Port of Richmond
Clean Air Action Plan
2015 PROGRESS REPORT

2015 Port of Richmond Clean Air Action Plan Progress Report

Executive Summary

The goal of this 2015 Port of Richmond CAAP Progress Report is to provide Richmond residents, city officials and other interested parties with an update on the progress that has been made on reducing air emissions and health risks from operations at the Port of Richmond since the adoption of The Port of Richmond Clean Air Action Plan in 2010.

Key Findings:

- ***Overall emissions from operations at the Port of Richmond public facility have been reduced substantially over the past five years.*** This reduction has occurred for both criteria pollutants and greenhouse gases, **with estimated reductions of almost 90 percent for Diesel Particulate Matter (DPM),** the pollutant of most concern to public

health, and reduction of 95 percent in emissions of Oxides of Sulfur. Other criteria pollutants and greenhouse gases were reduced by roughly 50 percent.[1]

- **These substantial emissions reductions over the past five years have resulted primarily from implementation of new regulations requiring the use of very low-sulfur fuel by Ocean Going Vessels operating in California** promulgated by the California Air Resources Board and the International Maritime Organization, **more stringent regulations of Heavy Duty Trucks operating at California Ports** as well as the introduction of **new cleaner locomotives**, as well as operational changes at the Port of Richmond.
- Emissions estimates have been calculated for 2014 and 2010; these estimates and have been compared with the initial emissions inventory conducted in and 2005. Below are summary tables showing the significant reductions in criteria pollutants from all major activities at the Port or Richmond since the Clean Air Action Plan was adopted in 2010.

Table 1: Estimated Annual Port of Richmond Emissions Reductions, 2010 - 2014 (tons/year)*

Year	ROG	CO	NO_X	PM	SO_2	CO_2
2010 Baseline	8.6	28.1	164	**13.4**	84.7	11,573
2014	4.4	14.2	73.6	**1.6**	3.9	5,754
Percentage Reduction 2010 – 2014	**49%**	**49%**	**55%**	**88%**	**95%**	**50%**

Sources: SF Bay Area Seaports Air Emission Inventory, Port of Richmond 2005 Emissions Inventory, Bay Planning Coalition, October 2009 and Honda Port of Entry at the Point Potrero Marine Terminal Final Environmental Impact Report, September 2008, Port of Oakland 2012 Seaport Air Emissions Inventory, Environ, November 5, 2013, Port of Long Beach 2011 and 2013 Air Emissions Inventories.

*** These estimates were calculated using** the California Air Resources Board (CARB) methodology. 2014 emissions estimates were calculated using **0.1% Sulfur Fuel correction factor from CARB applied to 63 OGV vessels for 2014.**

***** On Site Truck Emissions were reduced by same factor as Port of Oakland, reflecting new California Air Resources regulations of heavy duty truck emissions from Port-related activities.**

[1] See table 1 for detailed emissions reductions by criteria pollutant. Emissions reduction estimates have been calculated consistent with the California Air Resources Board (CARB) methodology.

Figure 1: Port of Richmond Emissions, 2010 (Blue Bars) – 2014 (Green Bars)

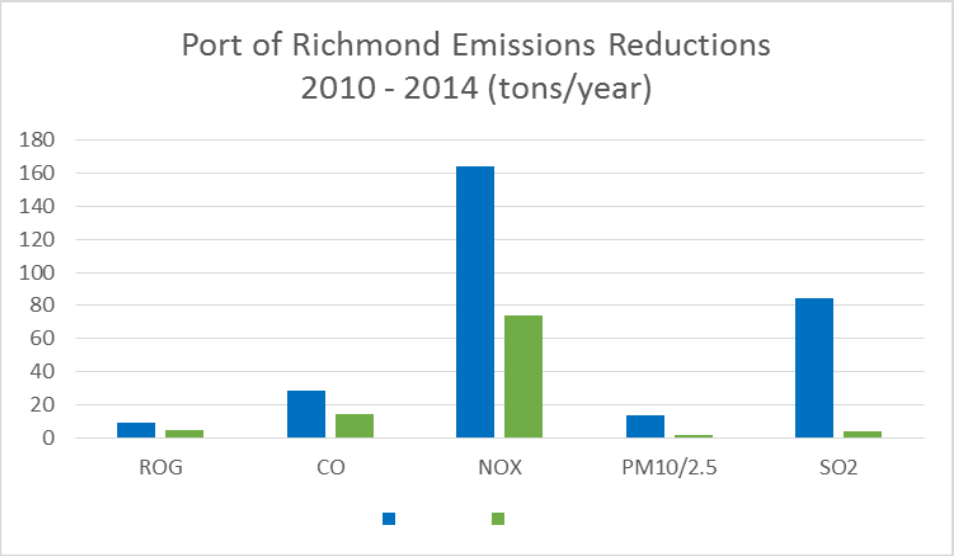


Table 2: 2014 Estimated Annual Port of Richmond Emissions (tons/year)*

Source	ROG	CO	NO_X	PM	SO_2	CO_2
Ocean-going Vessels (OGV, to 24 nm)**	2.7	5.8	53.3	1.2	5.4	2,473
Harborcraft	0.9	3.4	9.4	0.4	0.1	694
Cargo Handling Equipment (On-site)	0.1	0.6	0.2	0.0	0.0	163
Heavy Duty Trucks (On-site)***	0.6	3.7	9.0	0.1	0.0	*2,225*
Locomotives (On-site)	0.1	0.7	1.7	0.0	0.0	190
Total	**4.4**	**14.2**	**73.6**	**1.6**	**3.9**	**5,754**

Sources: SF Bay Area Seaports Air Emission Inventory, Port of Richmond 2005 Emissions Inventory, Bay Planning Coalition, October 2009 and Honda Port of Entry at the Point Potrero Marine Terminal Final Environmental Impact Report, September 2008, Port of Oakland 2012 Seaport Air Emissions Inventory, Environ, November 5, 2013, Port of Long Beach 2011 and 2013 Air Emissions Inventories.

