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 hydrocarbon (HC)
- Carbon monoxide (CO)
- Carbon dioxide (CO₂)
- Methane (CH₄)
- Nitrous oxide (N₂O)

**Methodology Overview**

Port tenants and shipping lines play an essential role in the development of an activity-based Emissions Inventory (EI) by providing the most accurate activity and operational information available. Emissions estimates are developed for each of the various source categories in a manner consistent with the latest estimating methodologies agreed upon by the Port and the participating regulatory agencies. The information gathered, analyzed, and presented in this 2007 EI continues to improve the understanding of the nature and magnitude of Port-related emission sources. Development of this inventory was coordinated with the U.S. Environmental Protection Agency - Region 9 (EPA), California Air Resources Board (CARB), and SCAQMD.

The geographical extent of the 2007 inventory is described in section 1 and in each source category section of the report. The geographical extent of the port-related emissions did not change from the 2005 inventory and includes emissions from all source categories within the harbor district; emissions from rail locomotives and on-road trucks transporting cargo to or from the Port up to the cargo’s first point of rest within the South Coast Air Basin (SoCAB) or up to the basin boundary, whichever comes first; and emissions from commercial marine vessels within the harbor and up to the study area boundary. Figure ES.1 shows the SoCAB boundary.
Figure ES.1: South Coast Air Basin Boundary

Figure ES.2 shows the geographical extent for the ocean-going vessels and harbor craft. The over-water boundary is bounded in the north by the southern Ventura County line at the coast and in the south with the southern Orange County line at the coast.
Findings
Table ES.1 and Figure ES.3 illustrate the differences in vessel calls and container cargo throughputs between 2005 and 2007. In 2007, there was 9% increase in TEU throughput at the Port from 2005. The average TEUs handled per call went up 11%. The number of containership calls decreased by 2% overall calls decreased by 15% from 2005 to 2007.

Table ES.1: TEUs and Vessel Call Comparison, %

<table>
<thead>
<tr>
<th>EI Year</th>
<th>All Calls</th>
<th>Containership Calls</th>
<th>TEUs</th>
<th>Average TEUs/Call</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>3,166</td>
<td>1,384</td>
<td>6,709,818</td>
<td>4,848</td>
</tr>
<tr>
<td>2007</td>
<td>2,700</td>
<td>1,358</td>
<td>7,312,465</td>
<td>5,385</td>
</tr>
<tr>
<td>Change (%)</td>
<td>-15%</td>
<td>-2%</td>
<td>9%</td>
<td>11%</td>
</tr>
</tbody>
</table>
2007 Air Emissions Inventory

Figure ES.3: TEUs and Vessel Call Comparison, %

Ocean-going Vessels
Figure ES.4 shows that the majority of the vessels that called at the Port in 2007, there were 2,700 inbound calls to the port. Containerships made the majority (50%) of the calls followed by tankers (19%), bulk carriers (9%), auto carriers (7%), cruise vessels (6%), RoRo (4%), and general cargo vessels (3%). Ocean-going tugs and miscellaneous vessels account for the remaining two percent.

Figure ES.4: Distribution of Vessel Types by Inbound Calls
The proportion of ocean-going vessels employing emission reduction strategies are listed in Table ES.2 and summarized below:

- The percent of calls with vessels that had fuel-efficient slide valves is 16% as compared to 0% in 2005.
- The percent of calls with IMO-compliant vessels (model year 2000 and newer) is 56% as compared to 36% in 2005.
- The percent of vessel calls that switched to a cleaner fuel for auxiliary engines at berth and within 24 nm is 100% as compared to 14% in 2005.
- The percent of vessel calls that switched to a cleaner fuel for main engines during transit is 6% which includes the cruise ships and a few tankers.
- In 2007, approximately 89% of the vessel calls complied with the VSR program as compared to 68% in 2005.
- In addition to ready-reserve vessels that cold iron, 19 calls at a bulk terminal cold ironed in 2007.

**Table ES.2: OGV Emission Reduction Strategies**

<table>
<thead>
<tr>
<th>Year</th>
<th>Slide Valve (%)</th>
<th>IMO Compliant (%)</th>
<th>Fuel Switch Aux Eng (%)</th>
<th>Fuel Switch Main Eng (%)</th>
<th>VSR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>0%</td>
<td>36%</td>
<td>14%</td>
<td>0%</td>
<td>68%</td>
</tr>
<tr>
<td>2007</td>
<td>16%</td>
<td>56%</td>
<td>100%</td>
<td>6%</td>
<td>89%</td>
</tr>
</tbody>
</table>

**Harbor Craft**

Figure ES.5 presents the distribution of the 100 commercial harbor craft inventoried for the Port of Long Beach in 2007.
The following observations can be made of the 2007 harbor craft inventory for replaced engines.

