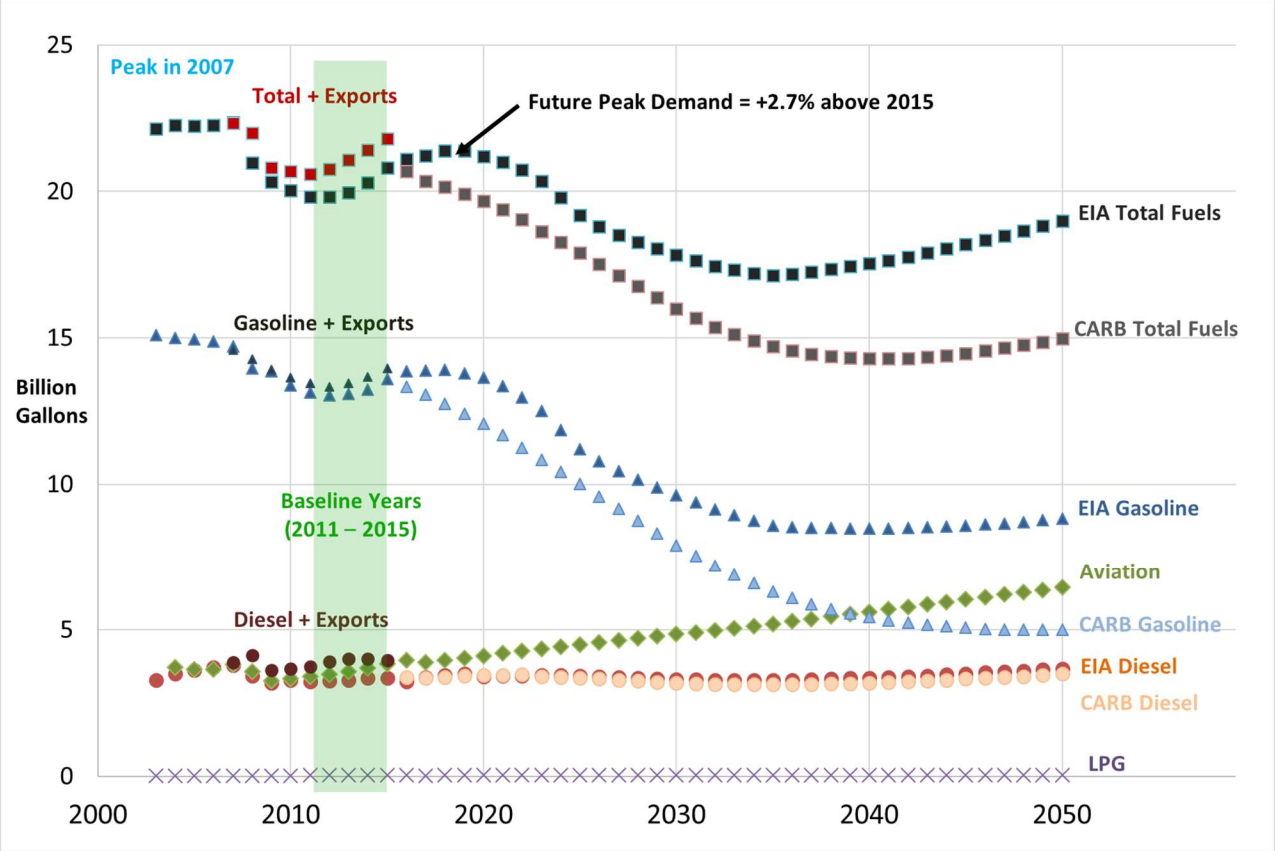
The California Health and Safety Code generally requires two different economic analyses for regulations planned and proposed by an air district. The first (H&S Code §40728.5) is a socioeconomic analysis of the adverse impacts of compliance with the proposed regulation on affected industries and business. The second analysis (H&S Code §40920.6) is an incremental cost effectiveness analysis when multiple compliance approaches have been identified by an Air District. Section 40920.6 applies only to rules requiring retrofit control technology. Since Rule 12-16 does not explicitly require installation of retrofit control technology, it is not possible to perform an incremental cost analysis.

Since the emissions limits in proposed Rule 12-16 are set at a level consistent with the full-capacity operation of the impacted facilities, they should be able to comply without incurring costs. Figure 3, below, provides the relevant information on California transportation fuel demand scenarios. In the case of increasing demand projections, the Energy Information Administration expects Pacific Region fuel demand to increase to a peak in 2018, then decline until ~ 2035. Gasoline demand is expected to reduce after 2020, aviation fuel demand shows a steady increase, and diesel demand is expected to be nearly flat. The California Air Resources Board also projects transportation fuel demand, and indicates a steady reduction in demand until ~2040.

Figure 3 also shows transportation fuel demand for the previous 10 years, including fuels exported to foreign markets. This data indicates demand for West Coast refineries peaked in 2007, including a relatively small volume of exported fuels. Total transportation fuel production was about 20.6 - 22 Billion gallons per year during the baseline period of 2011 – 2015. The highest projected demand scenario has total fuel demand at 21.4 Billion gallons in 2018. GHG emissions limits are set consistent with the Bay Area refining system’s ability to meet future transportation fuel demands.

In the second scenario, where one refinery has an unplanned outage, other refineries must increase production to supply the shortfall. If the refinery unplanned outage is two weeks (14 days) or less, the remaining West Coast refineries can supply the market from existing inventories, and make up the production needed. If the unplanned shutdown lasts longer than 2 weeks, alternate supplies from beyond the West Coast are needed, incurring significant shipping costs to bring in gasoline – from the U.S. Gulf Coast and potentially from as far away as Europe and Asia.

Figure 3: California Refined Fuel Demand



Sources:
http://www.energy.ca.gov/almanac/transportation_data/gasoline/
http://www.energy.ca.gov/almanac/petroleum_data/
https://www.eia.gov/outlooks/aeo/data/browser/#/
https://www.arb.ca.gov/planning/vision/vision.htm

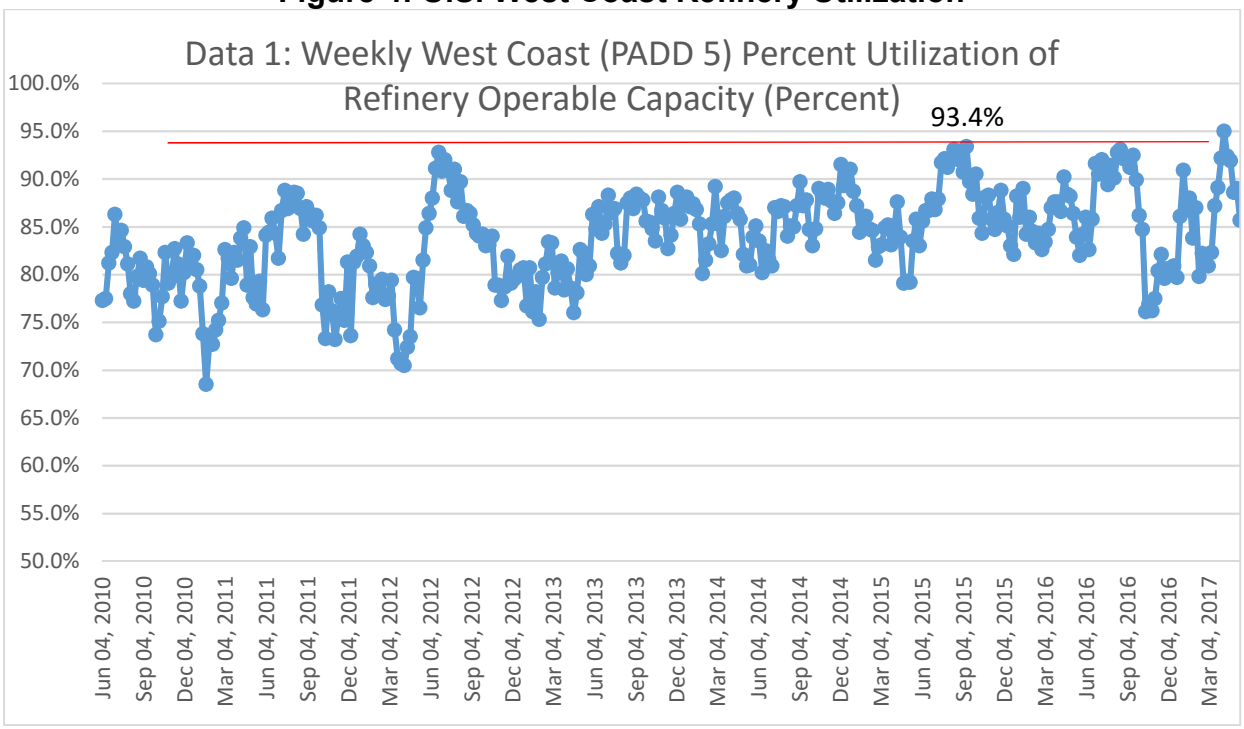
Staff also analyzed refinery operating utilization from the U.S. Energy Information Administration during the five-year baseline period from 2011 – 2015. This information is displayed on Figure 4, and is summarized in the Table 4 below:

Table 4: Average US West Coast Refinery Operating Utilization

Year	Average Utilization (%)	Peak Utilization (%)
2010	80.3	86.3
2011 – 2015	83.7	93.4
2011	80.7	88.8
2012	82.0	92.8
2013	83.4	88.6
2014	85.8	91.5
2015	86.5	93.4
2016	85.9	93.1

Note: Utilization data available for PADD 5 refineries, but not available for Bay Area refineries alone.