**** Estimates calculated using CARB 0.1% Sulfur Fuel correction factor plus 63 OGV vessels for 2014.**

***** On Site Truck Emissions were reduced by same factor as Port of Oakland, reflecting new California Air Resources regulations of heavy duty truck emissions from Port-related activities.**

Table 3: 2010 Estimated Annual Port of Richmond Emissions (tons/year)

Source	ROG	CO	NO_X	PM	SO_2	CO_2
Ocean-going Vessels (OGV, to 24 nm)	4.7	10.0	119	11.3	83.1	6,448
Harborcraft	0.9	3.4	13.8	0.5	1.6	1,135
Cargo Handling Equipment (On-site)	0.1	0.6	0.2	0.0	0.0	163
Heavy Duty Trucks (On-site)	2.7	13.4	30.1	1.6	0.0	3,638
Locomotives (On-site)	0.1	0.7	1.7	0.0	0.0	190
Total	**8.6**	**28.1**	**164**	**13.4**	**84.7**	**11,573**

This CAAP Progress Report:

- Estimates emissions of both criteria pollutant and greenhouse gas (mainly carbon dioxide) emissions from public Port activities, and compares these to emissions prior to adoption of the CAAP. This analysis reveals that while ocean-going vessels remain the largest source of emissions, the total emissions of all criteria pollutants has been reduced substantially, particularly Diesel Particulate Matter and Oxides of Sulfur.
- Describes the key emissions reduction measures implemented since the 2010 CAAP was adopted, including:
  - Newly implemented state, federal and international regulatory emission reduction measures that have been adopted and implemented since 2010, including:
  - California Air Resources Board (CARB) regulation of ocean-going vessels both at berth in California ports, and at sea off the California coast.
  - Newly implemented International Maritime Organization standards
  - Control measures for commercial harborcraft
  - California's Drayage Truck Regulation
- Identifies voluntary emission reduction measures that have been taken, including vessel speed reduction.
- Estimates emissions reductions from both regulatory and voluntary emission reduction measures, including
  - Ocean-going vessel fuel sulfur rule
  - Vessel speed reduction
  - Heavy-duty truck idle rule

Comparing Public Port of Richmond and Other California Ports

California Ports have made significant progress over the past decade in reducing emissions from ships, trucks, and other equipment operating at ports. Emissions from operations at the Port of Richmond, like other California Ports, have been significantly reduced in recent years. What continues to set the Port of Richmond apart from California's larger Ports such as the Ports of Oakland, Los Angeles and Long Beach, is the significantly lower overall levels of emissions generated at the Port of Richmond than these other California port facilities for both criteria pollutants and greenhouse gases. Emissions from operations as the Port of Richmond are one to two orders of magnitude lower than emissions at California's large container ports. This significantly lower level of emissions is due primarily to the smaller size, amount and types of activities at the Port of Richmond.

To provide perspective for the air emissions at the Port of Richmond, Table 4 and Figure 2 display the annual air emissions of six major criteria pollutants from the public Port of Richmond compared to the Port of Oakland, Port of Long Beach, and the Port of Los Angeles for 2012, the most recent year for which comparative data is available. Emissions at the Port of Richmond are 1 to 2 percent of the emissions from either the Port of Long Beach or Los Angeles, and between 3 and 6 percent of the

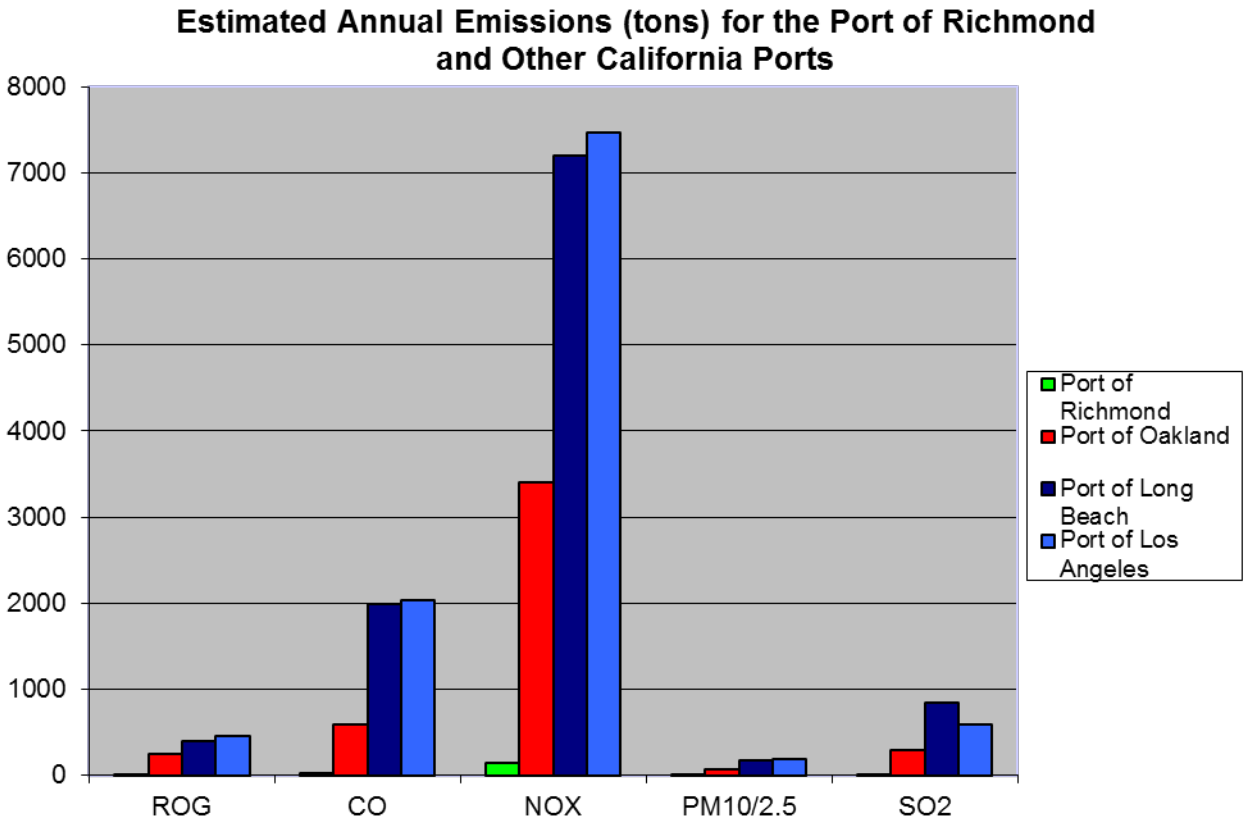
emissions from the Port of Oakland. The annual emissions of greenhouse gases (CO_2) for the Port of Richmond are just over 1 percent of the values for the other California ports.