- 13 vessels have Tier 2 engines (most engines 2004 and newer)
- 27 vessels have Tier 1 engines (most engines ranging from 2000 to 2003 model year)
- 84 vessels have Tier 0 engine (engines older than 1999)

Note that a vessel may have a combination of engines that meet different standards if the engines are not all replaced at the same time. For example, a vessel may receive funding to replace the auxiliary engines, but not propulsion engines or vice-versa. Based on engine count, the following observations can also be made:

- 42 Tier 2 engines (12%)
- 73 Tier 1 engines (22%)
- 222 Tier 0 engines (66%)

**Cargo Handling Equipment**

Figure ES.6 presents the distribution of the 1,457 pieces of equipment inventoried at the Port for 2007. Of all the CHE inventoried at Port facilities, 52% were yard tractors, 22% were forklifts, 11% were top handlers, seven percent were rubber-tired gantry (RTG) cranes, two percent were side handlers, 1% were sweepers, and five percent were other equipment.

*Figure ES.6: Distribution of 2007 Port CHE by Equipment Type*
Over 80% of all CHE equipment at the Port are used by container terminals. Table ES.3 shows the percentage of container terminal CHE as compared to the total Port CHE.

### Table ES.3: Percentage of Container Terminal CHE as Compared to Total CHE

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Total Count</th>
<th>Container Terminal Count</th>
<th>Container Terminal Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forklift</td>
<td>316</td>
<td>105</td>
<td>33%</td>
</tr>
<tr>
<td>RTG crane</td>
<td>98</td>
<td>98</td>
<td>100%</td>
</tr>
<tr>
<td>Side pick</td>
<td>39</td>
<td>39</td>
<td>100%</td>
</tr>
<tr>
<td>Top handler</td>
<td>157</td>
<td>155</td>
<td>99%</td>
</tr>
<tr>
<td>Yard tractor</td>
<td>754</td>
<td>752</td>
<td>100%</td>
</tr>
<tr>
<td>Sweeper</td>
<td>20</td>
<td>8</td>
<td>40%</td>
</tr>
<tr>
<td>Other</td>
<td>73</td>
<td>19</td>
<td>26%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,457</strong></td>
<td><strong>1,176</strong></td>
<td><strong>81%</strong></td>
</tr>
</tbody>
</table>

Table ES.4 is a summary of the emission reduction technologies by equipment type. One hundred percent of the diesel equipment used ULSD in 2007. The count of diesel equipment using ULSD does not match total equipment count because the inventory includes equipment with non-diesel engines (i.e. gasoline, propane, LNG). Many of the equipment using alternative fuel may have installed a retrofit, in other words, the technologies may be used in combination with one another.

### Table ES.4: CHE Emission Reduction Technologies by Equipment

<table>
<thead>
<tr>
<th>Equipment</th>
<th>DOC Installed</th>
<th>On-Road Engines</th>
<th>USLD Fuel</th>
<th>Emulsified Fuel</th>
<th>O$_2$ Diesel</th>
<th>DPF Installed</th>
<th>Vycon Installed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forklifts</td>
<td>34</td>
<td>0</td>
<td>162</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>RTG cranes</td>
<td>11</td>
<td>0</td>
<td>98</td>
<td>0</td>
<td>12</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Side handlers</td>
<td>37</td>
<td>0</td>
<td>39</td>
<td>0</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Top handlers</td>
<td>87</td>
<td>0</td>
<td>157</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Yard tractors</td>
<td>521</td>
<td>134</td>
<td>754</td>
<td>0</td>
<td>84</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Sweepers</td>
<td>1</td>
<td>0</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>0</td>
<td>64</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>692</strong></td>
<td><strong>134</strong></td>
<td><strong>1,287</strong></td>
<td><strong>0</strong></td>
<td><strong>116</strong></td>
<td><strong>12</strong></td>
<td><strong>2</strong></td>
</tr>
</tbody>
</table>
Table ES.5 shows the percent of diesel powered equipment that used the emission reduction technologies.

