PORT OF LOS ANGELES BASELINE AIR EMISSIONS INVENTORY - 2001

Executive Summary
July 2005

Prepared by:
Starcrest Consulting Group, LLC

PORT-WIDE BASELINE AIR EMISSIONS INVENTORY
EXECUTIVE SUMMARY

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Prepared for:

PORT OF LOS ANGELES

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QUALITY ASSURANCE & ENVIRONMENTAL MANAGEMENT

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ACRONYMS AND ABBREVIATIONS

ARB	(California) Air Resources Board
ASTM	American Society for Testing and Materials
BAH	Booz Allen Hamilton, Inc.
BNSF	Burlington Northern Santa Fe Railroad
BSFC	brake specific fuel consumption
CHE	cargo handling equipment
CO	carbon monoxide
DF	deterioration factor
DMV	Department of Motor Vehicles
DPM	diesel particulate matter
DWT	deadweight tons
EEAI	Energy and Environmental Analysis, Inc.
EF	emission factor
EI	emissions inventory
EMD	(GE) Electromotive Division
EPA	U.S. Environmental Protection Agency
FCF	fuel correction factor
g/day	grams per day
g/hr	grams per hour
g/mi	grams per mile
GVWR	gross vehicle weight rating
HC	hydrocarbons
HDV	heavy-duty vehicle
hp	horsepower
hrs	hours
ICTF	Intermodal Container Transfer Facility
IFO	intermediate fuel oil
IMO	International Maritime Organization
ISO	International Organization for Standardization
ITB	integrated tug/barge
kW	kilowatts
lbs/day	pounds per day
LF	load factor
LPG	liquefied petroleum gas
MarEx	Marine Exchange of Southern California
MCR	maximum continuous rating
MDO	marine diesel oil
MMA	Meyer, Mohaddes Associates, Inc.
mph	miles per hour
MW	megawatts

ACRONYMS AND ABBREVIATIONS (Cont'd)

NO_x	oxides of nitrogen
OGV	ocean-going vessel
PCEEI	Pleasure Craft Exhaust Emissions Inventory
PHL	Pacific Harbor Line
PM	particulate matter
PM_{10}	particulate matter less than 10 microns in diameter
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
POLB	Port of Long Beach
ppm	parts per million
RIA	Regulatory Impact Analysis
RO	residual oil
Ro-Ro	roll-on/roll-off
rpm	revolutions per minute
RSD	Regulatory Support Document
RTG	rubber tired gantry crane
RTL	rich text language
SCAQMD	South Coast Air Quality Management District
SO_2	sulfur dioxide
SoCAB	South Coast Air basin
SSA	Stevedoring Services of America
SUV	sport-utility vehicle
TEU	twenty-foot equivalent unit
TOG	total organic gases
tpd	tons per day
tpy	tons per year
U.S.	United States
UP	Union Pacific Railroad
USACE	U.S. Army Corps of Engineers
VMT	vehicle miles of travel
VSR	Vessel Speed Reduction
VTS	Vessel Traffic Service

EXECUTIVE SUMMARY

The Port of Los Angeles (Port) has prepared a 2001 Baseline Emissions Inventory (EI) in response to concerns from the public about the potential health impacts to surrounding communities from Port operations and to provide the Port with a planning document for development, prioritization and implementation of emission control strategies to reduce these impacts.

To address community concerns about air quality and other impacts, the Board of Harbor Commissioners on October 10, 2001, acting on the request of Mayor James Hahn, adopted a "goal that there will be no net increase in air emissions or traffic impacts from future Port operations." To initiate action on meeting the goal, the Board directed staff to conduct several environmental baseline studies. The Board approved the Concept Plan for the Port-wide Environmental Studies in December 2001 that combined several of the original air quality initiatives into a single Air Studies Program.

The 2001 Baseline EI is a major milestone for the Port and represents successful completion of the first component of the Air Studies Program. The inventory's comprehensive activity-based approach provides emission estimates, focusing on emissions of diesel particulate matter, for all significant sources operating in the Port. Development of this EI has been coordinated with the U.S. Environmental Protection Agency - Region 9 (EPA), California Air Resources Board (ARB), and South Coast Air Quality Management District (SCAQMD).