Table 4. 2012 Estimated Annual Emissions (tons/year) for the Port of Richmond and Other California Ports

Port	ROG	CO	NO_X	DPM	SO_2	CO_2
Port of Richmond	8.6	18.5	139	4	16.9	9,606
Port of Oakland	250	589	3398	77	290	NA
Port of Long Beach	393	1,985	7,193	181	844	733,174
Port of Los Angeles	459	2,027	7,473	187	592	851,560

Sources: SF Bay Area Seaports Air Emission Inventory, Port of Richmond 2005 Emissions Inventory, Bay Planning Coalition, October 2009, Honda Port of Entry at the Point Potrero Marine Terminal Final Environmental Impact Report, September 2008, Port of Oakland 2012 Seaport Air Emissions Inventory, Environ International Corporation, November, 2013, Port of Long Beach Air Emissions Inventory – 2012, Starcrest Consulting Group, July 2013, and Port of Los Angeles Air Emissions Inventory – 2013, Starcrest Consulting Group, July, 2014.

Figure 2: Estimated 2012 Emissions (tons/year) for the Port of Richmond, Port of Oakland, Port of Long Beach and Port of Los Angeles



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Acronyms and Abbreviations

AMECS	Advanced Maritime Emissions Control System
ARRA	American Recovery and Reinvestment Act
ATCM	Airborne Toxic Control Measure
BAAQMD	Bay Area Air Quality Management District
BNSF	Burlington–Northern Santa Fe
CAA	federal Clean Air Act
CAAB	Clean Air Advisory Board
CAAP	Clean Air Action Plan for the Port of Richmond
CAEATFA	California Alternative Energy and Advanced Transportation Financing Authority
CARB	California Air Resources Board
CARE	Community Air Risk Evaluation
CI	compression ignition
CO	Carbon monoxide
CO_2	carbon dioxide
CSI	California Solar Initiative
CTC	California Transportation Commission
DPM	diesel particulate matter
ECAA	Energy Conservation Assistance Account
EIR	Environmental Impact Report
FEIR	Final Environmental Impact Report
GHG	greenhouse gas
GSE	Ground support equipment
Honda CAAP	Honda Port of Entry Clean Air Action Plan
IMO	International Maritime Organization
LSI	large spark-ignition
LNG	Liquid natural gas
MMRP	Mitigation Monitoring and Reporting Program
NAAQS	National Ambient Air Quality Standards
NO_X	Nitrogen oxides
NREC	National Railway Equipment Company
OAL	Office of Administrative Law
OGV	ocean going vessels
PM	particulate matter
PM_{10}	Particulate matter measuring 10 micrometers and smaller
$PM_{2.5}$	Particulate matter measuring 2.5 micrometers and smaller
POLA	Port of Los Angeles
POLB	Port of Long Beach
PPMT	Point Potrero Marine Terminal
ppmw	Parts per million by weight
ROG	Reactive Organic Gases
SIP	State Implementation Plan
SO_2	Sulfur dioxide
SO_X	sulfur oxides
U.S. EPA	U.S. Environmental Protection Agency
VMT	vehicle miles traveled
VSR	vessel speed reduction

Table of Definitions

Auto Carrier – A Self-propelled dry-cargo vessel that carries containerized automobiles.

Breakwater – The breakwater is the geographic marker for the change from open ocean to inland waterway (usually a bay or river).

Carbon Monoxide – A colorless, odorless toxic gas produced by the incomplete combustion of organic materials used as fuels.

Cargo Handling Equipment – A variety of equipment such as bucket loader, forklift, generator, container handler, crane, and tractor to assist in the movement of cargo.

Cold Ironing – Cold ironing uses shore power to provide electricity to the ship instead of using the auxiliary engines.

Criteria Pollutants – The six pollutants listed in the CAA that are regulated by the EPA through the NAAQS because of their health and/or environmental effects. The criteria pollutants are nitrogen dioxide, sulfur dioxide, carbon monoxide, ozone, particulate matter, and lead.

Cruise Mode – Time at service speed (also called sea speed or normal cruising speed) usually considered to be 94 percent of maximum speed.

Emission Factor – The rate at which a pollutant is emitted into the atmosphere by a source.

Emission Inventory – A complete list of sources and rates of pollutant emissions within a specific area and time interval.

Feasible Measure – Capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors.

Heavy-duty Truck – On-road (typically diesel) trucks used extensively to move cargo into and out of ports.

Harborcraft – Help vessels maneuver in the harbor during arrival and departure and shifts from berth. Also known as tugboats.

Hotelling Mode – Hotelling is the time at pier/wharf/dock or anchorage when the vessel is operating auxiliary engines only or is cold ironing. Auxiliary engines are operating at some load conditions the entire time the vessel is manned, but peak loads will occur after the propulsion engines are shut down. The auxiliary engines are then responsible for all onboard power or are used to power off-loading equipment, or both.

Hydrocarbons – Compounds of hydrogen and carbon including methane and ethane. Gases that are generated by unburned and wasted fuel and come from incomplete combustion of fossil fuels and from evaporation of liquid fuels.

Maneuvering Mode – Maneuvering within a port generally occurs at 5 to 8 knots on average, with slower speeds maintained as the ship reaches berth or anchorage. Even with tug assist, the propulsion engines are still in operation.

National Ambient Air Quality Standard (NAAQS) – Air quality standards established by U.S. EPA to protect human health (primary standards) and to protect property, the environment, and aesthetics (secondary standards).

Nitrogen Oxides (NO_X) – A poisonous and highly reactive gas produced when fuel is burned at high temperatures causing some of the ambient nitrogen in the air to burn also.