### Table ES.5: Percent of Emission Reduction Technologies

<table>
<thead>
<tr>
<th>Equipment</th>
<th>DOC Installed</th>
<th>On-Road engines</th>
<th>USLD Fuel</th>
<th>Emulsified Fuel</th>
<th>O₂ Diesel</th>
<th>DPF</th>
<th>Vycon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forklifts</td>
<td>21%</td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
<td>2%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>RTG cranes</td>
<td>11%</td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
<td>12%</td>
<td>0%</td>
<td>2%</td>
</tr>
<tr>
<td>Side handlers</td>
<td>95%</td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
<td>18%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Top handlers</td>
<td>55%</td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
<td>6%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Yard tractors</td>
<td>69%</td>
<td>10%</td>
<td>100%</td>
<td>0%</td>
<td>11%</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>Other</td>
<td>3%</td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>54%</strong></td>
<td><strong>10%</strong></td>
<td><strong>100%</strong></td>
<td><strong>0%</strong></td>
<td><strong>9%</strong></td>
<td><strong>1%</strong></td>
<td><strong>0%</strong></td>
</tr>
</tbody>
</table>

**Rail Locomotives**

Table ES.6 shows the various throughput comparisons for rail locomotives for 2005 and 2007. From 2005 to 2007, there was a 43% increase in total on-dock rail and a 16% increase in near-dock rail.

### Table ES.6: TEU Throughput Comparison

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2007</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Port Throughput</td>
<td>6,709,818</td>
<td>7,312,465</td>
<td>9%</td>
</tr>
<tr>
<td>Total On-Dock Rail</td>
<td>1,125,176</td>
<td>1,607,117</td>
<td>43%</td>
</tr>
<tr>
<td>% On-Dock</td>
<td>17%</td>
<td>22%</td>
<td></td>
</tr>
<tr>
<td>Near-Dock Rail</td>
<td>555,694</td>
<td>643,919</td>
<td>16%</td>
</tr>
<tr>
<td>% Near-Dock</td>
<td>8%</td>
<td>9%</td>
<td></td>
</tr>
</tbody>
</table>
**Heavy-Duty Vehicles**

Table ES.7 shows a decrease in total idling time from 2005 to 2007. This is due to mainly to three factors:

- The terminals modernized their gate system with optical character recognition (OCR) and added several queuing lines at the in and out gates which increased the efficiency at the gates and thus reduced idling time.
- Assembly Bill 2650 (known as the Lowenthal Bill), introduced in 2004, required that each marine terminal in California operate in a manner that does not cause the engines on trucks to idle or queue for more than 30 minutes while waiting to enter the gate into the marine terminal.
- Since July 2005, all marine terminals at the Port of Long Beach and Port of Los Angeles, offer off-peak shifts on nights and weekends. As part of the program, a Traffic Mitigation Fee is required for cargo movement through the ports during peak daytime hours.

<table>
<thead>
<tr>
<th>Table ES.7: HDV Total Idling Time Comparison, hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>EI Year</td>
</tr>
<tr>
<td>2005</td>
</tr>
<tr>
<td>2007</td>
</tr>
</tbody>
</table>

**Summary of 2007 Emission Estimates**

The emission results for the Port of Long Beach 2007 Air Emissions Inventory are presented in Table ES.8 and ES.9.

<table>
<thead>
<tr>
<th>Table ES.8: 2007 Port-related Emissions by Category, tpy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
</tr>
<tr>
<td>---------------------------------</td>
</tr>
<tr>
<td>Ocean going vessels</td>
</tr>
<tr>
<td>Harbor craft</td>
</tr>
<tr>
<td>Cargo handling equipment</td>
</tr>
<tr>
<td>Rail locomotives</td>
</tr>
<tr>
<td>Heavy-duty vehicles</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>
Table ES.9: 2007 Port-related GHG Emissions by Category, tpy

<table>
<thead>
<tr>
<th>Category</th>
<th>CO₂</th>
<th>N₂O</th>
<th>CH₄</th>
<th>CO₂ Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocean going vessels</td>
<td>433,929</td>
<td>25</td>
<td>6</td>
<td>441,652</td>
</tr>
<tr>
<td>Harbor craft</td>
<td>76,354</td>
<td>3</td>
<td>2</td>
<td>77,205</td>
</tr>
<tr>
<td>Cargo handling equipment</td>
<td>189,324</td>
<td>4</td>
<td>5</td>
<td>190,624</td>
</tr>
<tr>
<td>Rail locomotives</td>
<td>80,316</td>
<td>2</td>
<td>7</td>
<td>81,119</td>
</tr>
<tr>
<td>Heavy-duty vehicles</td>
<td>494,664</td>
<td>14</td>
<td>22</td>
<td>499,349</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,274,588</strong></td>
<td>47</td>
<td>41</td>
<td><strong>1,289,950</strong></td>
</tr>
</tbody>
</table>

Figure ES.7 shows the distribution of the 2007 total port-related emissions for each pollutant and category.

