SECTION 1 INTRODUCTION

The Port of Long Beach (the Port or POLB) shares San Pedro Bay with the neighboring Port of Los Angeles (POLA). Together, the San Pedro Bay Ports comprise a significant regional and national economic engine for California and the United States (U.S.), through which more than 40% of all containerized trade in the nation flows. The San Pedro Bay Ports customs district accounts for approximately $300 billion in annual trade. Economic forecasts suggest that the demand for containerized cargo moving through the San Pedro Bay region will more than double by the year 2020. The economic benefits of the Ports are felt throughout the nation.

The Ports recognize that their ability to accommodate the projected growth in trade will depend upon their ability to address adverse environmental impacts (and, in particular, air quality impacts) that result from such trade. Therefore, in November 2006, the San Pedro Bay Ports adopted their landmark, joint Clean Air Action Plan designed to reduce air emissions and health risks while allowing port development to continue. This detailed annual activity-based inventory, with associated emissions estimates, is a critical and integral component to the success of the Clean Air Action Plan.

The Port of Long Beach (Port) is a landlord port; it builds terminal facilities and leases them to shipping lines and stevedoring companies. The Port does not operate the terminals, ships, yard equipment, trucks or trains that move the cargo.

The Port of Long Beach is recognized as a global leader in its strong and long-standing commitment to the environment and its effort to reduce emissions. The Port set a new industry standard by adopting its Green Port Policy in January 2005. The Port of Long Beach has won many awards for its environmental stewardship. In 2004, the Port received an American Association of Port Authorities (AAPA) environmental award for its Diesel Emissions Reduction Program. In 2006, the Port received AAPA’s Comprehensive Environmental Management Award of Excellence for the comprehensive Green Port Policy.

1.1 Reason for Study

This activity-based inventory includes port-related equipment, vehicle, and marine operations within the study’s geographical boundary (discussed in Section 1.5.3). The inventory includes physical parameters (source specifics such as engine size, age, fuel type, model, make, etc.), activity parameters (source specifics such as hours of operation, speed, transit times, number calls, date operational, etc.), and emissions reduction device parameters (type, reduce efficiency, etc.). Emissions estimates and reductions from control strategies are generated based on these parameters that have been collected for a specific calendar year. The annual emissions inventory will be a critical component to the Clean Air Action Plan. The inventory will be used to track and report the progress of the plan and provide the information needed to track efficiency improvements at all levels of port-related operations. The inventories will also be used for environmental impact analyses and reporting. Finally,
the relationships identified between activity, cargo throughputs, and emissions will be used as the basis for developing improved emissions forecasts based on potential cargo demands.

The Port released its first activity-based emissions inventory in 2004. The 2002 Baseline Air Emissions Inventory (2002 BAEI) evaluated emissions from 3 port-related source categories: off-road cargo handling equipment, rail locomotives and on-road heavy-duty vehicles that operate within the Port’s boundary in April, 2004. An Addendum to the 2002 Inventory (2002 Addendum) was concurrently developed with the 2005 Inventory to evaluate emissions from ocean-going vessels, harbor craft, and the off-port emissions associated with rail locomotives and on-road heavy-duty vehicles.

This 2005 Port of Long Beach Air Emissions Inventory has been prepared by the Port as a follow-up to the 2002 Baseline Air Emissions Inventory (2002 BAEI) and Addendum to 2002 BAEI. This document presents emissions estimates based on 2005 activity levels and also includes a discussion of emission reduction technologies and strategies used in 2005 to reduce emissions from Port facilities. All future updates, starting with the 2006 Port-wide emissions inventory (which is currently being compiled), will include greenhouse gases (GHGs) from port-related sources.

1.2 Goods Movement

Goods Movement (GM) has become a key issue associated with both growth of the California economy and the significant challenges to meeting the National Ambient Air Quality Standards (NAAQS) in the (SoCAB). Business, Transportation and Housing Agency (BTH) and the California Environmental Protection Agency (Cal/EPA) has recently updated their Goods Movement Action Plan (GMP). The purpose of the GMP is to develop an action plan to address GM related issues such as current and future infrastructure needs, impact on environment, adverse impact mitigation measures to protect public health and community concerns, public safety and security issues, and workforce development opportunities regarding goods movement.

As stated in the GMP, “it is the policy of this Administration to improve and expand California’s goods movement industry and infrastructure in a manner which will:

- Generate jobs
- Increase mobility and relieve traffic congestion
- Improve air quality and protect public health
- Enhance public and port safety
- Improve California’s “quality of life”

The GMP is focused to address goods movement in California’s four major “port-to-border” goods movement corridors:

---

Over decades, these corridors have been major routes for ship to rail, ship to truck, and truck to rail exchanges to move millions of containers per year to their ultimate destinations. As stated in the GMP, “to help develop order of magnitude estimates of how effort should be distributed among the corridors, the agencies compiled a series of indices to compare and contrast key indicators among the corridors. Items included:

- Value by customs district
- Maritime container volume
- Port of Entry tonnage
- Logistics jobs
- Daily vehicle hours of delay
- Mean average annual daily truck volume
- Total emissions per day
- Population

While the relative fractions or contributions of each of these factors vary by corridor, an unweighted aggregate of the fractions indicate that the Los Angeles/Long Beach-Inland Empire corridor in southern California ranks first by a large margin with about 60 percent of the aggregate shares. The Bay Area, Central Valley, and San Diego corridors represent 19 percent, 13 percent, and 8 percent, respectively. More specific analysis will be necessary to determine the relative allocation of effort among the corridors to achieve simultaneous and continuous improvement.”