Figure 4: U.S. West Coast Refinery Utilization



Analysis of refinery utilization was performed to determine if the caps in Rule 12-16 would create a de facto production limitation for Bay Area refineries.

The data in Table 4 shows that the US West Coast refineries averaged 83.7 percent utilization during the 2011 – 2015 baseline period, ranging from an average utilization of 80.7 percent in 2011 to 86.5 percent in 2015. Refinery utilization increased in 2015, driven by higher gasoline and total fuel consumption, and by a significant refinery outage.[2]

[2] ExxonMobil's Torrance refinery was off-line from March 2015 – May 2016.

Refining utilization continued to be high in 2016. Peak refining utilization appears to be about 93.5 percent.

As described above, facility emissions limits were based on the average annual emissions during the baseline period. During this period, refinery utilization averaged 83.7 percent, and the highest annual utilization during the baseline period was 86.5 percent. The facility emissions limits have been established at the mean emission rate during the baseline period plus three times the standard deviation (normal variation in the data) to allow for normal year-to-year changes on an individual refinery basis, with an additional 3 percent added to ensure the refineries can meet the projected 3 percent increase in transportation fuel demand projected to peak in 2018. The resulting GHG Emissions limits are 7-15 percent above the peak GHG emissions from each refinery during the baseline period.

Given that the GHG emission limits are above peak refinery GHG emissions during the baseline period by more than 7 percent, they appear to be consistent with the current production capacity for the refineries as a group; Air District staff does not expect the cap in Rule 12-16 to have significant impacts on the market for refined fuels if fuel consumption is consistent with EIA projections or production capacity is not reduced by refinery closure or outage.

If one refinery on the West Coast experiences a significant, extended outage, a GHG emissions limit on Bay Area refineries may end up being a significant constraint on the market. When the supply for fuels is constrained, the impacts can be dramatic and felt statewide. In 2015, the ExxonMobil refinery in Torrance was offline for most of the year. This reduced refining production capacity in the state by roughly 10 percent. Because of this moderate reduction in supply, gasoline prices increased 27.6 cents over the typical cost of gasoline in California. The direct cost to the California economy was over $2 billion.[3] In addition, imports of refined products increased ten-fold, resulting in additional GHG emissions from shipping.

A. Socioeconomic Impact Analysis of Rule 12-16

The analysis of the socioeconomic impacts of proposed Rule 12-16 focus on whether the GHG Emission Limits create a production limit at each refinery that could impact supply-demand balance for transportation fuels.

Limiting Refinery Production

District staff analyzed a variety of data sources on refinery capacity and utilization, and observed that emissions limits contemplated in proposed Rule 12-16 do not appear to inhibit refining capacity, as the caps in the proposed rule appear to be consistent with the current maximum production capability of area refineries. Based on an analysis of US Energy Information Administration's (EIA) and the California Air Resources Board's year 2050 projections of demand in California for a variety of types of delivered energy (i.e. motor gasoline, jet fuel, liquid petroleum gases, kerosene, distillate fuel oils, etc.),

[3] Gonzales, Dan, Timothy Gulden, Aaron Strong and William Hoyle. Cost–Benefit Analysis of Proposed California Oil and Gas Refinery Regulations. Santa Monica, CA: RAND Corporation, 2016.

BAAQMD projected the amount of fuel that the five Bay Area refineries would need to generate each year beyond 2015, to fulfill either EIA's or CARB's demand projections. BAAQMD then determined that GHG emissions generated by refineries' activity associated with either EIA's or CARB's projections would not exceed the proposed annual limit of 19 million metric tons contemplated in Rule 12-16. Thus, the proposed GHG limits should not inhibit the refining system as a whole in meeting future transportation fuel demand.

BAAQMD staff also reviewed whether the imposition of a GHG emissions limit would render the region at greater risk to supply disruptions that could result upward spikes in the price of fuel in the short-term or long-terms. In other words, staff sought to determine whether there is enough slack in the refining system to be able to weather an unplanned outage of a limited duration. BAAQMD determined that any lack of supply due to an unplanned outage of no more than two weeks at one refinery for could be made up from other refineries in PADD 5, as well as the four remaining refineries operating in the Bay Area.[4] One caveat BAAQMD staff noted was that incidents on the order of the Chevron fire of 2012 or the Exxon-Mobil FCC explosion in Southern California in 2015 could result in significant disruptions to supply.

Another caveat expressed by District staff is that they do not expect the cap in Rule 12-16 to have significant impacts on the market for refined fuels so long as fuel consumption does not significantly increase above level projected by either EIA and CARB. Consumption for fuel can increase in absolute and relative terms for a variety of reasons, with a corresponding increase in price of fuel at the retail level. For example, population growth and an increase in the number of persons commuting into the area would result in greater demand for fuel whose supply could be limited by proposed Rule 12-16, resulting in a bidding-up of the price of fuel.

While the impact of a limited supply of refined product relative to demand on the retail price of fuel is observable in that prices tend to go up, how much prices increase can vary widely. Price spikes tend to be an inherent, if latent, feature of the oil refining-gasoline consuming activity, due to the combined facts that people tend to keep buying gas to drive their cars to work and other places even as the price of gas rises, and that California refineries tend to operate very close to capacity, meaning that refineries are unable to boost supply significantly when they need to. As Borenstein notes, “The market can easily become out of balance if there is an unexpected jump in demand, or more commonly, if a refinery experiences a supply disruption or outage and output is reduced.”[5] Thus, in the case of the temporary shut-down of the southern Californian refinery in Torrance in 2015, BAAQMD staff quoted a California Energy Commission report that found that the 10 percent reduction in supply led to 27.6 cents increase in the cost of gasoline.[6] ADE estimates that between February 12, 2015 and March 13, 2015 the average price of gasoline in the City of Los Angeles increased by 32 percent as a result of the Torrance

[4] PADD5 = “PADD 5” refers to a US EIA acronym for “Petroleum Administration for Defense Districts 5”, which consists of the states of Alaska, Washington, Oregon, California, Nevada, and Arizona.
[5] Borenstein, Bushnell, and Lewis, “Market Power in California’s Gasoline Market” (May 2004), page 8
[6] Bay Area Air Quality Management District, Draft 12-16 and Draft 11-18 (Draft Staff Report: October 2016) page 23 (citing California Energy Commission)

shutdown, which occurred on February 18, going from $2.65 a gallon to $3.51 a gallon.[7] The peculiarities of the California market also explain the magnitude of price increases in California when supply shocks occur. By way of example, Phoenix, Arizona in 2003 experienced a 30 percent drop in volume resulting from a pipeline failure, which then led to a 37 percent increase in price of gas in Phoenix.[8] The FTC observed that prices in Phoenix in 2003 did not rise even faster largely because West Coast refineries were able to ship more gasoline into Arizona to hold down prices. The unique blend required in California makes it difficult (but not impossible) to ameliorate the effects of supply shocks along the lines of Phoenix in 2003, which perhaps explains why in one instance a ten percent drop in supply in southern California leads to almost 32 percent increase in price while a steeper 30 percent supply drop in Phoenix at another instance led to 37 percent price increase there.[9]

While the Torrance and the Phoenix examples demonstrate prices could rise by 32 to 37 percent in a short-time due to supply cuts, projecting changes to price following supply shocks is still not an exact science. One could apply the Torrance and Phoenix examples to roughly estimate price impacts. Thus, if production at refineries is capped per the limits contemplated in proposed Rule 12-16, then a percentage increase in population over some time period would be equivalent to a reduction in supply of gasoline by a similar percentage over the same period. Since ABAG projects the nine-county San Francisco Bay Area region to grow by 9.2 percent over the ten-year 2015-2025 period, when we apply the Torrance example, we arrive at an estimated 29.4 percent increase in price over the same ten-year period.[10] This price increase would average less than three percent a year, which would have a cumulative effect but would be much less than a short-term price shock such as occurred in the Torrance incident, or other price fluctuations that occur due to market conditions. For example, in January 2015, regular gasoline in California cost $2.68 per gallon, of which $1.29 was attributable to the price of crude oil purchased by the refinery. Six months later, a gallon of regular gas was $3.45, of which $1.45 was attributable to crude oil, for a 12 percent increase over a six-month period in the cost of a gallon of gas attributable to crude oil.[11] The overall price of gas in this six month-period increased by 29 percent, from $2.68 to $3.45 a gallon.