The 2001 EI includes tenant source category emissions that occur on Port-owned land within the Port boundary/district. Figure ES.1 shows the land area of active Port terminals in 2001, designated in yellow, including the area to the northeast. This figure illustrates the in-Port area of study. In addition to in-Port emissions, emissions from locomotives and on-road trucks transporting Port cargo have been estimated for activity that occurs outside the Port, but within the South Coast Air Basin (SoCAB) boundaries. Figure ES.2 shows the SoCAB boundary and the location of the Port. Since both the Port and Port of Long Beach are interconnected with intermodal transportation linkages, every effort was made to only account for freight movements originating from or having a destination at the Port. For marine vessels, the geographical extent of the EI is the same boundary that was used in previous marine vessel inventories for the South Coast Air Quality Management District. Figure ES.3 shows the geographical extent of the out-of-Port study area for marine vessels.

The scope of the study includes five source categories: ocean-going vessels (OGVs), harbor craft (e.g., tugboats, ferries, commercial fishing vessels, dredges, etc.), off-road cargo handling equipment (CHE), railroad locomotives and on-road heavy-duty vehicles (HDV). For each source category, baseline emission estimates were developed for oxides of nitrogen (NO_X), total organic gases (TOG), carbon monoxide (CO), particulate matter less than 10 microns (PM_{10}) and 2.5 microns ($PM_{2.5}$) in diameter, diesel particulate matter (DPM), and sulfur dioxide (SO_2). The inventory does not include stationary sources, as these are included in stationary source permitting programs administered by the SCAQMD.