**Figure ES.7: 2007 Port-related Emissions by Category, %**
Another way to view the total emissions is in relation to whether they occurred inside the Port boundary or outside the Port boundary.

The following were included in the emissions inside the Port boundary:

- Harbor maneuvering and hotelling emissions from ocean-going vessels
- In-harbor emissions from harbor craft
- All cargo handling equipment emissions
- On-terminal and on-port on-road emissions from heavy-duty vehicles
- On-port emissions from rail including switching and line haul

The following were included in the emissions outside the Port boundary:

- Transit emissions from ocean-going vessels between the breakwater and the SoCAB boundary.
- Emissions from harbor craft operating between the breakwater and the SoCAB boundary
- No cargo handling equipment emissions outside of port boundaries
- Off-port on-road emissions from heavy-duty vehicles up to the SoCAB boundary or first point of rest
- Off-port emissions from rail up to the SoCAB boundary or first point of rest

Table ES.10 and Figure ES.8 show the distribution of Port-related emissions as it relates to the port boundary.
Table ES.10: 2007 Port-related Emissions in the SoCAB Basin and within the Port Boundary, tpy

<table>
<thead>
<tr>
<th>Category</th>
<th>Port Related Emissions</th>
<th>PM$_{10}$</th>
<th>PM$_{2.5}$</th>
<th>DPM</th>
<th>NO$_x$</th>
<th>SO$_x$</th>
<th>CO</th>
<th>HC</th>
</tr>
</thead>
<tbody>
<tr>
<td>OGV</td>
<td>Inside Port boundary</td>
<td>222</td>
<td>178</td>
<td>123</td>
<td>3,692</td>
<td>2,619</td>
<td>343</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>Outside Port boundary</td>
<td>270</td>
<td>216</td>
<td>267</td>
<td>3,380</td>
<td>1,841</td>
<td>333</td>
<td>152</td>
</tr>
<tr>
<td>OGV</td>
<td>Total Port-related emissions</td>
<td>492</td>
<td>394</td>
<td>391</td>
<td>7,072</td>
<td>4,460</td>
<td>676</td>
<td>301</td>
</tr>
<tr>
<td>Harbor Craft</td>
<td>Inside Port boundary</td>
<td>39</td>
<td>36</td>
<td>39</td>
<td>969</td>
<td>0</td>
<td>257</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td>Outside Port boundary</td>
<td>10</td>
<td>9</td>
<td>10</td>
<td>242</td>
<td>0</td>
<td>64</td>
<td>15</td>
</tr>
<tr>
<td>Harbor Craft</td>
<td>Total Port-related emissions</td>
<td>49</td>
<td>45</td>
<td>49</td>
<td>1,211</td>
<td>1</td>
<td>321</td>
<td>77</td>
</tr>
<tr>
<td>CHE</td>
<td>Inside Port boundary</td>
<td>39</td>
<td>36</td>
<td>39</td>
<td>1,339</td>
<td>1</td>
<td>334</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>Outside Port boundary</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CHE</td>
<td>Total Port-related emissions</td>
<td>39</td>
<td>36</td>
<td>39</td>
<td>1,339</td>
<td>1</td>
<td>334</td>
<td>46</td>
</tr>
<tr>
<td>HDV</td>
<td>Inside Port boundary</td>
<td>32</td>
<td>30</td>
<td>32</td>
<td>553</td>
<td>0</td>
<td>237</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td>Outside Port boundary</td>
<td>264</td>
<td>243</td>
<td>264</td>
<td>5,412</td>
<td>5</td>
<td>1,811</td>
<td>269</td>
</tr>
<tr>
<td>HDV</td>
<td>Total Port-related emissions</td>
<td>296</td>
<td>273</td>
<td>296</td>
<td>5,964</td>
<td>5</td>
<td>2,048</td>
<td>365</td>
</tr>
<tr>
<td>Locomotives</td>
<td>Inside Port boundary</td>
<td>19</td>
<td>17</td>
<td>19</td>
<td>529</td>
<td>17</td>
<td>85</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Outside Port boundary</td>
<td>30</td>
<td>27</td>
<td>30</td>
<td>807</td>
<td>29</td>
<td>131</td>
<td>46</td>
</tr>
<tr>
<td>Locomotives</td>
<td>Total Port-related emissions</td>
<td>49</td>
<td>44</td>
<td>49</td>
<td>1,336</td>
<td>47</td>
<td>217</td>
<td>75</td>
</tr>
<tr>
<td>Total</td>
<td>Inside Port boundary</td>
<td>351</td>
<td>297</td>
<td>253</td>
<td>7,082</td>
<td>2,638</td>
<td>1,256</td>
<td>383</td>
</tr>
<tr>
<td>Total</td>
<td>Outside Port boundary</td>
<td>574</td>
<td>495</td>
<td>571</td>
<td>9,841</td>
<td>1,875</td>
<td>2,340</td>
<td>482</td>
</tr>
<tr>
<td>Total</td>
<td>Total Port-related emissions</td>
<td>925</td>
<td>791</td>
<td>824</td>
<td>16,923</td>
<td>4,513</td>
<td>3,596</td>
<td>865</td>
</tr>
</tbody>
</table>
In order to put the Port-related emissions into context, the following figures and tables compare the Port’s contributions to other sources in the South Coast Air Basin\(^1\). The 2007 SoCAB emissions used for this comparison were interpolated from the 2005 and 2008 emissions found in the 2007 AQMP Appendix III. In the South Coast Air Basin, 9% of diesel particulate matter emissions, 5% of NO\(_x\) emissions, and 26% of SO\(_x\) emissions are attributed to port-related emissions from Port of Long Beach.