In short, proposed Rule 12-16 would introduce a regime to limit the production of refined petroleum products, but for various reasons, the price of these refined products can go up and down, consequently lessening the effect in modelling the socioeconomic impacts of a limit on the production of refined petroleum products supply on the wider economy.

---

[7] GasBuddy California http://archive.is/tlKBy

[8] Federal Trade Commission, Gasoline Price Changes: The Dynamic of Supply, Demand, and Competition (2005), page 29

[9] While it is true that California's market for refined product is almost a closed market due to the special blends generated only for Californians, there are some refiners outside of California who produce to California's standard, although delivery of their products takes 2 to 5 weeks and entails prohibitive transport costs. See Borenstein, Bushnell, and Lewis, "Market Power in California's Gasoline Market" (May 2004), page 20 ; see also US EIA, "California's gasoline imports increase 10-fold after major refinery outage" (October 2015) http://archive.is/oRGoI

[10] See http://archive.is/qGomH: The nine-county San Francisco Bay Area region is projected to grow over the ten-year 2015-2025 period by 672,600 persons, from 7,461,400 to 8,134,000. Including estimated number of non-residents commuting daily into the Bay Area for jobs, the total number of persons in the Bay Area will go from 7,938,800 in 2015 to 8,668,700 in 2025, for a 9.2 percent increase over the ten-year 2015-2025 period.

[11] See http://bit.ly/2mkDgLW

Small Business Disproportionate Impacts

According to the State of California, among other things, small businesses generate annual sales of less than $10 million.[12] Of the eight sources affected by the proposed rule, none are small businesses. As a result, small businesses are not disproportionately impacted by proposed Rule 12-16.

V. REGULATORY IMPACTS

The previous version of Rule 12-16 included a cap on criteria pollutant emissions. The criteria pollutant limits have been removed from this version of the rule which largely eliminates the Air District's Staff's significant concerns about the legal defensibility of the rule. The current rule focuses on GHG emissions. This would not conflict with Air District, state and federal requirements for new source review permitting.

The only potential regulatory conflict is with the statewide Cap-and-Trade program. However, CARB has expressed support for Rule 12-16 as an approach that "could help to ensure that these sources do not add to the state's overall emissions of greenhouse gases and criteria or toxic pollutants."[13] Also, since the limits are set high enough to be consistent with the full-capacity operations of the refineries, the rule would not interfere with the refineries' ability to participate in Cap-and-Trade as they are currently configured. Moreover, the rule is consistent with the draft Scoping Plan that calls for significant decreases in refinery carbon intensity.

A fixed GHG cap that would prevent increases in refinery GHG emissions may also limit potential increases of refinery criteria pollutants emissions from associated sources. An initial report by the California Office of Environmental Health Hazard Assessment (OEHHA) on emissions from facilities in various industrial sectors, including petroleum refining, found moderate correlations between GHG and criteria pollutant emissions.[14] GHG emissions at refineries are predominantly associated with combustion processes, which also generate emissions of criteria pollutants. Although Rule 12-16 would not reduce refinery GHG emissions, the rule would prevent increases in GHG emissions, which may also, to some extent, limit increases in criteria pollutant emissions and associated localized and regional exposures to these pollutants.

On a regional scale, constraints to increases in refinery criteria pollutant emissions may also limit increases in refinery contributions to regional levels of criteria pollutants, such as $PM_{2.5}$. The Air District estimates that refinery emissions contribute to approximately 5 percent of the annual-average total $PM_{2.5}$ concentrations in the Bay Area.[15] This estimate

[12] http://www.leginfo.ca.gov/cgi-bin/displaycode?section=gov&group=14001-15000&file=14835-14843
[13] Letter from Richard W. Corey, Executive Officer, CARB to Jack Broadbent, Executive Officer, BAAQMD, April 5, 2017.
[14] OEHHA, 2017. Tracking and Evaluation of Benefits and Impacts of Greenhouse Gas Limits in Disadvantaged Communities: Initial Report. February.
[15] BAAQMD, 2017. Final 2017 Clean Air Plan. Adopted April 19, 2017.

includes contributions to both primary and secondary $PM_{2.5}$ from refinery emissions. On a localized scale, the relationship between facility-wide emissions levels and potential localized impacts is much more complex. Because $PM_{2.5}$ from refineries is produced predominantly from combustion, the resulting $PM_{2.5}$ is sent aloft, and therefore typically contributes to regional $PM_{2.5}$ as opposed to producing localized impacts, such as those associated with wood smoke or diesel engines. It is possible that some combustion sources may have localized impacts depending on the stack height of the specific source, local meteorology, and topography of the surrounding area. While Rule 12-16 may limit the increase of regional impacts, any constraints on potential localized impacts would be highly dependent on the specific conditions of the individual source, facility, and surrounding area.

In conclusion, Rule 12-16 is compatible with statewide efforts to limit refinery pollution and will prevent significant increases in pollutants with global impact (GHG) and pollutants with localized and regional impact (criteria pollutants such as $PM_{2.5}$).

VI. THE RULE DEVELOPMENT / PUBLIC PARTICIPATION PROCESS

The publication of this document is intended to support the initial public comment portion of the development of these two rules. Key milestones dates for the rest of the process are as follows:

November 9, 2016	Open House in Richmond
November 10, 2016	Open House in Oakland
November 14, 2016	Open House/Scoping Meeting in San Francisco
November 15, 2016	Open House in San Jose
November 16, 2016	Open House/Scoping Meeting in Martinez
November 17, 2016	Open House in Fremont
December 2, 2016	Comment deadline for draft rules and NOP/IS
March 24, 2017	Final rules, staff report, draft EIR published for comment
March 27, 2017	Workshop in Cupertino
March 28, 2017	Workshop in Benicia
March 29, 2017	Workshop in Hayward
March 30, 2017	Workshop in Richmond
May 8, 2017	Comment deadline for final proposed rule
May 25, 2017	Board Package, including Final Staff Report, Responses to Comments, and final rule language published

May 31, 2017	Public Hearing - Board continuation of Public Hearing to revise proposed Rule 12-16 to establish GHG Emission Limits only.
June 6, 2017	Publication of revised rule, staff report and socioeconomic report.
June 12, 2017	Comment deadline for revised proposed rule
June 21, 2017	Continued Public Hearing on revised proposed rule

IV. CONCLUSION / RECOMMENDATION

Pursuant to the California Health and Safety Code Section 40727, before adopting, amending, or repealing a rule the Board of Directors must make findings of:

- Necessity,
- Authority,
- Clarity,
- Consistency,
- Non-duplication, and
- Reference.

The Air District staff believes Rule 12-16 as currently proposed meets the requirements of this statue for the reasons listed below.

Necessity:

The proposal is necessary because neither top-down nor market-based approaches to climate protection have proven effective in sufficiently reducing climate pollutants[16] and there are no finalized plans to impose a carbon tax nor direct regulation of industrial sources of GHGs. Because there has been two decades of efforts without significant demonstrable progress on the state, federal or international levels, it is imperative / necessary for local governing agencies such as the Air District with the political will to do as much as legally possible to regulate GHG emissions. Because of this imperative, the Air District is compelled to act within its authority to limit and reduce GHG emissions from refineries and other significant sources to achieve short-term, interim, and long-term GHG reduction goals until such efforts are no longer necessary.

- International Treaties: Little to no progress has been made since the ratification of the 1997 Kyoto Protocol was adopted in Kyoto, Japan, on and became effective in 2005. Although the United States was a signatory to the Protocol, it has never been ratified. While, the U.S. also entered into the Paris Accord, on June 1, 2017, the current President announced that the United States will withdraw from the Paris climate agreement, rejecting the climate agreement significantly compromises the

[16] Air District GHG emissions projection indicate that stationary source GHG emissions will not achieve the short term 2020 goal of 1990 emissions.

nearly 200-nation pact that brings the world's countries together in the fight against climate change.

- Market-Based Approach: The State's Cap-and-Trade approach to reducing GHGs from various industrial sectors have yet to produce significant reductions from the refineries in the Bay Area. Changes in GHG emissions from the petroleum refining industrial sector have not been the result of regulation—but primarily due to economic and market forces, relating more to the state of the economy, with decreases since the passing of AB 32 related to the downturn in the economy and more currently, trending to increase as the economy improves.