As a part of the GMP, the CARB is responsible to develop an emissions reduction plan from international as well as domestic goods movement related future activities of the four corridors mentioned above. In April of 2006, CARB board adopted an Emissions Reduction Plan for Ports and Goods Movement in California. The international goods movement category includes emissions from all on-port sources, including

---

Port of Long Beach

2005 Air Emissions Inventory

- All ocean-going vessels up to 24 nautical miles,
- All harbor craft up to 24 nautical miles,
- All cargo handling equipment,
- All on-port trucks operation,
- All on-port rail operations,
- International goods movement portion of off-port truck operation, and
- International goods movement portion of off-port rail operation.

Again as stated in the GMP, “as set forth by the CARB Board on April 20, 2006, the State’s five specific goals for addressing the air pollution associated with goods movement are:

A. Reduce total statewide international and domestic goods movement emissions to the greatest extent possible and at least back to 2002 levels by year 2010;

B. Reduce the statewide diesel particulate matter (PM) health risk from international and domestic goods movement 85 percent by year 2020;

C. Reduce NO\textsubscript{x} emissions from international goods movement in the South Coast 30 percent from projected year 2015 levels, and 50 percent from projected year 2020 levels based on preliminary targets for attaining federal air quality standards;

D. Apply the emission reduction strategies for ports and goods movement statewide to aid all regions in attaining air quality standards; and

E. Make every feasible effort to reduce localized risk in communities adjacent to goods movement facilities as expeditiously as possible.”\textsuperscript{3}

This inventory will be utilized by the state to track emissions from port-related sources and to document reductions from both regulatory and Port lead reduction efforts. There are two types of control that the Port has over port-related sources: direct and indirect.

The Port has direct control through lease agreements with tenants/terminals located on port property and through tariffs. Using leases for example, the Port can negotiate conditions that could directly affect equipment operated on their leased terminal. There are limits however, to the frequency that this type of direct control can be utilized since most leases are signed for 20 or more years. The second type of direct control the Ports can utilize are changes to the tariff. A Port Tariff is the published set of rates, charges, rules and regulations for those doing business with a port. Each Port publishes its own tariff. A tariff is generally applicable to all tenants. However, individual operating leases may set

\textsuperscript{3} From Emissions Reduction Plan for Ports and Goods Movement approved by CARB’s Board on April 20, 2006. http://arb.ca.gov/planning/gmerp/gmerp.htm;
requirements to a specific version of the tariff (i.e., later changes don’t apply). All potential tariff changes will need to go through legal evaluation prior to being enacted.

Indirect control is again through the use of leases and tariff changes; however, the targets would be vessels, locomotives, and vehicles that call on the terminal which are not owned by the tenant. The Port can potentially affect these sources, for example, by negotiating standards for trucks calling at a terminal. There are some limitations to the extent at which this control mechanism can be used and legal review and analysis is required. The Clean Air Action Plan utilizes both direct and indirect control of port-related sources.

1.3 Marine Container Cargo Movements

Container terminals and their associated cargo movements are complex intermodal operations that are critical to international trade. Containerized cargo has significantly increased the efficiency and capacity the transportation system over the prior general cargo/break bulk cargo models (which still exist for non-containerized cargo). Due the inherent efficiencies of containerized cargo, the types of cargo shipped via containers are growing yearly. To better understand the operations of the international transportation network associated with ports, this subsection describes overseas container transport, import cargo containers and their distribution locally and nationally, export cargo containers (locally and nationally), and how empty cargo containers are dealt with.

**Overseas Container Transport**

Imported cargo generally starts at an overseas manufacturer, supplier, or consolidation facility, where items are boxed and placed inside metal shipping containers. Containers generally come in two common sizes 20’ or 1 twenty-foot equivalent (TEU), or 40’ or 2 TEUs. Other sizes such as 45’ and 53’ are also used. The U.S. buyer may contact an industry professional know as a “freight forwarder,” or logistics company, to coordinate transportation of the cargo. The container will then be transported to a foreign port, assessed for possible security risks, and then place on board container ships which are specialized specifically to carry containerized cargo. Containers ships calling at the San Pedro Bay Ports range form 2,000 – over 8,000 TEUs per ship. The container ships transport the containerized cargo to the San Pedro Bay Ports, where it is unloaded, and forwarded to local or national destinations. Figure 1.1 presents the steps that are associated with overseas cargo movements.
Figure 1.1: Overseas Container Transport