\(^1\) SCAQMD, Final 2007 AQMP Appendix III, Base & Future Year Emissions Inventories, June 2007.
Table ES.11 and Figure ES.12 present the total net change in emissions for all source categories in 2007 as compared to 2005. Port PM, SO\textsubscript{x} and hydrocarbon emissions decreased from 2005 to 2007 despite a TEU throughput increase of 9\%. NO\textsubscript{x} and CO emissions increased in 2007 from 2005.
Table ES.11: Port-wide Emissions Comparison, tpy and % Change

<table>
<thead>
<tr>
<th>EI Year</th>
<th>PM10</th>
<th>PM2.5</th>
<th>DPM</th>
<th>NOx</th>
<th>SOx</th>
<th>CO</th>
<th>HC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>1,137</td>
<td>959</td>
<td>1,041</td>
<td>16,720</td>
<td>6,623</td>
<td>3,379</td>
<td>909</td>
</tr>
<tr>
<td>2007</td>
<td>925</td>
<td>791</td>
<td>824</td>
<td>16,923</td>
<td>4,513</td>
<td>3,596</td>
<td>865</td>
</tr>
<tr>
<td>Change (tpy)</td>
<td>-211</td>
<td>-167</td>
<td>-218</td>
<td>203</td>
<td>-2,110</td>
<td>217</td>
<td>-44</td>
</tr>
<tr>
<td>Change (%)</td>
<td>-19%</td>
<td>-17%</td>
<td>-21%</td>
<td>1%</td>
<td>-32%</td>
<td>6%</td>
<td>-5%</td>
</tr>
</tbody>
</table>

Table ES.12 presents the greenhouse gas emissions comparison for 2005 and 2007 in tons per year. CO₂ emissions increased by 7% which may be due to the 9% increased activity.

Table ES.12: Port-wide GHG Emissions Comparison, tpy and % Change

<table>
<thead>
<tr>
<th>EI Year</th>
<th>CO₂</th>
<th>N₂O</th>
<th>CH₄</th>
<th>CO₂ Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>1,187,963</td>
<td>46</td>
<td>38</td>
<td>1,203,172</td>
</tr>
<tr>
<td>2007</td>
<td>1,274,588</td>
<td>47</td>
<td>41</td>
<td>1,289,950</td>
</tr>
<tr>
<td>Change (tpy)</td>
<td>86,625</td>
<td>0</td>
<td>2</td>
<td>86,778</td>
</tr>
<tr>
<td>Change (%)</td>
<td>7%</td>
<td>1%</td>
<td>6%</td>
<td>7%</td>
</tr>
</tbody>
</table>