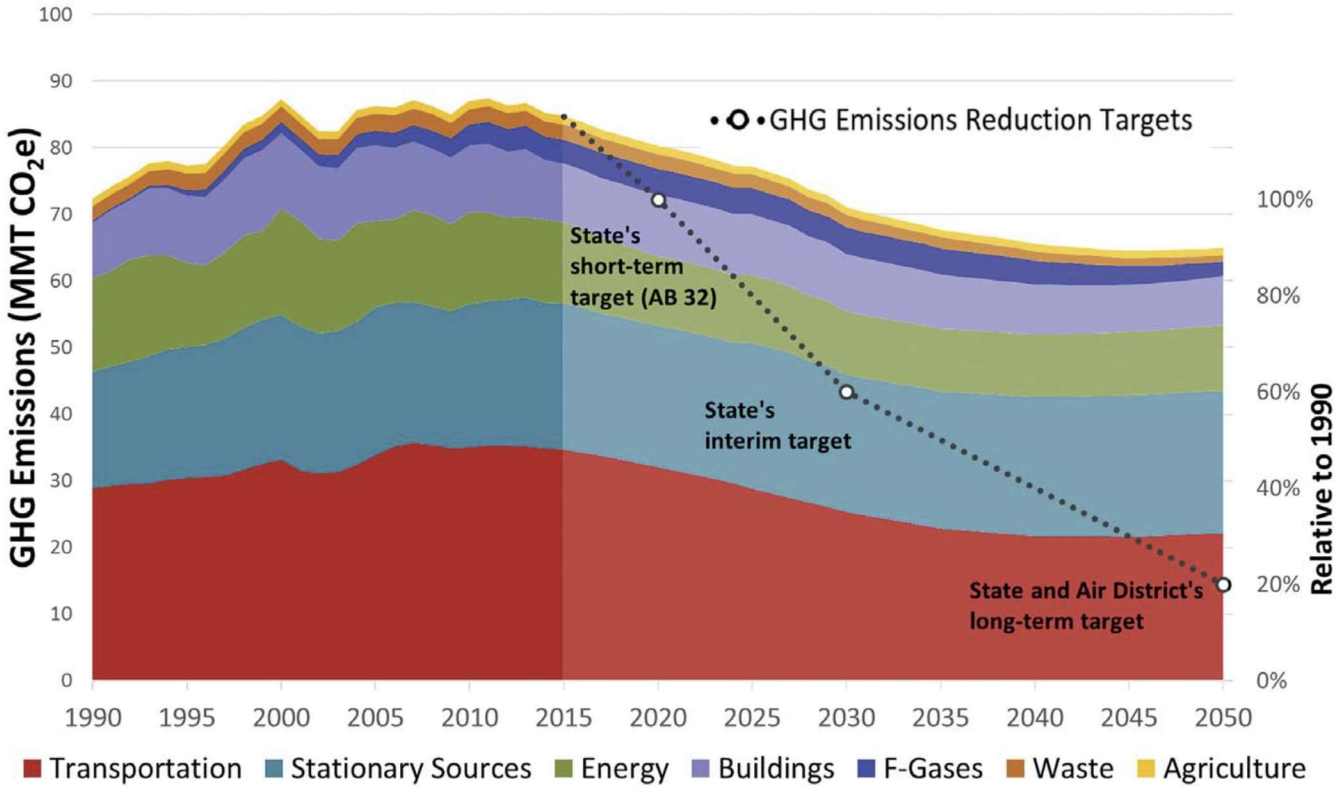
- No Direct State Regulation of Refinery GHG Emissions: Since the passing of AB 32, in 2006, CARB has not adopted any regulation that directly limits or reduces the GHG emissions from refineries. Up to this point, the State has solely relied on market forces via Cap-and-Trade to address GHG emissions from this sector. It is imperative to ensure that GHG emissions are limited as soon as possible to curtail increases in GHG emissions from major sources such as refineries in our efforts to control the contributing pollutants to anthropogenic climate change.

- Global Pollutant, Locally Emitted: While it is accepted that GHGs collectively have a global impact, these pollutants are emitted locally from various sources, including mobile / fuel, stationary source / industrial, energy, agricultural, water, waste management, and natural lands sectors. Historically, the stationary sources are controlled most effectively at the local level by the agencies most familiar with them, that have a long history regulating their emissions – the local air districts.

- Necessary First Step to Limiting GHG Emissions: Limiting GHG emissions from refineries is a needed first step to ensure that as demand for transportation grows and crude and product slates change, GHG emissions from this significant source does not erase any progress made in the last few years while CARB and the Air District look for additional ways to limit or reduce GHG emissions.

- State and Air District Interim and Long-term GHG Reduction Targets: In 2013 the Air District adopted a long-term GHG emissions reduction goal of 80 percent of 1990 levels by 2050. Recently, in the 2017 Clean Air Plan, the Air District adopted the interim GHG reduction goal of 40 percent reduction by 2030. These goals are consistent with the State's interim and long-term GHG reduction goals. AB 32 also established a short-term goal of reducing the State's GHG emissions to 1990 levels by 2020. Figure 3-9 from the Air District Clean Air Plan shows that we are NOT on-track to meet the 2020 goal, and dramatic reductions are needed in less than 13 years to achieve the 2030 goal.

Projected Bay Area GHG Emissions by Sector Based on State Policies, (100-year GWP)



- Achieving Adopted Goals: To achieve these goals, major sources of GHG emissions in the Air District would have to make significant reductions in their GHG emissions. Air District emissions inventory indicates that refineries were responsible for 68 percent of the stationary source GHG emissions in 2015. The following table illustrates the annual emissions and percent emission reduction needed if refineries were to proportionate reduce their GHG emissions to meet the short-term, interim and long-term goals.

Refinery GHG Emissions Projections Based on State and Air District GHG Goals

Calendar Year	**State and/or Air District GHG Reduction Goals** (relative to 1990)	**Refinery GHG Emissions** (MMT CO_2e)	**Percent Reduction of 2015 GHG Emissions needed**	**Percent Reduction needed each year**
2015	n/a	14.5	n/a	n/a
2020	100%	11.6	20%	5%
2030	40% Below	7.2	50%	3%
2050	80% Below	2.2	85%	1.75%

The Air District's best estimated projections show that the Air Basin would not achieve its goals for 2020, 2030, nor 2050 even considering state policies and regulations already adopted, as well as those that are likely to be adopted and implemented over the next ten to 15 years.[17] To successfully implement many of the state policies and regulations, the State will need cooperation and assistance from the regional and local agencies.[18] The finding of necessity is further discussed in Appendix A to the Staff Report.

Authority:

California law gives the Air District "primary responsibility" for control of "air pollution" from stationary sources within its jurisdiction (H&SC § 40000), with "air pollutant" defined to include, among other things, "carbon" and "gases" (H&SC § 39013). This designation of authority to the air districts is independent of the federal Clean Air Act's coverage of GHG emissions, and is fully independent of EPA's authority in this area. Similarly, it does not depend upon any aspect of CARB's authority over GHGs or other pollutants. AB 32 specifically included a provision preserving the Air Districts' preexisting authority over GHG emissions (H&SC § 38594). The Air District is also expressly allowed to set standards more stringent than those in State law (H&SC § 39002). Air districts therefore have authority to regulate GHGs from stationary sources which have been the subject of State legislation and CARB rules, and to impose stricter GHG emission standards on these sources. The authority under which this rule is proposed is further discussed in Appendix A.

Clarity:

Proposed new Regulation 12, Rule 16 has been written or displayed so that its meaning can be easily understood by the persons directly affected by them: the five Bay Area refineries:

1. Chevron Products Company, Richmond (BAAQMD Plant #10)
2. Phillips 66 Company—San Francisco Refinery, Rodeo (BAAQMD Plant #21359)
3. Shell Martinez Refinery, Martinez (BAAQMD Plant #11)
4. Tesoro Refining and Marketing Company, Martinez (BAAQMD Plant #14628)
5. Valero Refining Company—California, Benicia (BAAQMD Plant #12626) and associated Asphalt Plant (BAAQMD Plant #13193)

And the three affected, refinery-related facilities are:

1. Air Products and Chemicals hydrogen plant, Martinez (BAAQMD Plant #10295)
2. Air Liquide hydrogen plant, Rodeo (BAAQMD Plant #17419)
3. Martinez Cogen, L.P. (BAAQMD Plant #1820).

[17] Potential emission reductions from additional stat actions that may be included in the 2017 Scoping Plan update are not reflected in this analysis.
[18] Bay Area Air Quality Management District, 2017 Clean Air Plan, p. 3-19.