Notes:
1) Product ordered
2) Container to foreign port (not shown)
3) Security checks by U.S. Customs Agents based at foreign ports
4) Container loaded onboard
5) Coast Guard review of ship, crew, and cargo manifests
6) Port pilots board and dock the container ship
7) Unloading the ship with unionized longshore workers (see Figure 1.2 for further details)
8) Security checks by U.S. Customs Agents
9) Radiation detection

Import Container Transport
Once the ship arrives at the Port, the imported containers are either transported by train or by truck to their final destination, or to one of several intermediate destinations such as a railyard, warehouse, distribution center, or “transload” facility (a sorting, routing, and short-term storage facility). A container’s final destination will determine exactly what path it will take once it leaves the dock. Figure 1.2 presents the steps that are associated with imported container cargo movements.
Notes:

1) Unloading ship. The marine terminal operator will arrange for unionized longshore workers to unload the ship. Containers are placed on trucks, rail, or terminal cargo handling equipment for storage on terminal.

2) Freight forwarder or logistics provider will provide directions to the marine terminal operators and contact a trucking company or train operator to move the container out of the Port.

3) Cargo placed directly on rail using “on-dock” rail (as available).

4) Near-dock rail yards are used for terminals without on-dock rail or if additional rail capacity is needed. Trucks are used to “dray” containers from terminals to railyard.

5) Off-dock railyards are used to coordinate rail deliveries to national destinations. Containers are delivered by truck, then sorted and grouped by final destination. These railyards handle Port cargo as well as domestic cargo from other sources.

6) Shipping containers are often moved initially to a “transload” facility where cargo is unloaded, sorted, and repackage into larger-sized truck trailers. The cargo is then delivered from the facility to regional distribution centers, local stores, or off-dock railyards.

Export Container Transport
Export container cargo is similar to import containers however the flow is in the opposite direction. As with imported cargo, exported cargo may require multiple intermediate stops between its producer/manufacturer of the cargo and the Port. The figure below, presents the steps that are associated with exported container cargo movements.
Figure 1.3: Export Container Transport

Notes:
1) Local origin direct delivery to the marine terminal from the producer, manufacturer, or exporting company.
2) Local or non-local origin cargo is delivered to a warehouse/consolidator where the cargo may be temporarily stored with other cargo bound for export. Cargo may also be transferred from domestic truck trailers to marine shipping containers.
3) Some non-local origin cargo is shipped by rail are delivered to off-dock railyards where the cargo is placed onto truck for final delivery to marine terminals.
4) Some non-local origin cargo is shipped by rail directly to the marine terminal where it is loaded onto a ship or stored temporarily for the appropriate ship to arrive.
5) Some non-local origin cargo is shipped by rail to near-dock railyards, where the cargo is picked up by truck for a short trip to the marine terminal.
6) Vessel loading of export cargo is conducted after the ship has been unloaded of its import cargo.

Empty Containers
Since the U.S. imports more goods than it exports, many empties are sent overseas to be reused or used for other purposes domestically. Typically, about a third of the containers loaded onto a ship at the San Pedro Bay Ports will be filled with cargo, while about two-thirds will be empty. The figure below, diagrams the movement of empty containers after the delivery of full, imported containers to local businesses and/or transload facilities. Intermodal containers returning to the local area empty are not depicted; they would enter the system at the marine terminal or empty container storage yard.
Notes:
1) Delivery to a local exporter who needs to fill empty containers. Direct delivery of containers between importers and exporters is encouraged to reduce the number of truck trips a container takes in the South Coast (also known as a “virtual container yard”).
2) Empty containers are delivered to container storage yards from a transload facility or local importer to an empty container storage yard. From the storage yard, containers are moved by truck to the marine terminal for export or to a local exporter to be filled with cargo.
3) Direct delivery from a transload facility or local importer to the marine terminal for export.
4) Empty containers are loaded onto a container ship to be exported and reused overseas.

1.4 Regulatory Measures Addressing Port-Related Activities

Almost all of the emissions at the ports come from five diesel fueled source categories. In addition to ocean-going vessels (OGVs), these are On-Road Heavy-Duty Vehicles (HDVs), Cargo Handling Equipment (CHE), Harbor Craft and Rail Locomotives (RL). The responsibility for the emissions control of the majority of these sources falls under the jurisdiction of local SCAQMD, state (CARB) or federal EPA agencies. Below is a list of recently adopted and proposed regulatory measures that will reduce emissions from the Ports over the next five fiscal years and beyond.
1.4.1 Ocean-Going Vessels

EPA Advance Notice of Proposed Rulemaking for Standards for Marine Diesel Engines Up to 30 liters/cylinder

EPA has published an Advance Notice of Proposed Rulemaking (ANPRM) regarding its plan to propose new emission standards for marine diesel engines up to 30 liters per cylinder displacement. According to the ANPRM, EPA is considering standards modeled after the 2007/2010 highway and Tier 4 non-road diesel engine programs, with an emphasis on achieving large PM emission reductions as early as possible through the use of advanced emission control technology starting as early as 2011. This technology, based on high-efficiency catalytic after treatment, is enabled by the availability of clean diesel fuel with sulfur content capped at 15 ppm. EPA is currently developing the Notice of Proposed Rulemaking (NPRM) for this program.