Table ES.13 and Figure ES.13 show the tons of emissions per 10,000 TEU for 2005 and 2007. The table shows that the tons of emissions per 10,000 TEU went down in 2007 which is an improvement from 2005.
In summary, despite a 9% increase in activity from 2005 to 2007, the port-wide emissions decreased for particulate matter (PM), SO\textsubscript{x} and hydrocarbon emissions. Emissions efficiencies improved for all pollutants in 2007 from the 2005 emissions per container handled. In 2007, PM and SO\textsubscript{x} emissions from ocean-going vessels decreased because operators voluntarily complied with CARB’s marine auxiliary engine fuel regulation that was in place for 2007. The cargo handling equipment emissions decreased in 2007 due mainly to equipment turnover. For harbor craft, rail and heavy-duty trucks, the SO\textsubscript{x} emissions decreased in 2007 as compared to 2005 emissions due to the use of cleaner and lower sulfur fuel in 2007. For these source categories, the other pollutants increased emissions due to increase in activity since 2005.
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 two 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. Combined, the POLB and POLA’s customs district account for approximately $300 billion in annual trade. Economic forecasts suggest that the demand for containerized cargo moving through the San Pedro Bay region will triple by the year 2023. 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 two ports adopted their landmark, joint Clean Air Action Plan (CAAP) designed to reduce 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 CAAP.

The 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.

1.1 Reason for Study

The Port released its first activity-based emissions inventory in April 2004. The 2002 Baseline Air Emissions Inventory\(^2\) evaluated emissions from three port-related source categories: off-road cargo handling equipment, rail locomotives and on-road heavy-duty vehicles that operates within the Port’s boundary. An Addendum to the 2002 Inventory\(^3\) was concurrently developed with the 2005 Inventory\(^4\) to evaluate emissions from ocean-going vessels, harbor craft, and the off-port emissions associated with rail locomotives and on-road heavy-duty vehicles. As a follow-up to the 2005 inventory, the 2006 Air Emissions Inventory\(^5\) was released in June, 2008 and included emission estimates for greenhouse gases (GHGs) for port-related maritime mobile sources. This 2007 Inventory of Air Emissions provides the latest emissions of port-related operations using 2007 calendar year activity.

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1.2 Goods Movement

Goods Movement (GM) has become a key issue associated with both the growth of the California economy and the significant challenges to meeting the National Ambient Air Quality Standards (NAAQS) in the Southern California Air Basin (SoCAB). The Business, Transportation and Housing Agency (BTH) and the California Environmental Protection Agency (Cal/EPA) have jointly adopted a Goods Movement Action Plan (GMP). The GMP is intended 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:

- Los Angeles-Long Beach/Inland Empire
- Bay Area
- San Diego/Border
- Central Valley

Over decades, these corridors have become 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.

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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 California Air resources Board (CARB) is responsible for developing an emissions reduction plan based on international as well as domestic goods movement related future activities of the four corridors mentioned above. In April of 2006, CARB adopted the *Emissions Reduction Plan for Ports and Goods Movement in California*. The international goods movement category includes emissions from all on-port sources, including:

- 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.

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According to the GMP, 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.”

In 2007, CARB adopted the State Strategy for California’s 2007 State Implementation Plan which included a number of specific control strategies targeting goods movement. These strategies have either been adopted recently or are currently under development.

1.3 Container 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 to the inherent efficiencies of containerized cargo, the types of cargo shipped via containers are increasing annually. To better understand the operations of the international transportation network associated with ports, this subsection describes overseas container transport, import cargo containers export cargo containers, and how empty cargo containers are handled.

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8 CARB 2006.
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 feet or one twenty-foot equivalent (TEU), or 40-foot or two TEUs. Other sizes such as 45 foot and 53 foot are also used. The U.S. buyer may contact an industry professional know as a “freight forwarder,” or logistics company, to coordinate landside transportation of the cargo. The container is then transported to a foreign port, assessed for possible security risks, and placed on board a containership, which is specifically designed to carry containerized cargo. Containerships calling at the Port range from 2,000 to over 8,000 TEUs per ship. The containership transports the containerized cargo to the Port, where it is unloaded, and forwarded to local or national destinations. Figure 1.1 presents the steps that are associated with overseas cargo movements.

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9 Port of Long Beach, Cargo Movement In Focus, 2006.
Figure 1.1: Overseas Container Transport

Key:
1) Product ordered
2) Container transported to foreign port (not shown)
3) Security check conducted by U.S. Customs agents based at foreign ports
4) Container loaded onboard
5) Coast Guard review conducted for ship, crew, and cargo manifests
6) Containership boarded and docked by a Port pilot
7) Ship unloaded by longshore workers (see Figure 1.2 for details)
8) Security check conducted by U.S. Customs agents
9) Container surveyed for radiation
**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 illustrates the steps that are associated with imported container cargo movements.  