Ozone – A colorless, toxic gas formed by the photochemical reactions in the atmosphere of VOC with nitrogen oxides.

Particulate Matter (PM) – Particulate matter is made up of small solid particles and liquid droplets (aerosols). Suspended particulates refer to particles of approximately 100 micrometers or less in diameter.

$PM_{2.5}$ – Particulate matter of 2.5 micrometers or less in diameter.

PM_{10} – Particulate matter of 10 micrometers or less in diameter.

Pollutant – Substance in air, water, or soil that can cause disease or harm to the environment.

Roll On/Roll Off (RORO) – A Self-propelled vessel that handles cargo that is rolled on and off the ship, including ferries.

State Implementation Plan – The strategy to be used by a state to control air pollution in order that NAAQS violations will be eliminated.

Slow Cruise Mode – A speed less than cruise and greater than maneuvering. This is the maximum safe speed the vessel uses to traverse distances within a waterway leading to a port. Reduced speeds can be as high as 15 knots in the open water, but tend to be more in the order of 9 to 12 knots in most other areas.

Sulfur Dioxide (SO_2) – A corrosive gas produced mainly from the burning of fuels containing sulfur compounds.

Tanker – A Self-propelled liquid-cargo vessels including chemical tankers, petroleum product tankers, liquid food product tankers, etc.

Volatile Organic Compounds (VOC) – A general class of compounds, containing various levels of hydrogen and carbon that are chemically active in the atmosphere. VOC are created when fuels or organic materials are burned or evaporate into the atmosphere.

I. Introduction: Goals, Purpose, History and Structure

The goal of this Port of Richmond Clean Air Action Plan Progress Report (CAAP Progress Report) is to report on progress made in implementing the 2010 Clean Air Action Plan (CAAP), and to provide an estimate of the resulting reduction in emissions from Port-related activity. As described in the 2010 CAAP, the primary mechanism to achieve these emissions reductions has been the implementation of new state, federal and international regulations, principally pertaining to ocean-going vessels and trucks that operate at California ports (see Section IV).

In October 2008 the Richmond City Council approved the Honda Port of Entry Project. While this project would bring much-welcome jobs and revenue to the City of Richmond and would both improve operations and reduce emissions from the existing automobile import facility at the Port's Point Potrero Marine Terminal (PPMT), the Honda Port of Entry project would result in an emissions increase from an increase in ships calling at the PPMT. To mitigate these increased emissions, the Port of Richmond committed to developing a Clean Air Action Plan for the Honda Port of Entry (Honda CAAP) as part of that project's Final Environmental Impact Report (FEIR). In accordance with Mitigation Measure 6-2 in the Honda Port of Entry FEIR, the Port of Richmond completed the Clean Air Action Plan for the Honda Port of Entry in 2009.

The structure of this CAAP Progress Report is as follows: 1) an updated estimate of emissions for the Port of Richmond for 2014, with comparison to 2005 and 2010 levels; 2) description of recently implemented regulatory emission reduction measures; 3) discussion of voluntary emission reduction measures; and 4) a discussion of next steps for further emissions reductions from operations at the Port of Richmond.

II. Emissions Inventory

The foundation of the Port of Richmond's air quality strategy is a detailed inventory of port emissions. The Bay Planning Coalition developed a 2005 baseline emissions inventory for the public Port of Richmond in October 2009[2]. In addition, an emissions inventory was developed for the Honda Port of Entry Project[3]. This 2015 CAAP Progress Report calculates an estimated emissions inventory for 2014 and compares these emissions levels to both the 2005 actual operations inventory as well as the 2010 estimated emissions from the Honda Port of Entry project. This inventory evaluates emissions from the following source categories:

- Ocean-going vessels (e.g., auto carriers, tankers)
- Harbor vessels (e.g., assist tugs and tugboats, push or tow barges)
- Cargo handling equipment (e.g., yard tractors, forklifts)
- Locomotives (e.g., switching and line haul rail locomotives)
- Heavy-duty diesel-fueled vehicles (e.g., large on-road diesel trucks)

The primary air emission sources evaluated are associated with operational equipment used at terminals, trucks and locomotives serving the terminals, and ships and harbor vessels calling on the terminals. The area included in these emissions inventories includes the public port of Richmond, specifically tanker and cargo handling as well as auto carriers. Private operations, such as the Chevron refinery are not included in this inventory nor covered in this CAAP. Port fleet and commuter passenger vehicle emissions, including those licensed for operation of public roadways, are not included in the emissions inventory. Maintenance operations, Port and tenant office energy consumption, terminal and street lighting, electrified cargo handling equipment, building heating, ventilating, and air conditioning, and other ancillary sources are also not included. When combined, such sources typically constitute less than 5 to 10 percent of total port-related emissions, and hence are not reported here.

The inventory addresses the EPA-criteria pollutant emissions, as well as emissions of carbon dioxide (CO_2), the most prevalent greenhouse gas (GHG) in terms of human activity:

- Reactive Organic Gases (ROG, precursors to the EPA criteria pollutant ozone)
- Nitrogen oxides (NO_X), consisting primarily of nitrogen dioxide with lesser amounts of nitric oxide and other oxides of nitrogen (a precursor to the formation of ozone)
- Carbon monoxide (CO)
- Diesel Particulate Matter (DPM)
- Sulfur dioxide (SO_2)

[2] SF Bay Area Seaports Air Emission Inventory, Port of Richmond 2005 Emissions Inventory, Bay Planning Coalition, October 2009.