Emission Standards for Marine Diesel Engines Above 30 l/cyl (Category 3 Engines)

EPA is pursuing two parallel, related actions for emission standards for Category 3 marine diesel engines. (1) EPA is a member of the U.S. delegation that is participation in negotiations at the International Maritime Organization (IMO) with regard to amendments to Annex VI that consider additional NOx limits for new engines; additional sulfur content limits for marine fuel; methods to reduce PM emissions; potential NOx and PM limits for existing engines; and potential volatile organic compounds (VOCs) limits for tankers. The Sub-Committee on Bulk Liquids and Gases is expected to make recommendations to the Marine Environment Protection Committee by mid-2007. (2) EPA is planning to develop new national standards for Category 3 marine diesel engines over the next few years, taking into consideration the state of technology that may permit emission reductions and the status of international action for more stringent standards.

Emissions Standard for Marine Propulsion Engines

The IMO adopted limits for NOx in Annex VI to the International Convention for the Prevention of Pollution from Ships in 1997. These NOx limits apply to marine engines over 130 kilowatts (kW) installed on vessels built on or after 2000. The NOx standards are from 17.0 grams per kilowatt hour (g/kW-hr) [(for < 130 rpm) to 9.8 g/kW-hr (for <2000 revolutions per minute (rpm)), depending upon the engine speed in rpm. The required number of countries ratified the Annex in May 2004 and it went into force for those countries in May 2005. The Annex has not yet been ratified by the U.S. Engine manufacturers have been certifying engines to the Annex VI NOx limits since 2000 as the standards are retroactive.

Vessel Speed Reduction (VSR) Program

In May of 2001, a Memorandum of Understanding (MOU) between the POLA, POLB, EPA Region 9, CARB, SCAQMD, the Pacific Merchant Shipping Association (PMSA), and the Marine Exchange of Southern California was signed. This MOU calls for OGVs to voluntarily reduce speed to 12 knots at a distance of
20 nautical miles (nm) from Point Fermin. Reduction in speed demands less power on the main engine, which in turn reduces NO\textsubscript{x} emissions and fuel usage.

**Low Sulfur Fuel for Marine Auxiliary Engines**

In December of 2005, CARB adopted low sulfur fuel requirements for marine auxiliary engines within 24 nm of the California coastline. Starting in January of 2007, it requires use of marine diesel oil (MDO) or marine gas oil (MGO) with sulfur content of equal or less than 0.5% S by weight, followed by use of marine gas oil with sulfur content of equal or less than 0.1% S in 2010. The use of low sulfur fuel will reduce emissions of NO\textsubscript{x}, DPM, and SO\textsubscript{x}.

**1.4.2 Harbor Craft**

**Emission Standards for Harbor Craft Engines**

EPA has established new engine standards for new “category 1 & 2” diesel engines – engines rated over 50 horsepower (hp) used for propulsion in most harbor craft. These standards are to be phased in between 2004 and 2007 and limit NO\textsubscript{x}, hydrocarbon, CO and DPM, but the emissions reductions achieved are modest in next five years. EPA expects 24% reduction in NO\textsubscript{x} and 12% reduction in DPM in 2030 when the harbor craft engine fleet is fully turned over to these new engines.

**Low Sulfur Fuel Requirement for Harbor Craft**

In 2004, CARB adopted a low sulfur fuel requirement for harbor craft. Starting January 1, 2006 (in SoCAB) harbor craft are required to use on-road diesel fuel (e.g., ultra-low sulfur diesel [ULSD]), which has sulfur content limit of 15 parts per million (ppm) sulfur and lower aromatic content. Use of lower sulfur and aromatic fuel will result in NO\textsubscript{x} and DPM reduction benefits. In addition, use of low sulfur fuel will facilitate retrofitting of harbor craft with emissions control devices such as diesel particulate filters (DPFs) that have potential to reduce PM by 85%.

**DPM and NO\textsubscript{x} Emission Reductions from In-Use Harbor Craft**

As a part of Diesel Risk Reduction Plan and Goods Movement Plan, CARB staff is proposing a regulation to reduce DPM and NO\textsubscript{x} from new and in-use commercial harbor crafts. Under CARB’s definition, commercial harbor crafts include tug boats, tow boats, ferries, work boats, crew boats, military vessels and fishing vessels. The goal of this regulation is to achieve reduction in DPM and NO\textsubscript{x} by 25% in 2010, 30% in 2015 and 40% in 2020. Currently, CARB staff is soliciting public comments and updating the emissions inventory.