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10 Port of Long Beach, Cargo Movement In Focus, 2006.
Figure 1.2: Import Container Transport

Key:

1) Containership unloaded; 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) Trucking company or train operator contacted by freight forwarder or logistics provider to move container out of the terminal.

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) Containers are often moved initially to a “transload” facility where cargo is unloaded, sorted, and repackaged 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 and the Port. Figure 1.3 presents the steps that are associated with exported container cargo movements.\textsuperscript{11}

\textsuperscript{11} Port of Long Beach, Cargo Movement In Focus, 2006.
Figure 1.3: Export Container Transport

Key:

1) Local origin cargo delivered directly to the marine terminal from the producer, manufacturer, or exporting company.
2) Local or non-local origin cargo 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 shipped by rail and delivered to off-dock railyards where the cargo is placed onto truck for final delivery to marine terminals.
4) Some non-local origin cargo 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 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 conducted after the ship has been unloaded of its import cargo.
Empty Containers

Since the U.S. imports more goods than it exports, many empty containers are sent overseas to be reused or are used domestically for other purposes. Typically, about a third of the containers loaded onto a ship at the Port 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.

12 Port of Long Beach, Cargo Movement In Focus, 2006.
Key:

1) Empty container delivered to a local exporter to fill. Direct delivery of containers between importers and exporters is encouraged to reduce the number of truck trips a container takes in the South Coast.

2) Empty container delivered to container storage yard from a transload facility or local importer. 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) Empty container delivered directly from a transload facility or local importer to the marine terminal for export.

4) Empty container loaded onto a containership to be exported and reused overseas.
1.4 Regulatory and San Pedro Bay Ports Clean Air Action Plan (CAAP) Measures

This section discusses the regulatory and Port measures which address port-related activity. Almost all port-related emissions come from five diesel-fueled source categories: ocean-going vessels (OGVs), 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 (South Coast Air Quality Management District, SCAQMD), state (CARB) or federal (U.S. Environmental Protection Agency, EPA) agencies. The ports of Long Beach and Los Angeles adopted the landmark Clean Air Action Plan (CAAP) in November 2006 to curb port-related air pollution from trucks, ships, locomotives and other equipment by at least 45 percent in five years. A model for seaports around the world, the CAAP is the boldest air quality initiative by any seaport, consisting of wide-reaching measures to significantly reduce air emissions and health risks while allowing for the development of much-needed port efficiency projects. Below is a list of recently adopted and proposed regulatory measures in addition to the CAAP measures that will reduce emissions from the ports over the next five years and beyond.

1.4.1 Ocean-going Vessels

Emissions Standard for Marine Propulsion Engines

The International Maritime Organization (IMO) adopted limits for NOx in Annex VI to the International Convention for the Prevention of Pollution from Ships (MARPOL) in 1997. These NOx limits apply to marine engines over 130 kilowatts (kW) installed on vessels built on or after 2000. The current NOx standards are from 17.0 g/kW-hr (for < 130 rpm) to 9.8 g/kW-hr (for ≥ 2000 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 of 2005. Engine manufacturers have been certifying engines to the Annex VI NOx limits since 2000 as the standards are retroactive in other countries, once Annex VI is ratified. In April 2008, the Marine Environment Protection Committee of the IMO approved a recommendation for new MARPOL Annex VI sulfur limits for fuel and NOx limits for engines. On July 21, 2008, President Bush signed into law the Maritime Pollution Protection Act of 2008, ratifying MARPOL Annex VI by the United States. On October 9, 2008, the IMO adopted new international standards for marine diesel engines and their fuels. The sulfur limits included in the approved amendment limit fuel sulfur to 1% in emissions control areas (ECAs) by 2010, with a global limit of 3.5% sulfur in 2012, down from the current 4.5% sulfur limit. These sulfur levels will be further reduced to 0.1% sulfur in ECAs by 2015 and 0.5% sulfur globally by 2020, or no later than 2025. Engine emission rate limits for NOx for new builds are set at 14.4 g/kW-hr in 2011, down from 17.0 g/kW-hr for ships built between 2000 and 2010. The NOx limit will be further reduced to 3.4 g/kW-hr in 2016 for ships operating in ECAs. Finally, existing ships built between 1990 and 2000, will be subject to a retrofit requirement, limiting NOx to 17.0 g/kW-hr.
EPA’s Final Regulation – Control of Emissions of Air Pollution from Locomotive and Marine Compression Ignited Engines Less than 30 Liters Per Cylinder – (EPA, 2008)\textsuperscript{13}