Consistency

The propose rule is consistent with the California Global Warming Solution Act (H&SC Section 38500 et seq.) Cap-and-Trade Program, which is currently the only statewide regulation that addresses GHG emissions from refineries. Under Cap-and-Trade, each refinery is allowed a certain amount of GHG emissions—this is the refinery's GHG "allowance." If a refinery were to exceed its allowance, it must purchase GHG emission credits to cover the amount of GHG emission in excess of its allowance. If a refinery operates below its allowance, the difference between its GHG emissions and its allowance generates credits for that refinery that can be sold on the credits market. As written, proposed Rule 12-16 does not interfere with the Cap-and-Trade program. A refinery can operate both under the GHG emission limits and its allowance under Cap-and-Trade. In this sense, proposed Rule 12-16 is in harmony with the Cap-and-Trade program because Rule 12-16 encourages refiners to minimize the refineries' GHG emissions, which can help to generate GHG credits, which can be used in the Cap-and-Trade program. However, if a facility were to exceed its GHG emissions limit under Rule 12-16, it could not utilize credits under Cap-and-Trade to meet its 12-16 obligation.

Non-Duplication

Proposed Rule 12-16 meets the non-duplication finding because there is no other federal or state rule or regulation that directly limits GHG emissions petroleum refineries and, therefore, do not impose duplicative requirements and the requirements of proposed Rule 12-16 are necessary to execute the powers and duties granted to the Air District.

Reference

Both the State of California and the Air District have established GHG emission reductions goals, pursuant to the California Health and Safety Code. Proposed Rule 12-16, which is one step toward the achievement of these goals, is authorized under H&SC Sections 38594, 39002, 39013, and 40000.

A socioeconomic analysis prepared by Applied Development Economics, Inc. has found that the proposed rule should not have a significant economic impact or cause regional job loss. A revised California Environmental Quality Act (CEQA) Environmental Impact Report prepared by Environmental Audit, Inc., concludes that the proposed rule would not result in adverse environmental impacts. Air District staff has reviewed and accepted this analysis as well. The CEQA document was made available for public comments and one comment was submitted. The comment and response are found at the end of Appendix C: CEQA Environmental Impact Report.

The proposed new Rule 12-16 has met all legal noticing requirements, has been discussed with the regulated community and other interested parties, and reflect the input and comments of many affected and interested stakeholders. Air District staff recommends adoption of proposed new Rule 12, Regulation 16: Petroleum Refining

Facility-Wide Greenhouse Gas Emission Limits; and adoption of the revised CEQA Environmental Impact Report.

APPENDIX A
SUPPLEMENT TO REGULATORY FINDINGS

APPENDIX A: SUPPLEMENT TO REGULATORY FINDINGS

The Air District derives its regulatory authority from the Health and Safety Code. Before adopting, amending or repealing a rule or regulation, the Air District Board must make findings of authority, necessity, clarity, consistency, non-duplication, and reference, as defined in the Health and Safety Code (H&SC § 40727. Required findings). The following sections describe support for these findings regarding Proposed Rule 12-16.

Authority and Reference

In 2007, the U.S. Supreme Court ruled that greenhouse gases (GHGs) qualified under the federal Clean Air Act's definition of an "air pollutant" (*Massachusetts v. Environmental Protection Agency*). The Clean Air Act originally named six known pollutants, including ground-level ozone, particulate matter, carbon monoxide, lead, sulfur dioxide and nitrogen dioxide, but also established a process called the "endangerment finding" for the Environmental Protection Agency (EPA) to decide whether additional pollutants should be regulated under the act. In 2009, EPA issued its "endangerment finding" on GHGs stating that current and projected levels of six GHGs threaten the health and human welfare of current and future generations. EPA began regulating GHG emissions under the Clean Air Act from mobile and stationary sources with its *Light-Duty Vehicle GHG Standards and Corporate Average Fuel Economy Standards Rule* (LDV Rule) in 2010, and its *Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule* (Tailoring Rule) in 2011. The Tailoring Rule required major new and modified pollution sources such as power plants and factories to use the best available technology to limit carbon emissions. In 2014, the U.S. Supreme Court upheld EPA's authority to issue regulations targeting GHG emissions from mobile and stationary sources, though it narrowed slightly the scope of its Tailoring Rule (*Utility Air Regulatory Group v. Environmental Protection Agency*).

Regulatory efforts aimed at curbing GHG emissions began earlier in the State of California. In 2005, Governor Schwarzenegger's Executive Order (EO) S-3-05 set the following GHG emissions reduction targets for the State of California:

- By 2010, reduce GHG emissions to 2000 levels
- By 2020, reduce GHG emissions to 1990 levels
- By 2050, reduce GHG emissions to 80 percent below 1990 levels

EO S-3-05 also laid out implementation and reporting responsibilities among the state agencies, including the California Air Resources Board (CARB). In 2006, Assembly Bill 32 (AB 32), the *California Global Warming Solutions Act of 2006* (Nuñez, Chapter 488, Statutes of 2006), codified into statute the short-term GHG reduction target outlined in EO S-3-05. AB 32 requires the State of California to address climate change by reducing its GHG emissions to 1990 levels by 2020. In 2016, the California legislature passed the Senate Bill (SB 32), the *California Global Warming Solutions Act of 2016: emissions limit* (Pavley, Chapter 249, Statues of 2016), which codified into statute the GHG emissions reductions target of 40 percent below 1990 levels by the year 2030 contained in Governor Brown's EO B-30-15. Along with SB 32, the Legislature passed companion legislation

AB 197, which requires CARB to consider the social costs of GHG emissions and to prioritize direct emission reductions at large stationary sources, and from mobile and other sources. In addition, AB 197 requires annual posting of GHG, criteria and toxic emissions at the local and sub-county levels for stationary sources, and at least at the county level for mobile sources. These requirements are intended to protect the State's most impacted and disadvantaged communities and to ensure the transparency of the State's GHG reduction actions.

As discussed above, the authority to regulate GHG emissions from all sources is granted to federal agencies by the Clean Air Act, and to the State of California by the AB 32 and SB 32 statutes. However, the Air District has authority independent of that vested in both the State and federal agencies to regulate greenhouse gases.

California law gives the Air District "primary responsibility" for control of "air pollution" from stationary sources within its jurisdiction (H&SC § 40000), with "air pollutant" defined to include, among other things, "carbon" and "gases" (H&SC § 39013). This designation of authority to the air districts is independent of the federal Clean Air Act's coverage of GHG emissions, and is fully independent of EPA's authority in this area. Similarly, it does not depend upon any aspect of CARB's authority over GHGs or other pollutants. AB 32 specifically included a provision preserving the Air Districts' preexisting authority (H&SC § 38594). The Air District is also expressly allowed to set standards more stringent than those in State law (H&SC § 39002). Air districts therefore have authority to regulate GHGs from stationary sources which have been the subject of State legislation and CARB rules, and to impose stricter GHG emission standards on these sources.

Based on this authority, the Air District has already adopted GHG emission reduction goals, and passed a regulation related to GHG emissions from stationary sources. The Air District has, since 2008, implemented a fee program (Regulation 3, Schedule T) for GHG emissions that requires permitted facilities, including refineries, to quantify emissions of GHG emissions for inventory and fee purposes. In 2013, the Air District adopted a long-term GHG emissions reduction goal of 80 percent of 1990 levels by 2050. Recently, in the 2017 Clean Air Plan, the Air District adopted the interim GHG reduction goal of 40 percent reduction by 2030. These goals are consistent with the State's interim and long-term GHG reduction goals established by AB 32 and SB 32.

Necessity

There is a section in the H&SC that describes the criteria to establish a necessity finding for rules or regulations that apply to criteria air pollutants (H&SC § 40001(c). Rules and regulations). It reads "Prior to adopting any rule or regulation to reduce criteria pollutants, a district shall determine that there is a problem that the proposed rule or regulation will alleviate and that the rule or regulation will promote the attainment or maintenance of state or federal ambient air quality standards." Although Section 40001(c) is not necessarily applicable to GHGs, a necessity finding for Proposed Rule 12-16 should be analogous.

In broad terms, Proposed Rule 12-16 addresses climate change, the long-term change in Earth's climate largely attributed to the increase in anthropogenic GHG concentrations in the atmosphere. Climate change undoubtedly poses one of the most serious threats to the well-being, public health, natural resources, economy, and the environment of our planet. It is already affecting California and the Bay Area, and is predicted to result in the worsening of heat waves, drought, loss of snowpack, sea level rise, more frequent and intense wildfires, more severe smog, and harm to natural and working lands already occurring.[19]

The Intergovernmental Panel on Climate Change (IPCC), the international authority on the issue, concluded in its Fifth Assessment Report[20], issued in 2014, that "warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia" and that "continued emission of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems." Furthermore, the IPCC states that *aggressive and immediate GHG emissions reductions* are needed to limit the average global warming to under 2 degrees C by 2050 and avoid potentially catastrophic climate change impacts.