[3] Honda Port of Entry at the Point Potrero Marine Terminal Final Environmental Impact Report, September 2008.

a. Ocean-going Vessels

For ocean going vessels (OGV), emissions were calculated by multiplying emission factors by vessel-specific activity parameters such as in-use horsepower and hours of operation**.** Additional calculations were performed to adequately characterize the complicated activities of marine vessels (e.g., separate calculations were made for vessel transit of cruise and slow cruise, maneuvering, and hoteling activities for propulsion engines, auxiliary engines, and auxiliary boilers). Ocean-going vessels have historically accounted for 55 percent of ROG emissions, 35 percent of CO, 72 percent of NO_X, 84 percent of PM, 98 percent of SO_2, and 56 percent of CO_2 occurring due to public Port of Richmond operations. Moreover, main engine operation represents the greatest portion of the ocean-going vessel emissions.

b. Harborcraft

Emissions were calculated by multiplying emission factors by an appropriate measure of activity (such as annual hours of operation). Harborcraft represent approximate 10 percent of total emissions (10 percent of the total port ROG emissions, 12 percent of CO, 8 percent of NO_X, 4 percent of PM, 2 percent of SO_2, and 10 percent of CO_2.

c. Heavy-Duty Vehicles, Commuting Vehicles, and Port Fleet Vehicles

Heavy-duty truck activity estimated in the emissions inventory relates to the number of truck, employee and auto shuttling trips, and the estimated miles traveled within the Bay Area Air Quality Management District. This combination of the vehicles, trips and miles traveled is known as vehicle miles traveled (VMT). Emissions were determined based on the vehicle- and speed-specific emissions factors (typically in grams per mile) derived from CARB's emission factor model EMFAC2007. Emissions from auto carrier trucks include idling and moving within the facility and traveling to/from their destination beyond the facility boundaries.

d. Cargo Handling Equipment

The Port of Richmond operates a limited number of cargo-handling equipment. Cargo handling equipment represent one to two percent of total emissions at the Port of Richmond (1 percent of ROG emissions, 2 percent of CO emissions, and less than 1 percent of the remaining pollutants).

e. Locomotives

Railroad operations are typically described in terms of two different types of operation: line haul and switching. Line haul operations involve long-distance transportation between the Port and points across the country; whereas switching is the local movement of railcars to prepare them for line haul transportation, or to distribute them to destination terminals upon their arrival in port. In total, locomotives represent one to two percent of total emissions at the Port of Richmond (1 percent of ROG port emissions, 2 percent of CO, 1 percent of NO_X, less than 1 percent of PM and SO_2, and 2 percent of CO_2).

f. Electrical Usage

The Port of Richmond uses approximately 500,000 kilowatts of electricity to support operations. This is equivalent to less than 200 tons CO_2[4]. For comparison purposes, this level of CO_2 emissions is equivalent to less than one percent of the Carbon Dioxide emissions from the Ports of Los Angeles and Long Beach. The City of Richmond and its several departments, including the Port of Richmond, continue to identify opportunities to use renewable energy wherever cost effective.

Table 1. 2014 Estimated Annual Port of Richmond Emissions (tons/year)*

Source	ROG	CO	NO_X	PM	SO_2	CO_2
Ocean-going Vessels (OGV, to 24 nm)**	2.7	5.8	53.3	1.2	5.4	2,473
Harborcraft	0.9	3.4	9.4	0.4	0.1	694
Cargo Handling Equipment (On-site)	0.1	0.6	0.2	0.0	0.0	163
Heavy Duty Trucks (On-site)***	0.6	3.7	9.0	0.1	0.0	*2,225*
Locomotives (On-site)	0.1	0.7	1.7	0.0	0.0	190
Total	**4.4**	**14.2**	**73.6**	**1.6**	**3.9**	**5,754**

Sources: SF Bay Area Seaports Air Emission Inventory, Port of Richmond 2005 Emissions Inventory, Bay Planning Coalition, October 2009 and Honda Port of Entry at the Point Potrero Marine Terminal Final Environmental Impact Report, September 2008, Port of Oakland 2012 Seaport Air Emissions Inventory, Environ, November 5, 2013, Port of Long Beach 2011 and 2013 Air Emissions Inventories.

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***** On Site Truck Emissions were reduced by same factor as Port of Oakland.**

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Sources: SF Bay Area Seaports Air Emission Inventory, Port of Richmond 2005 Emissions Inventory, Bay Planning Coalition, October 2009 and Honda Port of Entry at the Point Potrero Marine Terminal Final Environmental Impact Report, September 2008.

[4] PG&E reports a CO2 per MW emission rate of 524, http://www.pge.com/about/environment/calculator/assumptions.shtml

III. Regulatory Emission Reduction Measures

The U.S. Environmental Protection Agency (U.S. EPA) is responsible for implementing a myriad of regulations and programs established under the federal Clean Air Act (CAA), such as establishing and reviewing the National Ambient Air Quality Standards (NAAQS) and judging the adequacy of State Implementation Plans (SIPs). However, U.S. EPA has delegated the authority to implement many of the federal programs to individual states, while retaining an oversight role to ensure that the programs continue to be implemented.

The California Air Resources Board (CARB) is responsible for establishing and reviewing California's air quality standards, compiling the California SIP, securing approval of this plan from U.S. EPA, and identifying toxic air contaminants. CARB also regulates mobile emissions sources in California, such as construction equipment, ships, trains, trucks, and automobiles, and oversees the activities of air quality management districts, which are organized at the county and/or regional level.

Local councils of governments, county transportation agencies, cities and counties, and various non–governmental organizations also join in the efforts to improve air quality through a variety of programs. These programs include the adoption of regulations and policies, as well as implementation of extensive education and public outreach programs. The Bay Area Air Quality Management District (BAAQMD) is the CARB-appointed regional agency with jurisdiction over the Port of Richmond. The BAAQMD is responsible for bringing the area into compliance and/or maintaining air quality within federal and State air quality standards. This includes the responsibility to monitor ambient (i.e. "outdoor") air pollutant levels and to develop and implement attainment strategies to ensure that future emissions are within federal and State standards.

A number of regulations and rules promulgated by CARB and others with direct application of emission sources within ports, in general, and the Port of Richmond, specifically, are discussed in the following sections.