Figure ES.1: Baseline Inventory In-Port Study Area

Figure ES.2: South Coast Air Basin Boundary

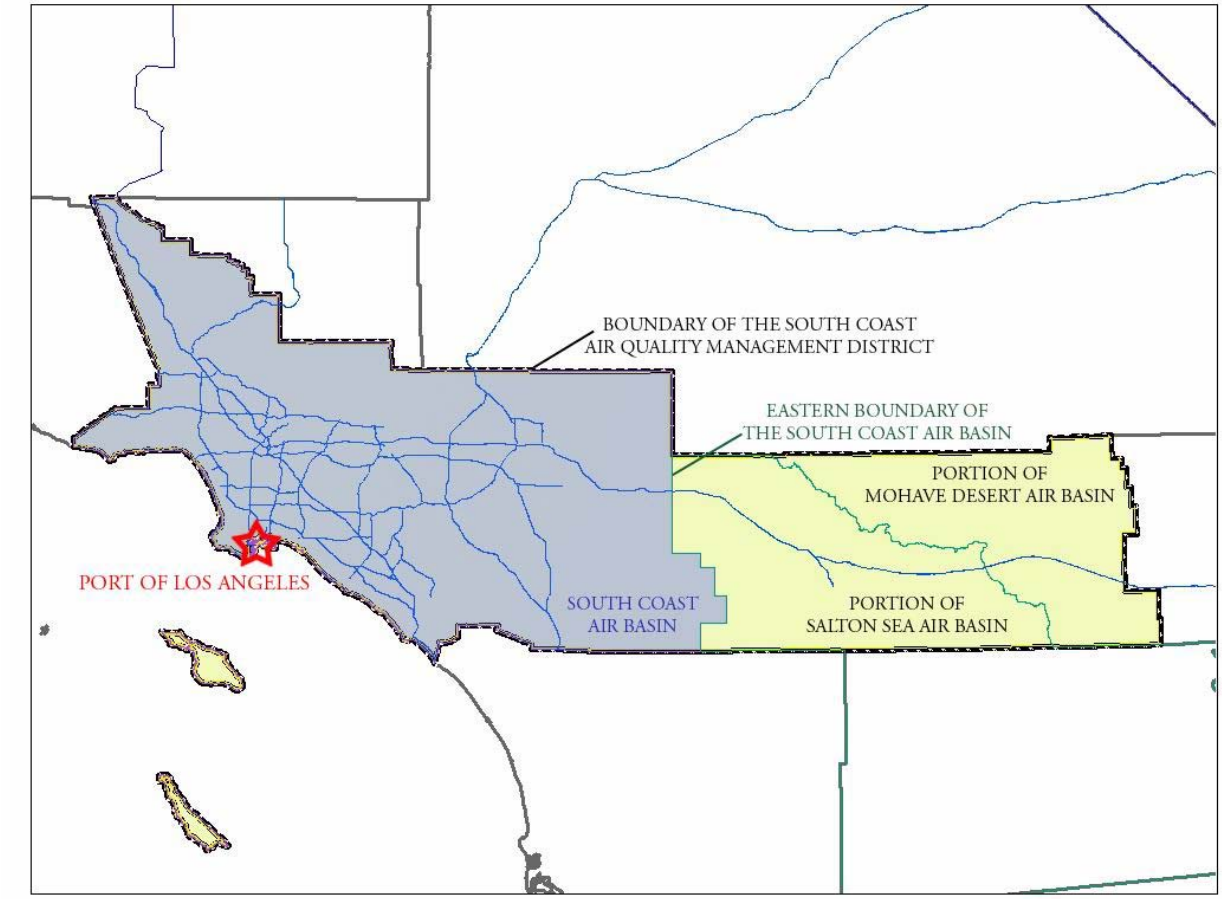
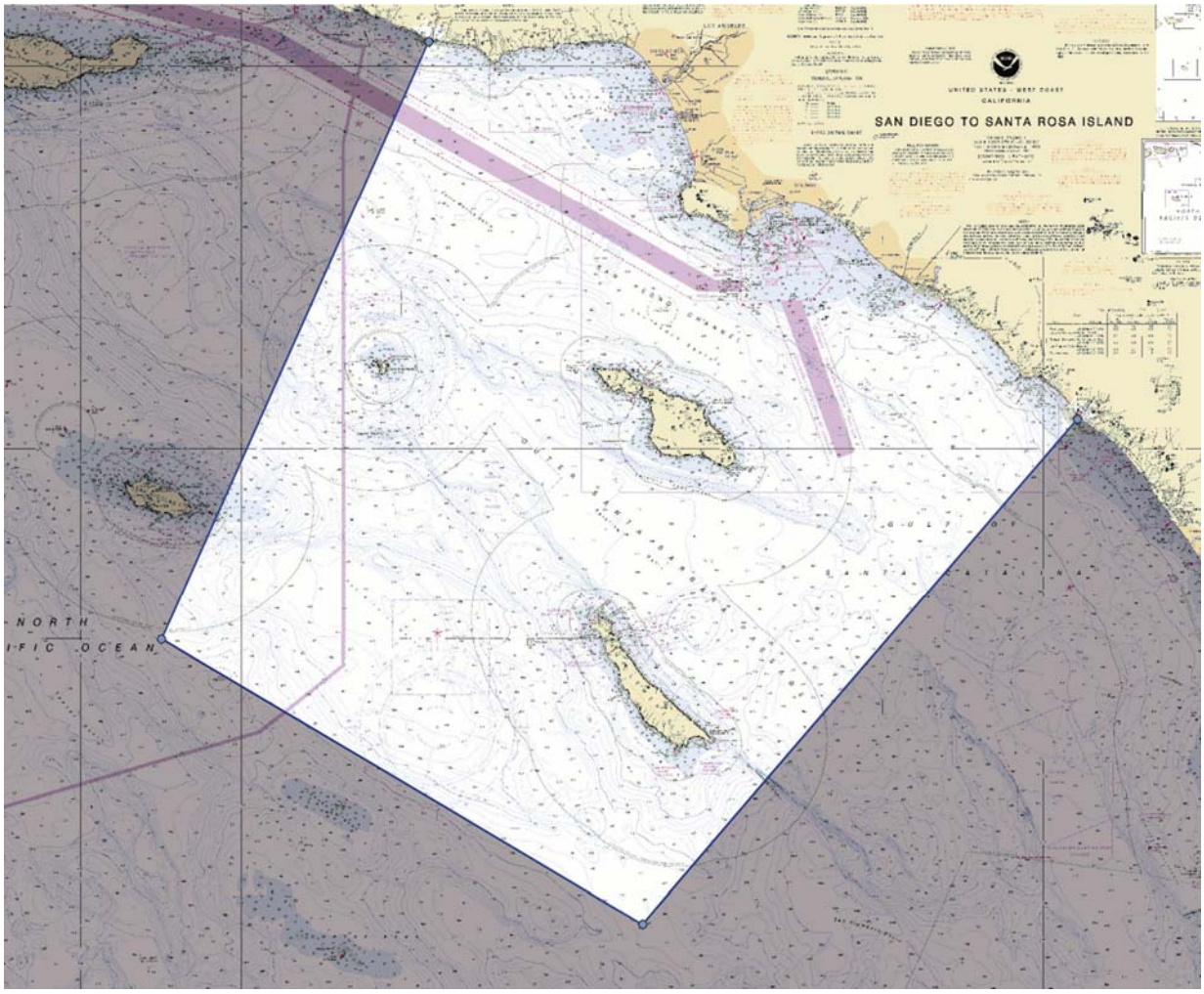