Though GHG have global effects, these pollutants are emitted locally from various sources, including the mobile, stationary source, energy, agricultural, water, waste management, and natural lands sectors. Refineries are the largest emitters of GHG emissions from the stationary source sector, both in the State of California and in the Bay Area. Historically, stationary sources of air pollutants are controlled most effectively at the local level. Local air districts, such as the Bay Area Air District, have the most expertise and familiarity with these sources and have a long history regulating their emissions. As discussed in the previous section, air districts have the primary regulatory authority for stationary sources of GHG emissions.

As explained below, Proposed Rule 12-16 is necessary and effective in avoiding increases in GHG emissions from Bay Area refineries that potentially could occur due to changes in processed crudes and that would prevent the State of California and the Air District from meeting their interim and long-term climate goals.

1. Bay Area refinery GHG emissions may increase with no Air District action

The refining sector is unique among all the source categories of GHG in the Bay Area. First, this sector includes the largest stationary sources of GHG emissions in the Air District. The top four sources of GHG emissions in the Air District are all refineries, with the fifth refinery ranking among the top ten GHG sources. While refineries represent around 18 percent of all Bay Area GHG emissions, they account for approximately 70 percent of GHG emissions from stationary sources, where the Air District's primary

[19] OEHHA (2013) Indicators of climate change in California. Available at: https://oehha.ca.gov/media/downloads/risk-assessment/document/climatechangeindicatorsreport2013.pdf
[20] IPCC (2014) Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the IPCC. Available at: https://www.ipcc.ch/report/ar5/syr/

regulatory authority resides.[21] Second, the refining sector is also subject to a unique set of circumstances that could lead to emissions increases This distinguishes refineries from other sectors of significant GHG-emitting stationary sources, and is the primary reason why adoption of a rule preventing increases in GHG emissions from refineries is a necessary and appropriate first step in the Air District's efforts to achieve GHG emissions reduction goals.

After refineries, the next largest stationary sources of GHG emissions are power generating facilities. These facilities are already subject to multiple requirements that can prevent increases in their GHG emissions, including the following:

- California's Renewable Portfolio Standard (RPS), which requires that 50 percent of the State's electricity be generated from renewable energy by 2030.
- SB 1368 (Perata, Chapter 598, Statutes of 2006) requires that baseload electricity generation owned by, or under long-term contract to, publicly owned utilities, meet a 1,100 pounds of carbon dioxide per megawatt-hour (lbs CO_2 / MWh) limit. This bill was passed to encourage reliance on power plants that minimize their emissions of GHG, and it prohibits facilities from switching to fossil fuels that generate higher GHG emissions.
- Recently constructed electricity generating facilities have operational limits such as startup and shutdown limits, co-pollutant caps, and one facility, Russell City Energy Center, already has a GHG limit. These startup and shutdown limits and co-pollutant and GHG emissions caps help act as a backstop limiting operations to a certain level.

It is also important to note that the power generating sector is not facing a situation analogous to refineries in which a change in the method of operations (in the case of refineries, possible changes to crude slate characteristics) could lead to systemic increases in emissions. The relatively advanced state of GHG regulation and the absence of factors indicating possible increases in emissions put the power generating sector in a lower priority position for GHG regulation by the Air District.

Currently, there are no regulations in place that would prevent GHG emission increases at refineries. There are several Air District rules targeting criteria air pollutant emissions from refineries, including recently adopted rules to reduce PM from FCCUs (Rule 2-5), VOC from equipment leaks (Rule 8-18) and SO_2 from coke calcining operations (Rule 9-14). While refinery criteria pollutant emissions have declined over time, refinery GHG emissions have been relatively constant over the last few years.[22]

[21] BAAQMD (2017) 2017 Clean Air Plan: Spare the Air, Cool the Climate. Chapter 3. Available at: http://www.baaqmd.gov/~/media/files/planning-and-research/plans/2017-clean-air-plan/attachment-a_-proposed-final-cap-vol-1-pdf.pdf?la=en

[22] According to CARB's GHG mandatory reporting data from 2008 through 2015.

Changes in crude slate or facility operations

Oil 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. Carbon intensity is the amount of CO_2 emitted for each unit of product generated or input processed (e.g., pounds of CO_2 emitted per kW of electricity generated for a power plant). The carbon intensity of a refinery is directly related to its energy consumption. The most thorough methodology to calculate the carbon intensity for the refining sector needs to account for the CO_2 emissions from all energy inputs.

In its proposed workshop report for Proposed Rule 13-1,[23] Air District staff calculated preliminary baseline carbon intensities for each refinery, using CARB GHG emissions for refineries and support facilities, and reasonable estimates of crude and non-crude oil throughput. These carbon intensities were calculated using the baseline period years of 2013 – 2015, though years representing abnormal operation for a refinery were substituted with an alternate year representing normal operation. No adjustments were made for net import of power, hydrogen or steam from external entities since that information was unavailable at the time of the workshop report. Crude throughput estimates are based on 90 percent utilization of each refinery's nameplate crude capacity found on the US EIA website.[24] No non-crude oil feedstocks are included for typical refinery operations, except one refinery that receives pipeline shipments of gas oil regularly. The carbon intensity calculations include adjustments for expected GHG emissions reductions from feasible and cost-savings energy improvement projects that were not implemented during the baseline period. The proposed workshop report describes the methodology for these calculations in more detail.

These preliminary baseline carbon intensity calculations showed that carbon intensity varies greatly among Bay Area refineries, ranging from 49 – 84 metric tons of CO_2 equivalent per thousand barrels feedstock (MT CO_2e / thousand bbls feedstock). This variation could be explained by the difference in the crude slate processed at each refinery and the variation in facility operations, such as in process and equipment efficiency. For illustrative purposes, Air District staff estimated an extreme scenario for GHG emissions increases from the refining sector. If all refineries were to modify their operations in a way that increases their carbon intensity to the upper range value then total Bay Area refinery GHG emissions could increase by as much as 33 percent. This scenario does not consider how refinery nameplate capacity or permit limits on criteria air pollutants may curtail GHG emissions. While these factors would likely have a tempering

[23] BAAQMD (2017) Draft Workshop Report on Draft Regulation 13: Climate Change Pollutants, Rule 1: Petroleum Refinery Carbon Intensity Limits or Facility-Wide GHG Emissions Limits. Available at: http://www.baaqmd.gov/~/media/files/planning-and-research/rules-and-regs/workshops/2017/reg-13-rule-1/draft-rg1301-workshop-report.pdf?la=en

[24] https://www.eia.gov/petroleum/refinerycapacity/table5.pdf

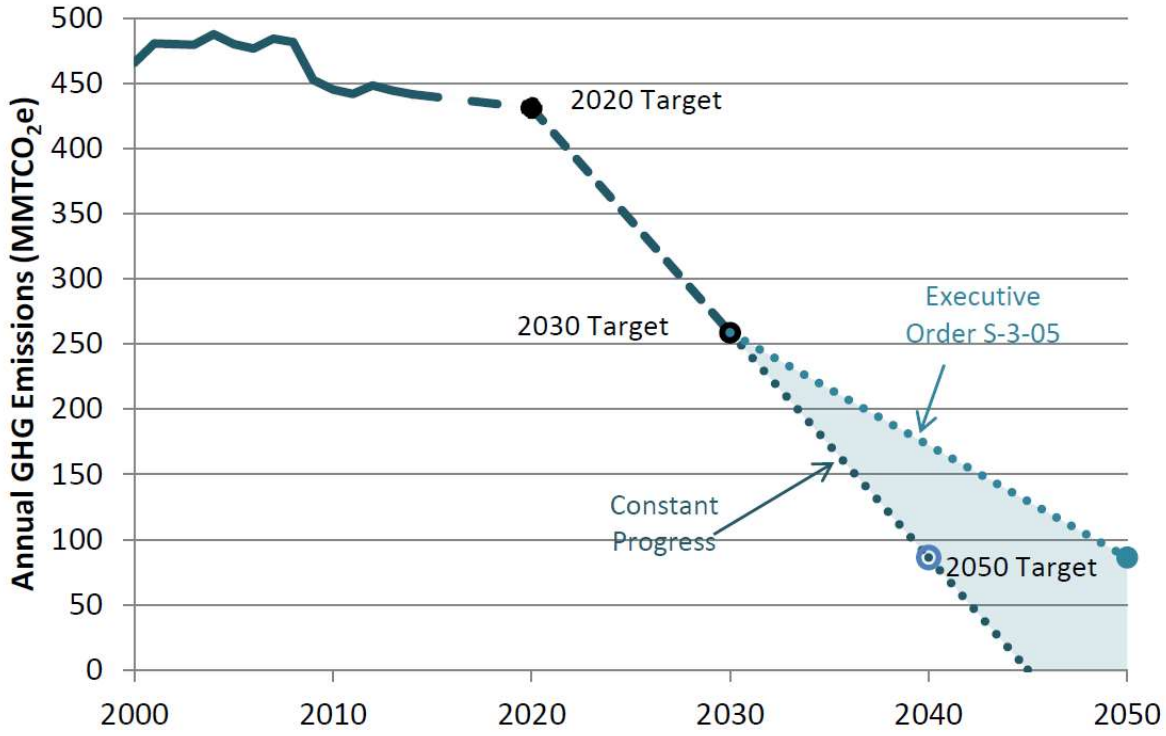
effect on GHG emissions increases, quantifying that effect would require further investigation.