Fuel Sulfur and Other Operational Requirements for Ocean-going Vessels within California Waters and 24 Nautical miles of the California Baseline (CCR, Title 13, Section 2299.2)

Originally adopted by CARB in 2008, this regulation required the use of low sulfur marine distillate fuels in order to reduce emissions of PM, diesel particulate matter (DPM), nitrogen dioxides (NO_X) and sulfur oxides (SO_X) from the use of auxiliary diesel and diesel-electric engines, main propulsion diesel engines, and auxiliary boilers on ocean-going vessels within any regulated California waters. This rule, which became effective on July 1, 2009, limits fuel sulfur content for auxiliary and main diesel engines to 1.5 percent by weight for marine gas oil and 0.5 percent by weight for marine diesel oil. On January 1, 2014 CARB reduced the allowable fuel sulfur content for auxiliary and main diesel engines to no more than 0.1 percent by weight for both marine gas oil and marine diesel oil. The relative reduction in emissions

of key criteria pollutants that result from the cleaner fuel required by these CARB regulations is summarized in table 5 below.[5]

Table 5. Fuel Correction Factors for calculating emissions reductions from CARB clean fuel regulations

Date	Fuel	Sulfur Content	PM	NOx	SO_x	CO_2
July 2009	**HFO**	**1.5%**	**0.82**	**1.00**	**0.555**	**1.0**
	MDO	**1.5%**	**0.47**	**0.94**	**0.555**	**1.0**
	MGO	**0.5%**	**0.25**	**0.94**	**0.185**	**1.0**
	MGO	**0.3%**	**0.21**	**0.94**	**0.111**	**1.0**
	MGO	**0.2%**	**0.19**	**0.94**	**0.074**	**1.0**
January 2014	**MGO**	**0.1%**	**0.17**	**0.94**	**0.037**	**1.0**

Source: Ports of Los Angeles and Long Beach Clean Air Report, 2015.

On December 22, 2009, EPA announced final emission standards under the Clean Air Act for new marine diesel engines with per-cylinder displacement at or above 30 liters (called Category 3 marine diesel engines) installed on U.S.-flagged vessels. The final engine standards are equivalent to those adopted in the amendments to Annex VI to the International Convention for the Prevention of Pollution from Ships. The emission standards apply in two stages: near-term standards for newly-built engines will apply beginning in 2011, and long-term standards requiring an 80 percent reduction in NO_X will begin in 2016.

On March 26, 2010, the International Maritime Organization (IMO) officially designated waters off North American coasts as an area in which stringent international emission standards will apply to ships. These standards will dramatically reduce air pollution from ships and deliver substantial air quality and public health benefits that extend hundreds of miles inland.

Airborne Toxic Control Measure for Commercial Harborcraft

The purpose of this regulation is to reduce DPM, SO_X, and NO_X from diesel propulsion and auxiliary engines on harborcraft operating in any *regulated California waters*. This section implements provisions of the Goods Movement Emission Reduction Plan, adopted by CARB in April 2006, to reduce emissions and health risk from ports and the movement of goods in California. On February 16, 1010, CARB staff drafted amendments to the California's Commercial Harborcraft Regulation which add in-use engine requirements for diesel engines on dredges, barges, and crew and supply boats that operate in regulated California waters.

[5] These fuel correction factors have been used to calculate estimated emissions reductions for 2014.

California's Drayage Truck Regulation (CCR, Title 13, Section 2027)

CARB adopted this measure in 2008 to reduce public exposure to DPM emissions, NO_X, and other air contaminants by setting emission standards for in-use, heavy-duty diesel-fueled vehicles that transport cargo to and from California's ports and intermodal rail facilities. Section 2027's definition of *port* specifically includes Port of Richmond. This regulation requires all drayage trucks that operate at California's ports and intermodal rail yards to meet the following requirements:

1. As of December 31, 2009, all drayage trucks operating at California ports were required to be equipped with:
    - 1994–2003 model year engines certified to California or federal emissions standards and a level 3 Verified Diesel Emission Control Strategy for PM emissions;
    - a 2004 or newer model year engine certified to California or federal emission standards; or
    - a 1994 or newer model year engine that meets or exceeds 2007 year California or federal emission standards.
2. Since December 31, 2011, all drayage trucks with 2004 model year engines have been required to be equipped with the highest level of Verified Diesel Emission Control Strategy for PM emissions.
3. Since December 31, 2012, all drayage trucks with 2005 and 2006 model year engines have been required to be equipped with the highest level Verified Diesel Emission Control Strategy for PM emissions.
4. As of December 31, 2013, all drayage trucks operating at California ports must be equipped with a 1994 or newer model year engine that meets or exceeds 2007 model year California or federal emission standards.

Heavy-Duty Vehicle Idling Emission Reduction Program

Under this rule, 2008 and newer model year heavy-duty diesel engines must either be equipped with a non-programmable engine shutdown system that automatically shuts down the engine after five minutes of idling, or optionally meet a stringent NO_X idling emission standard. The in-use truck requirements require operators of both in-state and out-of-state registered sleeper berth equipped trucks to manually shut down their engine when idling more than five minutes at any location within California.

On-Road Heavy-Duty Diesel Vehicles (In-Use)

In addition, on December 12, 2008, CARB approved a new regulation, the *On-Road Heavy-Duty Diesel Vehicles (In-Use) Regulation***,** to substantially reduce emissions from existing on-road diesel vehicles operating in California. The regulation requires affected trucks to meet performance requirements between 2011 and 2023. By January 1, 2023 all vehicles must have a 2010 model year engine or

equivalent; this includes on-road heavy-duty diesel fueled vehicles with a gross vehicle weight rating greater than 14,000 pounds.[6]

Standards for Nonvehicular Diesel Fuel Used in Diesel-Electric Intrastate Locomotives and Harborcraft (CCR Title 13, Section 2299)

CARB defines "intrastate locomotives" as those "operat[ing] within California for which at least 90 percent of [the] annual fuel consumption, annual hours of operation, or annual rail miles traveled occur within California. This definition would typically include, but not be limited to, diesel-electric locomotives used in the following operations: passenger intercity and commuter, short haul, short line, switch, industrial, port and terminal operations." The regulation requires that all nonvehicular diesel fuel sold and supplied for use in intrastate locomotives satisfy the requirements established for sulfur content (section 2281), aromatic hydrocarbon content (section 2282) and lubricity (section 2284), treated as if it were vehicular diesel fuel. Notably, these requirements also apply to fuel supplied to harborcraft typically operating in the Port of Richmond.