Figure ES.3: OGV and Harbor Vessel Out of Port Geographical Extent



Methodology Overview

The basic approach to developing an activity-based or "bottom-up" EI was based on interviews and conversations with tenants who own, operate and maintain equipment and own or charter vessels. Port tenants and shipping lines played an essential role in the success of this EI by providing the most accurate information available. The activity and operational data collected was then used to estimate emissions for each of the various source categories in a manner consistent with the latest estimating methods, as agreed on by the Port and participating regulatory agencies. The information that was gathered, analyzed and presented in this report improves the understanding of the nature and magnitude of Port-wide emission sources and is unprecedented in that it represents the first EI specifically covering Port sources of emissions disaggregated from all other sources contained in regional EIs. Specific data collection and analytical approaches unique to each of the five source categories are summarized below.

Ocean-Going Vessels

The basic methodology for estimating emissions from the various types of ocean-going vessels (auto carriers, bulk carriers, containerships, cruise ships, general cargo ships, ocean-going tugboats, refrigerated vessels, roll-on roll-off ships, bulk liquid tankers) that call on the Port utilized local activity-based data, previous marine emissions studies developed in California, elsewhere in the nation, and international studies. In addition to using available data on every OGV visit to the Port in 2001, the Port implemented an unprecedented Vessel Boarding Program that focused on gathering specific vessel characteristics and operational data and gaining an understanding of how the different types of OGVs arrive, depart, and transit the Port, as well as how they operate while at dock ("hotelling").

Harbor Craft

The Port harbor craft operators and marina managers were interviewed to develop a harbor craft list. ARB's 2002 Statewide Commercial Harbor Craft Survey and Pleasure Craft Exhaust Emissions Inventory supplemented this information. The harbor craft were separated into the following categories: assist tugboat, towboats and push boats, ferries, excursion vessels, crew boats, work boats, government vessels, dredges and dredging support, commercial fishing vessels, and recreational vessels. Valuable data was provided for assist tugs in the form of histograms on engine operations and loads. This is the first time that hard data of this caliber was used in a marine emissions inventory.

Cargo Handling Equipment

CHE consists of various types of equipment and vehicles that fall within the off-road designation and are used to move cargo within terminals and other off-road areas. The emission estimates for this group were prepared by the ARB using their OFFROAD[1] model, which has been developed to estimate emissions from off-road equipment fleets. Equipment operators and owners were interviewed and equipment lists with detailed specifications were developed that formed the inputs for the OFFROAD model. This ensured that specific information on the fleets that actually operate in the Port was used to estimate emissions.

[1] California Air Resources Board, OFFROAD, 2003. See http://www.arb.ca.gov/msei/off-road/off-road.htm.

Railroad Locomotives

Railroad operations are typically described in terms of two different types of operation, line haul and switching. Because of different types of information provided by the railroad companies, emissions were estimated using two basic methods. For most of the switching activities, emission estimates were based on the percentage of time spent in the different throttle notch settings. This information was obtained from on-board observations of switch engine operations during normal shift duties and from on-board dataloggers. For line haul activities (and a limited amount of switching activity), fuel usage was used as a surrogate measure of the level of activity of the locomotives. The EPA has published emissions information for switch and line haul locomotive operations in both throttle notch and fuel consumption modes and this information was used to cross-check between the estimating methods to demonstrate the degree of agreement.