The Air District is in the process of investigating and, if possible, quantifying the relationship between crude slate properties and GHG emitted during the processing of such crude slates. Air District Regulation 12, Rule 15 (Rule 12-15) requires monthly reporting of crude slate properties relevant to air pollutants such as API gravity (crude oil density), sulfur content, vapor pressure (crude oil volatility), BTEX (benzene, toluene, ethylbenzene and xylene) and metals (iron, nickel, and vanadium) content. The purpose of the crude slate reporting in Rule 12-15 is to establish a baseline crude slate for each of the refineries and then to track changes in that crude slate which, along with improved emissions data will help establish and monitor the relationship between crude slate and emissions from the refineries. This investigation may form the basis for future regulation focusing on crude slate characteristics. In the meantime, proposed Rule 12-16 is intended to act as a backstop to prevent GHG increases.

2. The State cannot meet its regulatory GHG emission reduction goals if Bay Area refinery emissions increase

The State's long-term climate goal of reducing 80 percent of its GHG emissions by 2050 is ambitious. It is based on the scientific consensus around the need for *aggressive and immediate GHG emissions reductions* to limit the average global warming to under 2 degrees C by 2050 and avoid potentially catastrophic climate change impacts. The 2030 limit was established to put the State on the path to meet its long-term goal by requiring constant progress toward 2050, and by encouraging the early development and implementation of policies that will need to be in place by then. To meet such challenging climate goals, all California economic sectors must not only stabilize their GHG emissions but dramatically decrease them. Moreover, these GHG emissions reductions must happen at a much faster pace than that required to meet the 2020 goal (see Figure A1).

Figure A1
Plotting California's Path Forward



Source: CARB 2017 Climate Change Scoping Plan Update: Figure I-5.

Of the three largest GHG emitting sectors, the industrial sector is the only one that does not have regulations in place to prevent GHG emission increases. The transportation sector is the largest contributor to the State's GHG emissions; it was responsible for 37 percent of these emissions during the year 2014. Currently, there are several state programs in place to reduce GHG emissions from mobile sources including the Low Carbon Fuel Standard (LCFS), the Mobile Source Strategy[25], and the Sustainable Freight Action Plan[26]. The energy sector, which includes in state electricity generation and electricity imports, accounted for 20 percent of California's 2014 GHG emissions. Emissions from this sector are expected to be reduced by the RPS, SB 350, SB 1368 and operational limits on recently constructed electricity generating facilities. Proposed Rule 12-16 is a preliminary step towards a regulatory program that actually reduces GHG emissions from the refinery sector.

Refineries represent about one third of the GHG emissions from the State's industrial sector, the second largest GHG source in California. Proposed Rule 12-16 focuses on the refining sector given that it is the largest California GHG sector without any backstop

[25] The Mobile Source Strategy is an integrated approach that addresses transportation emissions to simultaneously meet air quality standards, achieve GHG emission reduction targets, decrease health risk, and reduce petroleum consumption over the next fifteen years.
[26]

measures to prevent facility GHG emission increases. As other sectors' GHG emissions continue to decline due to measures in place, refineries could emit an increasingly larger portion of the State's GHG emissions. Thus, controlling their GHG emission will become even more critical. In its most recent Scoping Plan, CARB has placed particular importance on obtaining emission reductions from the refining sector, as discussed below.

CARB Scoping Plan and the State's refining sector

AB 32 tasked the California Air Resources Board with developing a Scoping Plan describing the State's approach to achieve the climate goals it established, and to update it every five years. The Scoping Plan, first approved by CARB in 2008, relied on an economic sector framework to identify a range of GHG reduction actions. The Scoping Plan identified a cap-and-trade program as one of the strategies that could be employed to meet the State's 2020 GHG reduction goals, alongside direct regulations, voluntary actions and alternative compliance mechanisms. The First Update to the Climate Change Scoping Plan was approved by CARB in 2014. This plan built upon the initial Scoping Plan with new strategies and recommendations, and with the development of focus areas that spanned more than one economic sector (e.g., short-lived climate pollutants).

Recently, CARB released the proposed 2017 Climate Change Scoping Plan Update (2017 Scoping Plan) to reflect the 2030 target and priorities set by SB 32 and AB 197. CARB is planning to present this plan to its Board for adoption on June 23, 2017. The proposed plan includes a few initiatives that affect the refining sector directly, including a Refinery GHG Reduction Measure. This measure would require a 20 percent reduction in GHG emissions from the refinery sector by 2030, and would require all refineries to become as efficient as California's most efficient existing refinery on a simple-barrel basis.[27] The regulation would not limit total GHG emissions, but rather require a decrease in carbon intensity through actions such as increasing energy efficiency, switching to lighter crude slates, and boiler electrification.

The inclusion of a measure directly targeting the refinery sector in CARB's proposed plan, in addition to a post-2020 Cap-and-Trade Program and other known commitments, denotes that emission reductions from this sector are critical to meet the State's climate goals. The 2017 Scoping Plan states three main reasons for the regulatory emphasis on the refinery sector:

- The refinery sector "includes some of the largest stationary sources of GHG emissions and is part of the largest economic sector of GHG emissions – transportation."
- The refinery measure "prioritizes direct GHG reductions at large stationary sources pursuant to AB 197."
- Studies show that many of the largest sources of emissions, such as refineries, are in disadvantaged communities. Thus, reducing GHG emissions from these

[27] CARB will also evaluate the complexity-weighted barrel as a metric for the Refinery Measure.

sources may provide co-benefits of reducing criteria and toxic air contaminants in these communities.

CARB calls for partnering with the State's local air districts as an initial implementation step for the refinery measure. CARB recognizes that air districts could help identify efficiency improvement opportunities for stationary source combustion equipment, given their traditional role in permitting these facilities. In addition, the local air districts' existing permitting process could facilitate the implementation of Best Available Retrofit Control Technology (BARCT)/All Feasible Measures,[28] which would also help "promote consistency of controls for similar emissions sources among districts with the same air quality attainment designations."

Bay Area petroleum refineries

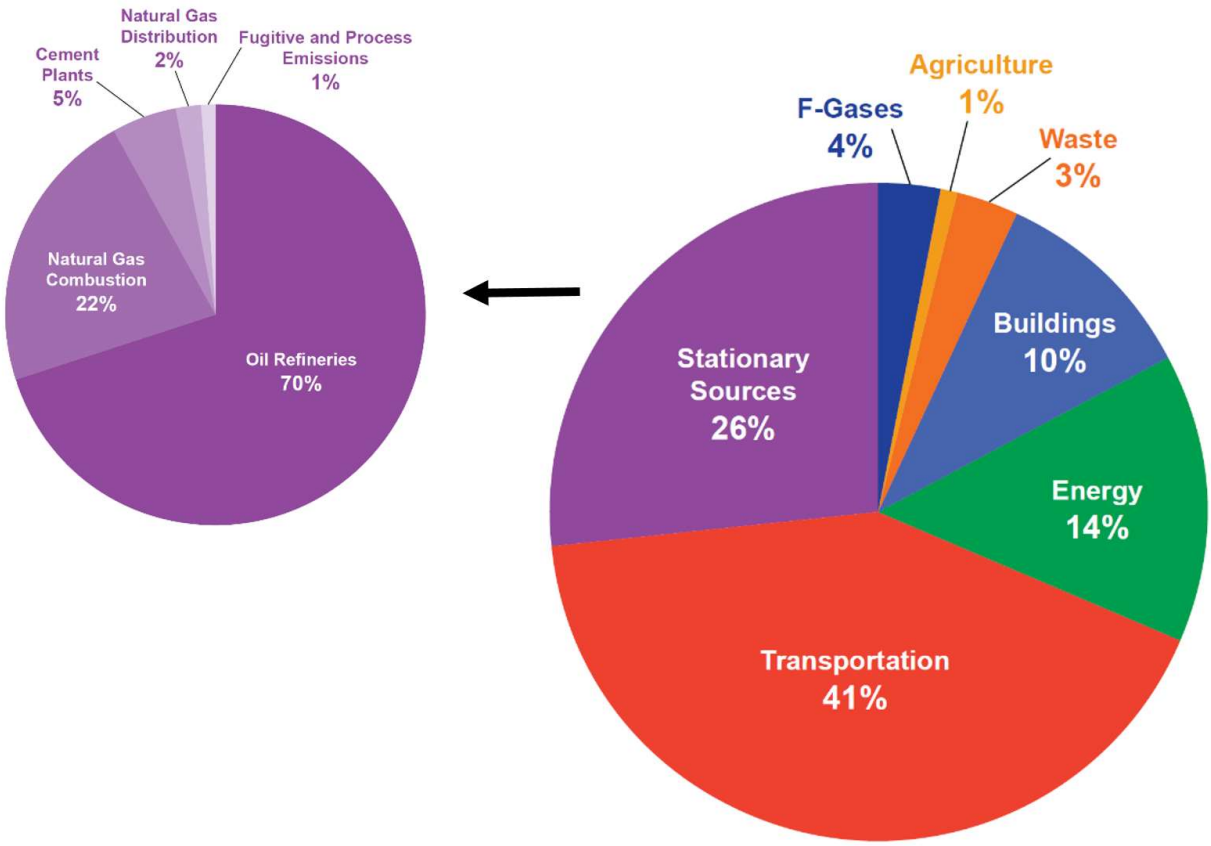
The Air District has five refineries and associated facilities within its jurisdiction. Bay Area refining facilities comprise about 55 percent of GHG emissions from the refinery sector in California. Below, there is a discussion indicating that the State cannot meet its aggressive mid-term and long-term climate goals if its refining industry (and every other large GHG sector) does not decrease its GHG emissions rapidly. Since Bay Area refineries emit over half of all GHG emissions from California's refining industry, it follows that these Bay Area facilities need to reduce their emissions as well, and cannot be allowed to increase their GHG emissions. Any GHG emission increases at refineries could jeopardize the progress toward the State's 2030 and 2050 reduction goals.