[6] In general, the regulation requires owners to reduce emissions in their fleet by upgrading existing vehicles one of three ways. The first option is to install PM retrofits and replace vehicles (or engines) according to a prescribed schedule based on the existing engine model year. The second option is to retrofit a minimum number of engines each year with a high level PM exhaust retrofit and to replace a minimum number of older engines with newer engines meeting the 2010 new engine standards. The third option is to meet a fleet average. With this option, a fleet operator can use PM and NO_X emission factors established by the regulation to calculate the average emissions of the fleet. Then, by the applicable compliance date each year, the owner can demonstrate that the fleet average emissions for PM and NO_X do not exceed the PM and NO_X fleet average emission rate targets set by the regulation.

IV. Potential Voluntary and Incentivized Emission Reduction Measures

Voluntary measures are actions agreed to and undertaken by operators, and are used or implemented by the participants without legal obligation. Examples of voluntary actions that have been taken by operators that have resulted in a decrease in emissions include procedural efficiency increases, purchase of new lower-emitting equipment, and use of alternative fuels in equipment.

Vessel Speed Reduction

Ocean going vessels approaching the Port of Richmond are required to slow down to 15 knots from the Golden Gate to the Port of Richmond. Under a voluntary VSR program, participant vessels have been requested to slow down to 12 knots as they approach or depart the Port of Richmond. When ships slow down, the load on the main engines decreases considerably compared to transiting at higher speeds, leading to a decrease in the total energy required to move the ship through the water. This energy reduction in turn reduces emissions for this segment of the transit. Since the load on the main engines affects power demand and fuel consumption, this strategy significantly reduces all pollutants including PM, NO_X, SO_X, and GHG emissions.

Alternative Fueled Equipment/Vehicles

The Port of Richmond operates a number of alternatively-fueled cargo-handling equipment hybrid onroad fleet vehicles. The Port will continue to explore funding and other mechanisms to provide additional alternatively-fueled equipment and fleet vehicles, and as fleet vehicles and equipment are retired they will be replaced with hybrid and alternatively-fueled equipment.

Exhaust Treatment Devices

Advanced Maritime Emissions Control System (AMECS) is a pilot system composed of an Emissions Treatment Subsystem and an Emissions Capture Subsystem. The system contains two emission–removal technologies: a Cloud–Chamber Scrubber for removal of SO_X, PM, and ROG, and a Selective Catalytic Reduction Reactor for the removal of NO_X. The AMECS treats ocean–going vessels while at berth. This system claims to reduce SO_X by up to 97 percent, PM by more than 92 percent, and NO_X by up to 97 percent. The system does not require modification of the ship.

The Port of Richmond will continue evaluate the applicability of AMECS and other exhaust gas scrubbing technologies that capture vessel stack emissions while at berth and “scrubs” exhaust streams either on-shore or on a barge.

e. Equipment/Vehicle Replacement/Retrofit

The retrofit of diesel particulate matter filters can reduce PM emissions by up to 85 percent with additional reductions of ROG and CO. Further, the retrofit of diesel oxidation catalyst can reduce PM by 50 percent and ROG by 50 percent. The replacement of older truck fleets nearing their useful life with newer models or rebuilt engines typical operate better and emit fewer pollutants.

On-site Renewable Energy Generation

The Port of Richmond, working with the City of Richmond, will continue to evaluate the feasibility of installing solar photovoltaic panels or other renewable energy generation for the use by the Port and its tenants.

Employee Transit and Alternative Transportation

The Port of Richmond will continue to work with the City, port employees, neighboring employers, AC Transit, and BART to provide enhanced transit access, such as free shuttle service for employees of the Port and its tenants between the Port and local transit modes, including the Richmond BART station.

V. Estimated Emission Reductions

Generally, emissions reduction initiatives include mandated regulatory measures such as ocean-going vessel sulfur fuel content, and voluntary measures such as vessel speed reductions. The following section provides an estimate of emission reductions since the Port of Richmond Clean Air Action Plan was adopted in 2010. The calculated emission benefits are based on full compliance with the regulatory sulfur fuel measure and participation with the voluntary measures of VSR and heavy-duty truck replacement.

A majority of the ocean-going vessels emission reductions of PM are associated with sulfur fuel requirements, while the sulfur fuel requirements, VSR program, and truck program each contribute to similar reductions in NOx emissions. Implementation of 0.1 percent sulfur fuel requirement for ocean going vessels has been the primary catalyst leading to a reduction of 90 percent of Diesel Particulate Matter (DPM), and a reduction of 95 percent in emissions of oxides of sulfur, and a reduction of roughly 50 percent in all other criteria pollutants and greenhouse gases. Details of these emissions reductions are presented in the following tables and figure:

Table 6: Estimated Annual Port of Richmond Emissions Reductions, 2010 - 2014 (tons/year)*

Year	ROG	CO	NO_X	PM	SO_2	CO_2
2010 Baseline	8.6	28.1	164	**13.4**	84.7	11,573
2014	4.4	14.2	73.6	**1.6**	3.9	5,754
Percentage Reduction 2010 – 2014	**49%**	**49%**	**55%**	**88%**	**95%**	**50%**

Sources: SF Bay Area Seaports Air Emission Inventory, Port of Richmond 2005 Emissions Inventory, Bay Planning Coalition, October 2009 and Honda Port of Entry at the Point Potrero Marine Terminal Final Environmental Impact Report, September 2008, Port of Oakland 2012 Seaport Air Emissions Inventory, Environ, November 5, 2013, Port of Long Beach 2011 and 2013 Air Emissions Inventories.