**1.4.3 Cargo Handling Equipment**

**Emissions Standards for Non-Road Diesel Powered Equipment**

The EPA’s and CARB’s Tier 1, Tier 2, Tier 3, and Tier 4 (interim Tier 4 and final) emissions standards for non-road diesel engines require compliance with progressively more stringent standards for hydrocarbon, CO, diesel particulate matter (DPM), and NO\textsubscript{x}. Tier 4 standards for non-road diesel powered equipment
complement the latest 2007+ on-road heavy-duty engine standards requiring 90 percent reduction in DPM and NO\textsubscript{x} when compared against the current level. To meet these standards, engine manufacturers will produce new engines with advanced emissions control technologies similar to those already expected for on-road heavy-duty diesel vehicles. These standards for new engines will be phased in starting with smaller engines in 2008 until all but the very largest diesel engines meet NO\textsubscript{x} and PM standards in 2015. Currently, the interim Tier 4 standard includes 90% reduction for PM and a 60% reduction in NO\textsubscript{x}.

**Cargo Handling Equipment Regulation**

In December of 2005 CARB adopted a regulation to reduce emissions from CHE such as yard tractors and forklifts starting in 2007. The regulation calls for the replacement or retrofit of existing engines with engines that use Best Available Control Technology (BACT). Beginning January 1, 2007 the regulation will require that newly purchased, leased, or rented CHE be equipped with either a 2007 or later on-road engine, a Tier 4 off-road engine or the cleanest verified diesel PM emissions control system which reduces DPM by 90% and NO\textsubscript{x} by at least 70% for yard tractors. For non-yard tractors cargo handling equipment currently verified technologies reduces PM by 85%.

**1.4.4 Railroad Locomotives**

**Emissions Standards for New and Remanufactured Locomotives and Locomotive Engines**

In 1998, EPA adopted Tier 0 (1973-2001), Tier 1 (2002-2004), and Tier 2 (2005+) emissions standards applicable to newly manufactured and remanufactured railroad locomotives and locomotive engines. These standards require compliance with progressively more stringent standards for emissions of hydrocarbon, CO, NO\textsubscript{x}, and DPM. Although the most stringent standard, Tier 2, results in over 40% reduction in NO\textsubscript{x} and 60% reduction in DPM compared to Tier 0, full potential of these reductions will not be realized in the next five years because of the long life of diesel locomotive engines.

**EPA Advance Notice of Proposed Rulemaking for Locomotives**

EPA has published an ANPRM regarding its plan to propose new emission standards for locomotives. According to the ANPRM, EPA is considering standards modeled after the 2007/2010 highway and Tier 4 non-road diesel engine programs, with an emphasis on achieving large PM emission reductions as early as possible through the use of advanced emission control technology starting as early as 2011. This technology, based on high-efficiency catalytic after treatment, is enabled by the availability of clean diesel fuel with sulfur content capped at 15 ppm. EPA is currently developing the NPRM for this program.

**Low Sulfur Fuel Requirement for Intrastate Locomotives**

In 2004, CARB adopted a low sulfur fuel requirement for intrastate locomotives. Intrastate locomotives are defined as those locomotives that operate at least 90
percent of time within borders of the state, based on hours of operation, miles traveled, or fuel consumption. Mostly applicable to switchers, starting January 1, 2006, statewide, intrastate locomotives are required to use CARB off-road diesel fuel which has sulfur content limit of 15 ppm sulfur (S) and lower aromatic content. Use of fuel with lower sulfur and lower aromatics will result in NOx and DPM reductions. In addition, use of low sulfur fuel will facilitate retrofitting of locomotives with emissions control devices such as DPFs that have potential to reduce DPM by 85%.

Statewide 2005 Memorandum of Understanding
In order to accelerate the implementation of Tier 2 engines in SoCAB, CARB and EPA Region 9 entered into an enforceable MOU in 1998 with two major Class 1 freight railroads [Union Pacific (UP) and Burlington Northern Santa Fe (BNSF)] in California. This MOU requires UP and BNSF to concentrate introduction of the Tier 2 locomotives in the SoCAB which will achieve 65% reduction in NOx by 2010.

In 2005, CARB entered into another MOU with UP and BNSF whereby these two railroads have agreed to phase out non-essential idling and install idling reduction devices, identify and expeditiously repair locomotives that smoke excessively and maximize the use of 15 ppm S fuel.

1.4.5 Heavy-Duty Vehicles
Emission Standards for New 2007+ On-Road Heavy-Duty Vehicles
In 2001, CARB adopted EPA’s stringent emission standards for 2007+ HDV, which will ultimately result in 90% reductions in emissions NOx and PM. Per this regulation, HDV engine manufacturers will be meeting a PM standard of 0.01 g/bhp-hr starting in 2007, which is 90% lower than the 2004 PM standard of 0.1 g/bhp-hr. The NOx standard requires a phase-in of the 0.2 g/bhp-hr NOx standards between 2007 and 2010. By 2010, all engines have to meet the 0.2 g/bhp-hr NOx standard, which is over 90% lower than the 2004 NOx standard of 2.4 g/bhp-hr. It is expected that between 2007 and 2010, on average, manufacturers will be producing HDV engines meeting the PM standard of 0.01 g/bhp-hr and a NOx standard of 1.2 g/bhp-hr. This latter standard is referred the 2007 interim standard.