3. The Air District cannot meet its climate goals if Bay Area refinery emissions increase

Refineries represent approximately 18 percent of all Bay Area GHG emissions, but account for about 70 percent of stationary source GHG emissions (see Figure A2). Given that the Air District's primary regulatory authority applies to stationary sources, and that the refinery sector is, by far, the largest stationary GHG source in the Bay Area, the Air District must act to ensure GHG emissions from refineries do not increase, and are eventually reduced in order to meet its interim and long-term climate goals.

[28] Examples of possible BARCT/All Feasible Measure for combustion controls include energy efficiency standards for larger combustion equipment, mandatory equipment replacement requirements, heat rate improvement projects, installation of electronic controls and waste heat recovery systems and optimization.

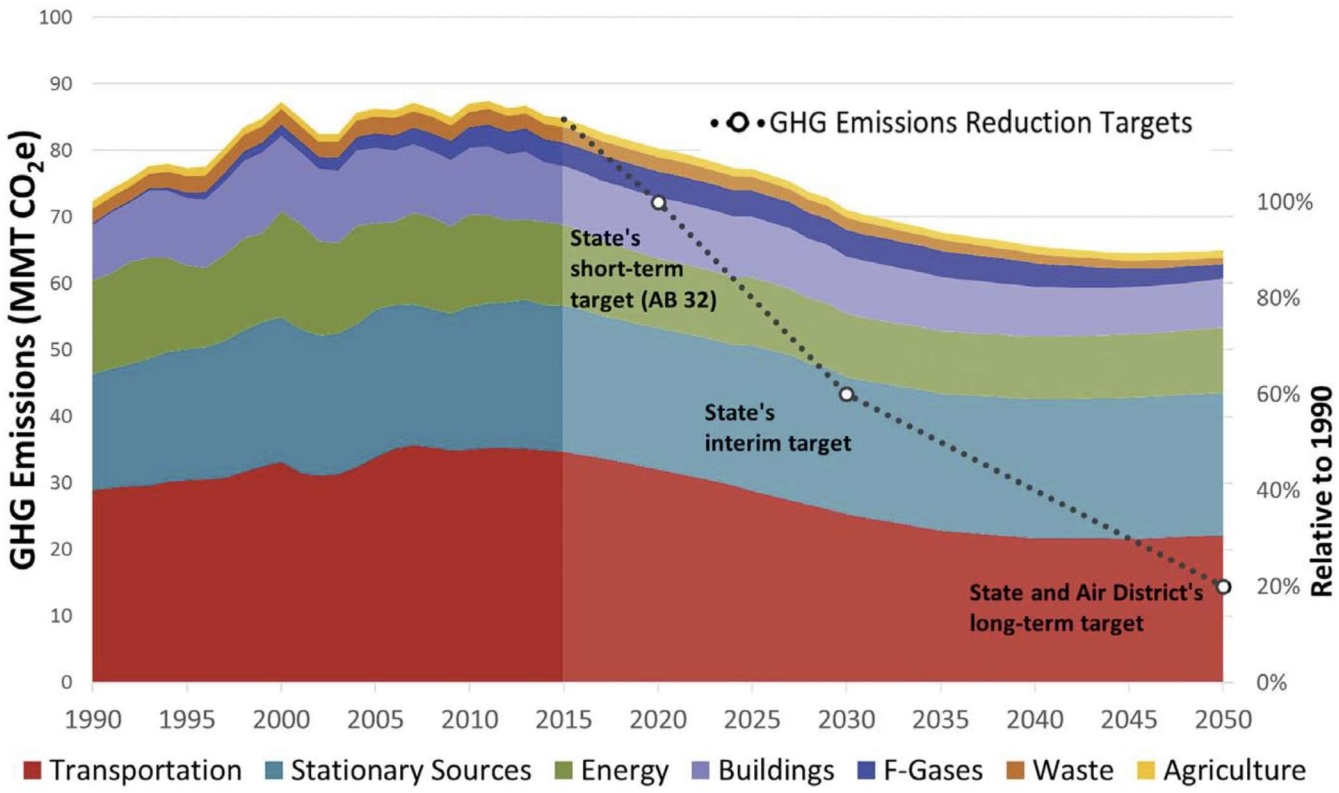
Figure A2
2015 Bay Area GHG Emissions by Source Category (Right) and Stationary Sources (Left)
(Total million MT CO_2e)



Source: Air District Clean Air Plan: Figures 3-6, 3-8.

Figure A3 shows estimated changes in Bay Area GHG emissions since 1990 and projected emissions through 2050. This figure highlights that existing commitments from CARB and other state agencies (as well as those likely to be adopted and implemented over the next 10 to 15 years) are insufficient to meet the Air District's climate goals.

Figure A3
Projected Bay Area GHG Emissions by Sector Based on State Policies, (100-year GWP)



Source: Air District Clean Air Plan: Figure 3-9.

Proposed Rule 12-16 would provide a backstop to prevent potential GHG emissions increases from changes in refinery operations. This rule constitutes a necessary and appropriate first step on the path to the GHG emission reductions needed to meet the State's and the Air District's climate goals. The Air District has the regulatory authority, expertise and resources to regulate GHG emissions at Bay Area refineries. CARB has expressly stated in its 2017 Scoping Plan that is planning to partner with local air districts to seek reductions from this sector.

Consistency and non-duplication

International

The Kyoto Protocol is an international treaty which extends the 1992 United Nations Framework Convention on Climate Change (UNFCCC). The treaty was adopted in Kyoto, Japan, on December 1997 and became effective in February 2005. It commits countries to reduce GHG emissions in recognition that climate change is caused by anthropogenic

GHG emissions, and based on the principle of common but differentiated responsibilities (i.e., historical emitters are responsible for the largest share of GHG reductions). Although the United States was a signatory to the Protocol, it never ratified it and withdrew from it in 2001. In 2015, all UNFCCC participants sign the Paris climate accord at the COP21 sustainable development summit, held in Paris, effectively replacing the Kyoto Protocol. As part of this non-binding agreement, the parties agreed to take voluntary action to limit warming to well below 2 degrees C, and below 1.5 degrees C above pre-industrial levels if feasible. All countries, including the U.S. signed the Paris agreement, except for Nicaragua and Syria.

However, on June 1st, 2017, President Trump announced that the United States would withdraw from the Paris climate accord. Given the legal framework of the accord, the withdrawal process would take four years. Though the U.S. remains part of the UNFCCC, it is not bounded by any international treaties to address climate change and decrease its GHG emissions.

National
At the national level, there are no requirements for refineries to limit GHG emissions from existing facilities.

State
Since the passing of AB 32, in 2006, CARB has not adopted any regulation that directly limits or reduces the GHG emissions from refineries. Up to this point, the State has solely relied on market forces via the Cap-and-Trade program to address GHG emissions from this sector. This strategy has not resulted in a statistically significant reduction in GHG emissions from Bay Area refineries. Although CARB has proposed in its 2017 Scoping Plan a refinery measure that would require a 20 percent reduction from the refinery sector by 2030, the Scoping Plan has not yet been adopted by its Board of Directors. CARB staff is bringing the proposed plan for adoption by its Board on June 23, 2017. Even if the 2017 Scoping Plan is adopted, the refinery measure would be implemented through new regulations for refineries developed through the rulemaking process which can take years.