Heavy-Duty Vehicles

There are two components to the estimation of HDV emissions presented in this report: on-road travel and on-terminal operations. For estimating on-road (off-terminal) HDV emissions, on-road activity information was developed by a traffic consultant, Meyer, Mohaddes Associates, Inc. (MMA), using trip generation and travel demand models that were used in previous Port traffic studies[2]. A Port-specific HDV model year distribution was developed by the ARB and the SCAQMD for this study by querying over 7,000 license plate numbers obtained from local terminals against the California Department of Motor Vehicles (DMV) registration database. For estimating on-terminal HDV emissions, terminal operators were interviewed with regards to on-terminal traffic patterns, including time spent waiting at the entry gate, time and distance on terminal while dropping off and/or picking up cargo, and time spent waiting at exit gates. Off-terminal and on-terminal emissions were estimated by multiplying the appropriate emission factor derived from EMFAC 2002[3] by the time and distance parameters established for the terminals.

Results

2001 emission estimates by source category in terms of tons per year (tpy) and tons per day (tpd) are summarized in Tables ES.1 and ES.2, respectively. These estimates include emissions related to 1) Port operations occurring within the Port boundary/district (In-Port) and 2) the transportation of Port-related cargo within the SoCAB (Regional).

[2] Meyer, Mohaddes Associates, Inc., June 2001. Ports of Long Beach/Los Angeles Transportation Study, and Meyer, Mohaddes Associates, Inc., April 2004. Port of Los Angeles Baseline Transportation Study.

[3] California Air Resources Board, EMFAC2002. EMFAC2002 is the emission factor model approved by EPA for use in estimating emissions for on-road vehicles in California.

Table ES.1: 2001 Emissions by Source Category, tons per year

	NO_X		TOG		CO		PM_{10}		$PM_{2.5}$		SO_2	
	In-Port	Regional	In-Port	Regional	In-Port	Regional	In-Port	Regional	In-Port	Regional	In-Port	Regional
Ocean-Going Vessels	1,967.6	6,922.7	55.6	233.6	159.8	553.9	68.8	561.0	55.1	449.9	1,098.5	4,117.5
Harbor Craft	1,968.0	3,530.7	172.2	376.0	701.5	1,622.8	99.7	178.0	91.7	163.7	152.0	506.4
Cargo Handling Equipment	1,862.6	1,862.6	204.5	204.5	725.5	725.5	111.6	111.6	102.6	102.6	44.1	44.1
Railroad Locomotives	445.9	2,465.8	17.0	99.7	49.6	249.4	9.9	60.1	9.1	55.2	3.1	89.8
Heavy-Duty Vehicles	872.5	4,463.5	53.1	185.5	246.0	815.3	24.4	87.9	22.4	77.9	6.1	33.6
Total	**7,116.6**	**19,245.3**	**502.4**	**1,099.3**	**1,882.4**	**3,966.9**	**314.4**	**998.6**	**280.9**	**849.3**	**1,303.8**	**4,791.4**

Table ES.2: 2001 Emissions by Source Category, tons per day

	NO_X		TOG		CO		PM_{10}		$PM_{2.5}$		SO_2	
	In-Port	Regional	In-Port	Regional	In-Port	Regional	In-Port	Regional	In-Port	Regional	In-Port	Regional
Ocean-Going Vessels	5.39	18.97	0.15	0.64	0.44	1.52	0.19	1.54	0.15	1.23	3.01	11.28
Harbor Craft	5.39	9.67	0.47	1.03	1.92	4.45	0.27	0.49	0.25	0.45	0.42	1.39
Cargo Handling Equipment	5.10	5.10	0.56	0.56	1.99	1.99	0.31	0.31	0.28	0.28	0.12	0.12
Railroad Locomotives	1.22	6.76	0.05	0.27	0.14	0.68	0.03	0.16	0.02	0.15	0.01	0.25
Heavy-Duty Vehicles	2.39	12.23	0.14	0.50	0.68	2.24	0.07	0.24	0.06	0.21	0.01	0.09
Total	**19.49**	**52.73**	**1.37**	**3.00**	**5.17**	**10.88**	**0.87**	**2.74**	**0.77**	**2.32**	**3.57**	**13.13**

Figure ES.4 illustrates the comparative contribution of each source category to total Port emissions, by key pollutant.