*** These estimates were calculated using** the California Air Resources Board (CARB) methodology. 2014 emissions estimates were calculated using **0.1% Sulfur Fuel correction factor from CARB applied to 63 OGV vessels for 2014.**

***** On Site Truck Emissions were reduced by same factor as Port of Oakland, reflecting new California Air Resources regulations of heavy duty truck emissions from Port-related activities.**

Figure 3: Emissions at the Port of Richmond, 2010 (Blue) – 2014 (Green)

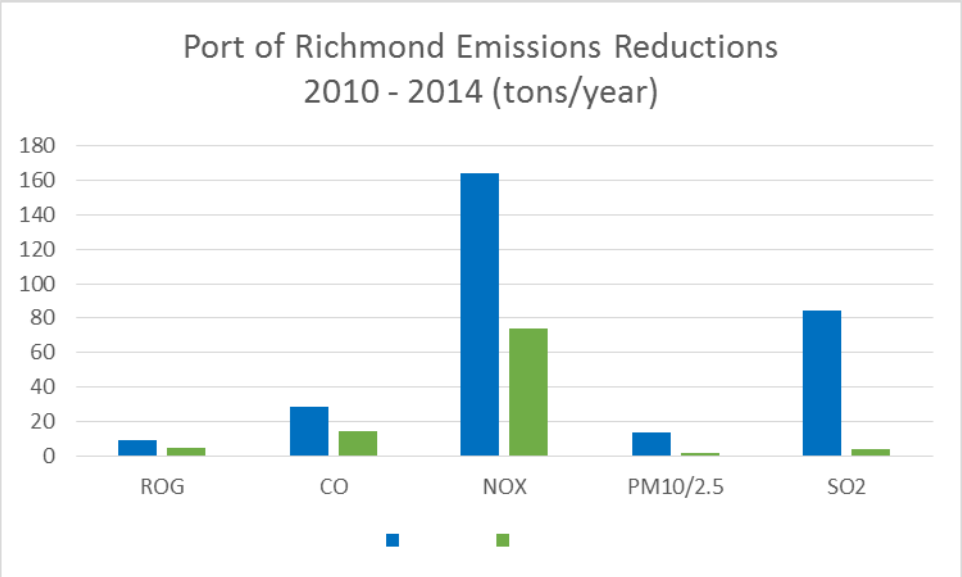

Table 7: 2014 Estimated Annual Port of Richmond Emissions (tons/year)*

Source	ROG	CO	NO_X	PM	SO_2	CO_2
Ocean-going Vessels (OGV, to 24 nm)**	2.7	5.8	53.3	1.2	5.4	2,473
Harborcraft	0.9	3.4	9.4	0.4	0.1	694
Cargo Handling Equipment (On-site)	0.1	0.6	0.2	0.0	0.0	163
Heavy Duty Trucks (On-site)***	0.6	3.7	9.0	0.1	0.0	*2,225*
Locomotives (On-site)	0.1	0.7	1.7	0.0	0.0	190
Total	**4.4**	**14.2**	**73.6**	**1.6**	**3.9**	**5,754**

Sources: SF Bay Area Seaports Air Emission Inventory, Port of Richmond 2005 Emissions Inventory, Bay Planning Coalition, October 2009 and Honda Port of Entry at the Point Potrero Marine Terminal Final Environmental Impact Report, September 2008, Port of Oakland 2012 Seaport Air Emissions Inventory, Environ, November 5, 2013, Port of Long Beach 2011 and 2013 Air Emissions Inventories.

**** These estimates were calculated using 0.1% Sulfur Fuel correction factor from CARB plus 63 OGV vessels for 2014.**

***** On Site Truck Emissions were reduced by same factor as Port of Oakland, reflecting new California Air Resources regulations of heavy duty truck emissions from Port-related activities.**

Table 8: 2010 Estimated Annual Port of Richmond Emissions (tons/year)

Source	ROG	CO	NO_X	PM	SO_2	CO_2
Ocean-going Vessels (OGV, to 24 nm)	4.7	10.0	119	11.3	83.1	6,448
Harborcraft	0.9	3.4	13.8	0.5	1.6	1,135
Cargo Handling Equipment (On-site)	0.1	0.6	0.2	0.0	0.0	163
Heavy Duty Trucks (On-site)	2.7	13.4	30.1	1.6	0.0	3,638
Locomotives (On-site)	0.1	0.7	1.7	0.0	0.0	190
Total	**8.6**	**28.1**	**164**	**13.4**	**84.7**	**11,573**

VI. CAAP Implementation: Next Steps

The Port of Richmond will continue to work with its tenants and others operating at the Port to ensure compliance with current and future state and federal air quality regulations. As part of its ongoing efforts to reduce emissions from operations at the Port of Richmond, Port staff will:

- Review current port practices to ensure compliance with state, federal and international air quality regulations;
- Notify responsible parties (ship, truck and rail operators and others) of their obligations and requirements under current regulations;
- Identify any emissions data collected by CARB that could be used in the Port of Richmond's emissions inventory update; and
- Identify funding sources to explore potential emission reduction programs.
- Review other port reductions measures and identify measures to evaluate further for Port of Richmond consideration.
- Report overall progress of the CAAP to City Council.
- Post progress reports prepared for City Council on the CAAP website regularly.

List of Preparers

Larry Magid, Principal, Public Policy Advising

References

Honda Port of Entry at the Point Potrero Marine Terminal Final Environmental Impact Report, September 2008.

Port of Houston Authority, Clean Air Strategy Plan, August 25, 2009.

Port of Houston Authority, 2007 Goods Movement Air Emissions Inventory at the Port of Houston, January 2009.

Port of Long Beach Air Emissions Inventory – 2013, Starcrest Consulting Group, 2014.

Port of Long Beach Air Emissions Inventory – 2011, Starcrest Consulting Group, 2012.

Port of Long Beach Air Emissions Inventory – 2008, Starcrest Consulting Group, December 2009.

Port of Los Angeles Air Emissions Inventory – 2013, Starcrest Consulting Group, July 2014.

Port of Los Angeles Air Emissions Inventory – 2008, Starcrest Consulting Group, December 2009.

Port of Oakland 2005 Seaport Air Emissions Inventory (Revised), Environ International Corporation, March 14, 2008.

Puget Sound Maritime Air Forum, Puget Sound Maritime Air Emissions Inventory, Starcrest Consulting Group, April 2007.

San Francisco Bay Area Seaports Air Emission Inventory, Port of Richmond 2005 Emissions Inventory, Bay Planning Coalition, October 2009.

San Diego Unified Port District, 2007 Clean Air Program Draft Report, Environ, December 2007.

San Pedro Ports, Draft 2010 Update San Pedro Bay Ports Clean Air action Plan, April 2010.

South Carolina Ports, 2005 Port of Charleston Baseline Air Emissions inventory, Moffatt & Nickol, September 12, 2008.