Heavy-Duty Vehicle On-Board Diagnostics (OBD) Requirement
In 2005, CARB adopted a comprehensive HDV OBD regulation, which ensures that the increasingly stringent HDV emissions standards being phased in are maintained during each vehicle’s useful life. The OBD regulation requires manufacturers to install a system in HDVs to monitor virtually every emissions related component of the vehicle.

Ultra-Low Sulfur Diesel (ULSD) Fuel Requirement
In 2003, CARB adopted a regulation requiring that diesel fuel produced or offered for sale in California for use in any on-road or non-road vehicular diesel engine (with
the exception of locomotive and marine diesel engines) contain no more than 15 ppm of S by weight, beginning June 2006 statewide. This ULSD fuel is needed in order for retrofit technologies, such as diesel particulate filters, to work successfully.

Reducing Emissions from On-Road Heavy-Duty Diesel Trucks Dedicated to Goods Movement at California Ports

As a part of CARB’s emissions reduction plan for ports and goods movement in California, staff of CARB is proposing a control measure to reduce emissions from on-road heavy-duty diesel trucks dedicated to goods movement at California ports. CARB staff is proposing three steps to reduce truck emissions: (1) replace older trucks with cleaner trucks; (2) install verified emissions control devices and; (3) establish emissions criteria for trucks entering the ports. Currently, CARB staff is conducting public meetings to obtain comments from stakeholders and expects to take the final regulation to their board’s approval in late 2007.

As stated at the beginning of this section, in addition to these regulations, CARB is pursuing additional regulations that would reduce emissions from port-related equipment sources. These include equipment in the following categories:

- Port trucks (through a fleet rule and incentive program)
- Harbor craft
- Ship main engines (through fuel, engine emissions requirements, and mandatory speed reduction)
- Ship auxiliary engines at dock (through shore-powering, engine controls, or other effective technologies)
- Ship incinerators (banned within 3 miles of the shore)

CARB anticipates completing these rulemaking actions by the end of 2007. The recently adopted CARB regulations (listed in 1.3.1-1.3.5), anticipated CARB rulemakings, and the measures in the Clean Air Action Plan will provide a vital and complementary combination to the overall effort to meet both State and San Pedro Bay Ports air quality improvement goals.

One non-regulatory program that is also helping to significantly reduce emissions from sources including those associated with ports is the Carl Moyer Program. This program is a CARB administered grant program implemented in partnership with local air districts to fund the replacement of older, “dirty” engines or to cover the incremental cost of purchasing cleaner-than-required engines and vehicles. Under this program, owners/operators of mobile emissions sources can apply for incremental funding to reduce emissions. The program is also being expanded to include a fleet modernization component. Emissions source categories at the Ports that have been successful in obtaining Carl Moyer funding includes: heavy-duty vehicles, cargo handling equipment, harbor craft, and rail locomotives. It is important to note that only emission reductions that are surplus to regulatory requirements are eligible for Carl Moyer funding. As regulations are developed
which require retrofit or replacement of specific equipment and/or vehicles, those projects will no longer be eligible for funding.

1.5 Scope of Study

The scope of the study is described in terms of the year of activity used as the basis of emissions estimates, the pollutants quantified, the included and excluded source categories and the geographical extent. The purpose of the 2005 Inventory of Air Emissions (2005 EI) is to develop emission estimates based on activities that occurred in calendar year 2005.

1.5.1 Pollutants

Exhaust emissions of the following pollutants have been estimated:

- Particulate matter (PM) (10-micron, 2.5-micron)
- Diesel particulate matter (DPM)
- Oxides of nitrogen (NOx)
- Oxides of sulfur (SOx)
- Total organic gas (TOG)
- Carbon monoxide (CO)

The listed pollutants are criteria pollutants, with the exception of DPM, which is considered a toxic air contaminant. In 1988, CARB identified DPM as a toxic air contaminant.

Organic compound emissions can be reported in various ways depending on the end use of the emissions estimates. Some examples of organic compounds include total hydrocarbon (HC), reactive organic gases (ROG), TOG, and VOC. CARB defines total organic gases as a means of total hydrocarbon plus oxygenated components such as alcohols and aldehydes that take part in ozone formation reactions. In this study, some of the tables and text may list and discuss hydrocarbons and total organic carbons depending on what is being discussed.

1.5.2 Emission Sources

The scope includes the following five source categories:

- Ocean-Going Vessels
- Harbor Craft
- Cargo Handling Equipment
- Railroad locomotives
- Heavy-Duty Vehicles

---

The inventory does not include stationary sources, as these are included in stationary source permitting programs administered by the SCAQMD. The inventory does not include emissions from vessels and equipment used for oil operations located within the port boundary and off-shore. The oil industry-related emissions are included in a separate study conducted by the Port.