Figure ES.4: Port-Related Emissions by Source Category, tons per day

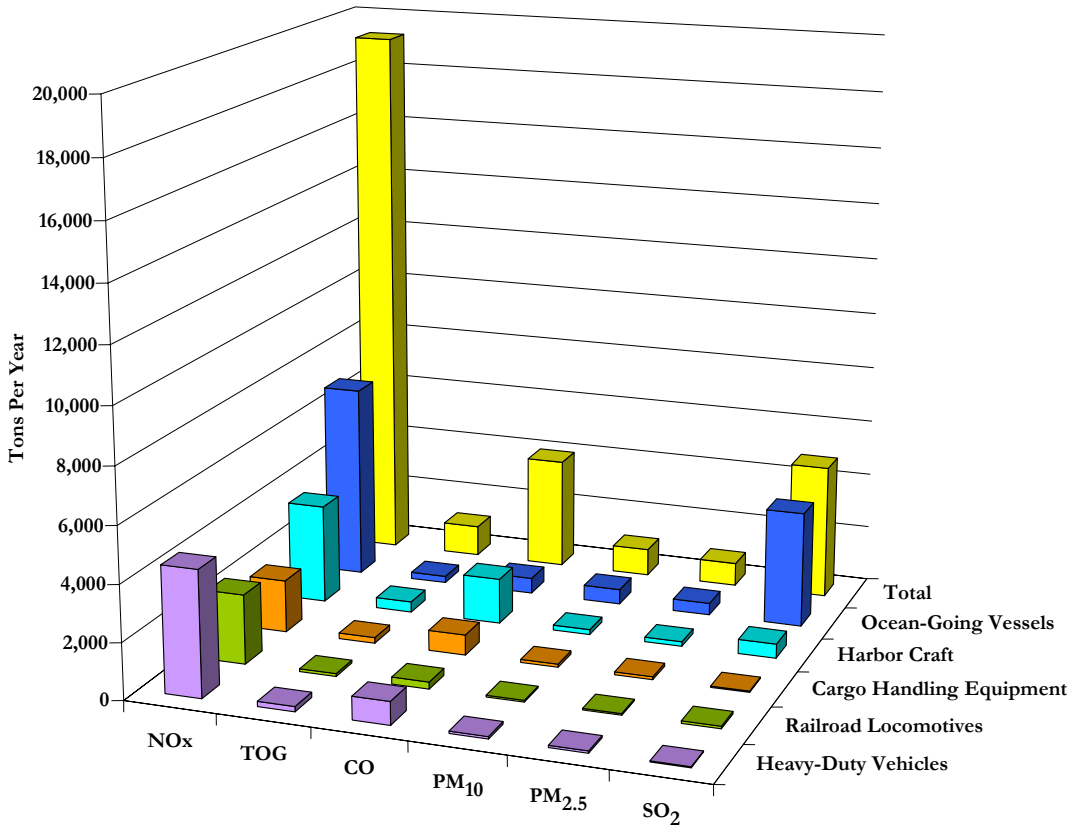


Table ES.3 illustrates the percentage breakdown of average annual emissions by source category for each pollutant and is an extension of the bar chart above.

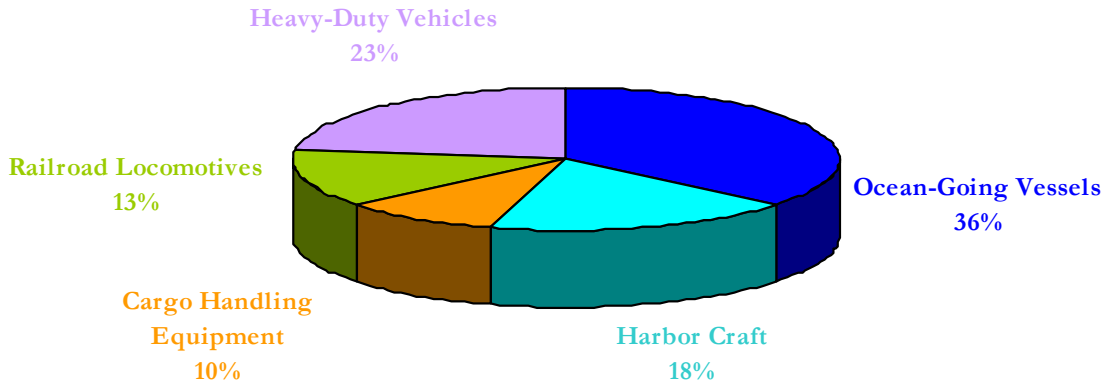
Table ES.3: Percentage Breakdown of Port Emissions in Air Basin