1.5.3 Geographical Extent
The 2005 EI includes tenant source category emissions that occur on Port-owned land within the Port boundary/district. An overview of the geographical extent is provided below for each of the source categories.

The geographical scope for cargo handling equipment is the terminals and facilities on which they operate. Figure 1.5 shows the land area of active Port terminals in 2005.

**Figure 1.5: Port of Long Beach Map of Terminals**
Emissions from switching and line haul railroad locomotives were estimated for on-dock rail yards, intermodal yards on Port property, and the rail lines linking these facilities. For heavy-duty trucks related to the hauling of cargo, emissions from queuing at terminal entry gates, for travel and idling within the terminals, and for queuing at the terminal exit gates have been included. In addition to emissions that occur inside the Port facilities, emissions from locomotives and on-road trucks transporting cargo to or from the Port have been estimated for activity that occurs within the SoCAB boundaries. Emissions are estimated up to the cargo’s first point of rest within the SoCAB or up to the basin boundary, whichever comes first. First point of rest is the location where the cargo, such as a container of goods, is first off-loaded from the transport device (truck or train) after leaving the Port. Examples include cargo transported from the Port by truck to a distribution center or to an off-Port intermodal yard.

Figure 1.6 shows the SoCAB boundary for rail and HDV in relation to the location of the Port. Since both the Port of Long Beach and the Port of Los Angeles 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, OGVs and commercial harbor craft, the geographical extent of the EI is based on the same boundary that was used in previous marine vessel inventories developed for the SCAQMD. Emissions for OGVs that called at the Port include transit within the study area, maneuvering inside the harbor, and hotelling at berth and at anchorages. Figure 1.7 shows the geographical extent of the study area for marine vessels.

Figure 1.7: OGV and Harbor Vessel Out of Port Geographical Extent
1.5.4 Facilities Not Included

There are certain industrial operations and other emission-producing activities that are located on Port property or on private property within the Port boundaries that are not included in this inventory. The facilities that have not been included are:

- Harbor Cogeneration
- SERFF
- Tidelands Oil Company
- Thums Oil Operations

Some of these operations and activities are within the Port for historical reasons, for example some operations were present prior to an area becoming Port property. Other operations take place on property leased from Port but are not in any way related to the activities or operations of the Port, and in many cases, the Port does not have authority or influence over these operations.

Emissions associated with the oil operations located at the Port are excluded from this inventory (Tidelands and Thums Oil Operations) but are included in a separate study conducted to quantify oil industry-related emissions published in 20065. Stationary sources are not included in this inventory.

1.6 General Methodology

The basic approach to developing an activity-based EI is through collecting data through interactive 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 development of this EI by providing the most accurate information available. The activity and operational data collected was input into a database for storage and to estimate emissions for each of the various source categories in a manner consistent with the latest estimating methods, as agreed to by the Port and the participating regulatory agencies. The information gathered, analyzed, and presented in this report continues to improve the understanding of the nature and magnitude of Port-wide emission sources. Specific data collection and analytical approaches unique to each of the five source categories are summarized below, along with a summary of the key updates to the 2005 inventory.

In general, emissions were estimated using the activity and operational information described above and emission factors, which are measures of emissions that express the mass of emissions in terms of a unit of activity. For example, emission factors may be expressed in terms of pounds of emissions (of a particular pollutant) per horsepower-hour. Horsepower-hours are the product of in-use horsepower times hours of operation. Emissions can be calculated, then, by multiplying hours of operation per year (activity data) by in-use horsepower (operational information) by an emission factor (such as pounds per

horsepower-hour) to provide an estimate of emissions in pounds of emissions per year. The actual calculations are often more complex than this example, because such parameters as in-use horsepower must be estimated as part of the calculations. In addition, the emission factors often vary depending on equipment-specific factors such as the model year and the accumulated hours of use. The methods of calculating emissions are more completely described in the sections covering each source category.

1.6.1 Ocean-Going Vessels
The basic methodologies for estimating emissions from the various types of ocean-going vessels that call on the Port utilize local activity-based data to the greatest extent possible. This includes call records from the Marine Exchange of Southern California, which tracks and records the movement of all OGVs entering or departing San Pedro Bay. In addition, the Port undertakes a Vessel Boarding Program that focuses on gathering specific vessel characteristics and operational data from ships visiting the Port, to gain a greater understanding of how the different types of OGVs arrive, depart, and transit San Pedro Bay and the harbor, as well as how they operate while at dock (“hotelling”).

Additional ship-specific OGV data was obtained from Lloyd’s Register of Ships (Lloyd’s), a marine vessel data system that can provide vessel specific data for virtually every OGV in the world fleet. Lloyd’s data was also used to develop profiles for parameters that are not known for every ship. The general vessel classifications included in the 2005 EI include the following.