	NO_X	TOG	CO	PM_{10}	$PM_{2.5}$	SO_2
Ocean-Going Vessels	36%	21%	14%	56%	53%	86%
Harbor Craft	18%	34%	41%	18%	19%	11%
Cargo Handling Equipmei	10%	19%	18%	11%	12%	1%
Railroad Locomotives	13%	9%	6%	6%	7%	2%
Heavy-Duty Vehicles	23%	17%	21%	9%	9%	1%

The following five figures illustrate the percentage breakdown of average annual emissions by source category for each pollutant and graphically display the data contained in Table ES.3. In summary, the ocean-going vessels account for the largest percentage of emission for every pollutant, except for CO emissions in which the recreational vessels, included in the harbor vessel category, have a large percentage of the estimated CO emissions.

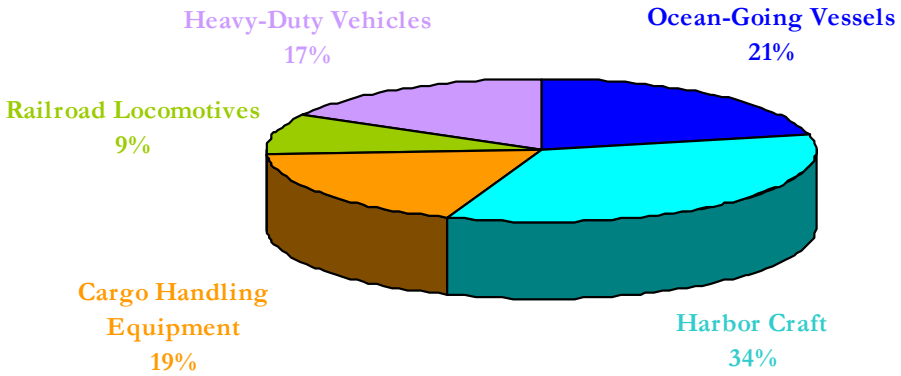
The NO_X emissions from ocean-going vessels represent 36% of Port-related emissions; heavy duty vehicles represent 23%; harbor craft represent 18%; locomotives represent 13%; and cargo handling equipment represent 10% of total Port NO_X emissions.

Figure ES.5: Percentage of Port NO_X Emissions by Source Category



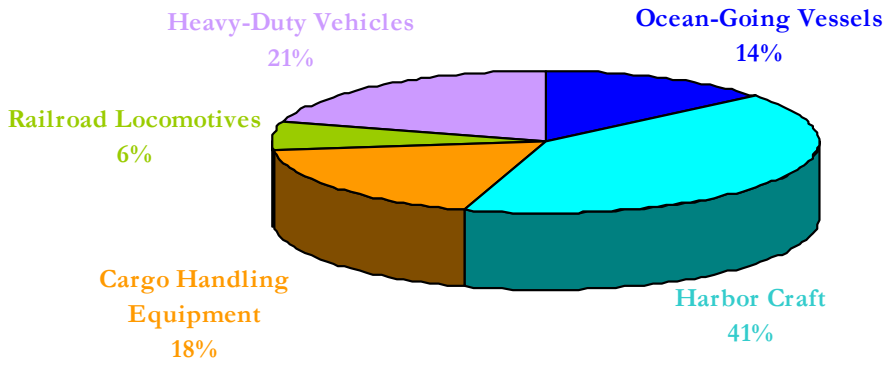
The TOG emissions from harbor craft represent 34% of Port-related emissions; ocean-going vessels represent 21%; cargo handling equipment represent 19%; heavy duty vehicles represent 17%; and locomotives represent 9% of total Port TOG emissions.

Figure ES.6: Percentage of Port TOG Emissions by Source Category



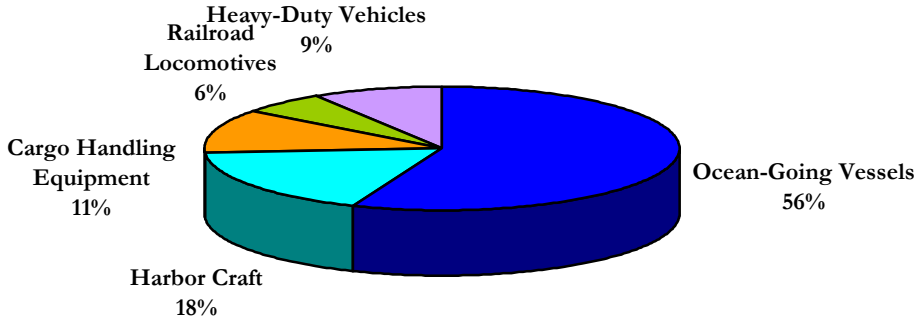
The CO emissions from harbor craft represent 41% of Port-related emissions; heavy duty vehicles represent 21%; cargo handling equipment represents 18%; ocean-going vessels represent 14%; and locomotives represent 6% of total Port CO emissions.

Figure ES.7: Percentage of Port CO Emissions by Source Category



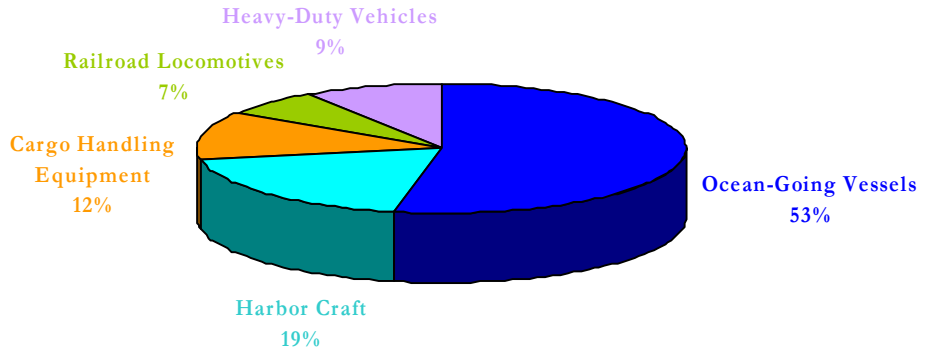
The PM10 emissions from ocean-going vessels represent 55% of Port-related emissions; harbor craft represent 18%; cargo handling equipment represents 12%; heavy duty vehicles represent 9%; and locomotives represent 6% of total Port PM10 emissions.

Figure ES.8: Percentage of Port PM_{10} Emissions by Source Category



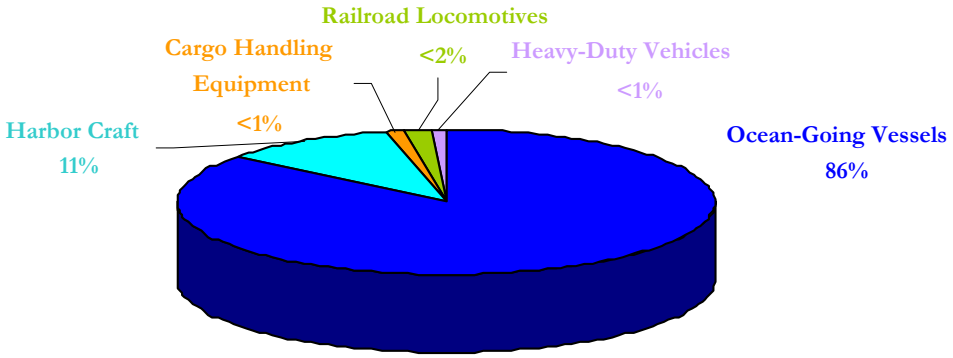
$PM_{2.5}$ emissions from ocean-going vessels represent 52% of Port-related emissions; harbor craft represent 20%; cargo handling equipment represents 12%; heavy duty vehicles represent 9%; and locomotives represent 7% of total Port $PM_{2.5}$ emissions.

Figure ES.9: Percentage of Port $PM_{2.5}$ Emissions by Source Category



The SO2 emissions from ocean-going vessels represent 86% of Port-related emissions; harbor craft represent 11%; locomotives represent less than 2%; and cargo handling equipment and heavy duty vehicles each represent less than 1% of the total Port SO2 emissions.

Figure ES.10: Percentage of Port SO_2 Emissions by Source Category



Next Steps

The successful completion of the Port-wide Baseline Emissions Inventory will enable the Port to initiate work on the remaining components of the Air Studies Program. Specifically, it provides the requisite data for preparation of a Port-wide health risk assessment and development of air emission control strategies necessary to achieve the Board's goal of "no net increase" in Port emissions. It also provides the foundation for future updates to the EI and preparation of project environmental analyses.