- Automobile carriers
- Bulk carriers
- Containerships
- Cruise ships
- General cargo ships
- Ocean-going tugboats
- Refrigerated vessels
- Roll-on roll-off ships
- Tankers

Emission factors were developed for different types of OGV engines by review of the literature and discussion/coordination with the regulatory agencies. Emissions were calculated by multiplying the emission factors by vessel-specific activity parameters such as in-use horsepower and hours of operation. Numerous calculations were made for each port visit to adequately characterize the complicated activities of OGVs; (e.g., separate calculations were made for vessel transit, maneuvering, and hotelling activities for propulsion, auxiliary engines, and auxiliary boilers). The results of all the calculations were summed to produce the overall emission estimates.
The emission estimates presented in the update include the effects of the following emission reduction measures in place in 2005.

- The vessel speed reduction (VSR) program requiring 12 knots during transiting outside the harbor
- Switching to a lower sulfur fuel near the coast or at berth on a voluntary basis by various shipping lines
- Newer vessels calling at the Port with cleaner and more fuel-efficient engines that meet or exceed standards set by the IMO

1.6.2 Harbor Craft

Harbor craft operators whose vessels work within Port waters were interviewed to update the inventory of harbor craft developed for the 2002 Baseline EI. The harbor craft are separated into the following categories:

- Assist tugboat
- Towboats and push boats
- Ferries
- Excursion vessels
- Crew boats
- Work boats
- Government vessels
- Recreational vessels

Emission factors were developed for different types of harbor craft engines by review of the literature and discussion/coordination with the regulatory agencies. Emissions were calculated by multiplying the emission factors by the appropriate measure of activity (such as annual hours of operation). The emission reductions accounted for in this inventory are the vessels that were replaced as of 2005, which make up one third of all the engines inventoried and the cleaner fuel used.

1.6.3 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 followed the OFFROAD model methodology, which has been developed by the CARB to estimate emissions from off-road equipment fleets. Equipment operators and owners were interviewed and the equipment lists with detailed specifications were updated for 2005. Significant improvements were seen for the 2005 CHE inventory. In 2005, newer pieces of equipment and various emission reduction technologies and programs were in place at the various terminals.

---

1.6.4 Railroad 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. Different companies conduct switching (Pacific Harbor Line) and line haul (Burlington Northern Santa Fe, Union Pacific) operations within the port and the line haul companies also operate switching locomotives at off-port rail yards.

The on-port switching company operates a dedicated fleet of locomotives, while the line haul locomotives that service the port are part of a nation-wide fleet, meaning that individual locomotives are not assigned specifically to port or South Coast Air basin service. Therefore, the types of information available for these two types of activity differs – for the on-port switching locomotives, information on each locomotive and its activity (e.g., fuel use and throttle notch setting frequency) can be used to estimate emissions, whereas for the line haul locomotives the information is more general (e.g., in terms of fuel use per ton of cargo and total tons of cargo carried). The EPA has published emissions information for switch and line haul locomotive operations in both throttle notch and fuel consumption modes, so this information was used to estimate emissions and to cross-check between the estimating methods. Emission reductions accounted for in the 2005 emission estimates include the use of emulsified fuel in one on-port switching locomotive.

1.6.5 Heavy-Duty Vehicles

Heavy-duty on-road vehicles transport cargo between the port and off-port locations such as rail yards, warehouses, and distribution centers. To develop emission estimates, truck activities have been evaluated as having three components:

- On-terminal operations, which include waiting for terminal entry, transiting the terminal to drop off and/or pick up cargo, and departing the terminals.
- Off-terminal port operations, consisting of travel on public roads within the Port jurisdictional boundaries.
- On-road operations outside the Port boundaries but within the SoCAB. This includes travel within the boundaries of the adjacent Port of Long Beach, because the routes many trucks take run through both ports on the way to and from Port terminals.
For estimating on-road HDV emissions, activity information was developed by a traffic consultant using the trip generation and travel demand models that were used in previous Port traffic studies\(^7\). For estimating on-terminal HDV emissions, terminal operators were interviewed with regard 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. A Port-specific HDV model year distribution was developed by the Port by querying about 35,000 unique license plate numbers obtained from local terminals against the California Department of Motor Vehicles (DMV) registration database.

Emissions from HDVs were estimated by multiplying the speed-specific emission factor derived from ARB’s emission factor model EMFAC 2007 by the distance parameters established for the terminals (on-terminal emissions) or road segments (on-road emissions). On-terminal idling emissions were estimated by multiplying the EMFAC idling emission factor by estimated idling times.

1.7 Report Organization

This report presents the 2005 emissions and the methodologies used for each category in each of the following sections:

- Section 2 discusses ocean-going vessels
- Section 3 discusses harbor craft
- Section 4 discusses cargo handling equipment
- Section 5 discusses locomotives
- Section 6 discusses heavy-duty vehicles
- Section 7 discusses findings and results
- Section 8 compares 2005 emissions to adjusted 2002 emissions
- Section 9 discusses limitations and strengths

The report also includes:

- Appendix A includes OGV input
- Appendix B includes harbor craft input
- Appendix C includes CHE input
- Appendix D includes rail
- Appendix E includes HDV
- Appendix F includes the validation data for Section 8 comparison