This regulation, adopted 14 March 2008, applies to all remanufactured and new-built auxiliary engines used on U.S. flagged ocean-going vessels. Engines covered are category 1 and 2 engines with greater than 800 horsepower (hp) rating less than 30 liter per cylinder (l/cyl) displacement. This is a three part regulation as follows:

1. Remanufactured engines – establishes more stringent emissions standards requirements for existing engines when they are remanufactured. Depending upon the availability, these standards are applicable as early as 2008.
2. Tier 3 – more stringent emissions standards for new engines with phase-in starting in 2009. Tier 3 standards target PM and NO\textsubscript{x} emissions based on currently available on-road and Tier 4 non-road technologies.
3. Tier 4 – most stringent emissions standards for new engines with phase-in starting in 2014. Tier 4 standards are based on highly efficient after-treatment catalyst technologies along with the use of ultra low sulfur fuel.

EPA’s Emission Standards for Marine Diesel Engines Above 30 Liters per Cylinder (Category 3 Engines)

EPA is pursuing two parallel, related actions for establishing emission standards for Category 3 marine diesel engines: (1) EPA is a member of the United States delegation that is participating in negotiations at the International Maritime Organization (IMO) with regard to amendments to Annex VI that consider additional NO\textsubscript{x} limits for new engines; additional sulfur content limits for marine fuel; methods to reduce PM emissions; potential NO\textsubscript{x} and PM limits for existing engines; and potential volatile organic compounds (VOCs) limits for tankers. (2) In January 2003, EPA adopted Tier 1 standards for Category 3 marine engines, which went into effect in 2004, establishing NO\textsubscript{x} standards based upon internationally negotiated emissions rates and readily available emissions-control technology. In November 2007, EPA issued an Advanced Notice of Proposed Rulemaking for new Tier 2 and Tier 3 national standards for Category 3 marine diesel engines. This rule would establish stricter standards for NO\textsubscript{x}, in addition to standards for PM and SO\textsubscript{x}. The currently proposed Tier 2 NO\textsubscript{x} standards for new builds could begin in 2011, and could achieve a 15 to 25\% reduction from the existing Tier 1 standard. The proposed Tier 3 NO\textsubscript{x} standards could begin in 2016 and could reduce NO\textsubscript{x} emissions 80\% from the Tier 2 standards, while the vessels are operated in specially designated areas. Performance-based SO\textsubscript{x} and PM standards could begin in 2011 and could be achieved through the use of 0.1\% sulfur distillate fuel or after-treatment technologies such as SO\textsubscript{x} scrubbers. Lastly, proposed NO\textsubscript{x} emissions limits for existing vessels could reduce emissions by 15 to 20\%.

\textsuperscript{13} See: \url{http://www.epa.gov/otaq/regs/nonroad/420f08004.htm#exhaust}. (EPA 2008).
CAAP Measure- SPBP-OGV2; Reduction of At-Berth OGV Emissions
This measure requires the use of shore-power for reducing hotelling emissions implemented at all major container and cruise terminals at the Port as soon as possible. Through the Technology Advancement Program, this measure also requires demonstration and application of alternative emissions reduction technologies for ships not capable of shore power.

CAAP Measure- SPBP-OGV5; OGV Main &Auxiliary Engine Emissions Improvements
This measure provides for main and auxiliary engine emissions reductions that are validated through the Technology Advancement Program. The goal of this measure is to reduce main and auxiliary engine DPM, NO₂, and SO₂ emissions by 90%. The first engine emissions reduction technology identified for this measure is the use of MAN B&W slide valves for main engines. The implementation mechanism for this measure is the terminal lease renewal.

CARB’s Regulation to Reduce Emissions from Diesel Auxiliary Engines on Ocean-going Vessels While at Berth at a California Port
On December 6, 2007, CARB adopted a regulation to reduce emissions from diesel auxiliary engines on OGV while at-berth for container, cruise and refrigerated cargo vessels. The regulation requires that auxiliary diesel engines on OGV to be shut down (i.e., use shore-power) for specified percentages of fleet’s visits and also the fleet’s at-berth auxiliary engine power generation to be reduced by the same percentages. As an alternative, vessel operators may employ any combination of clean emissions control technologies to achieve equivalent reductions. Specifically, by 2014, vessel operators relying on shore power are required to shut down their auxiliary engines at-berth for 50 percent of the fleet’s vessel visits and also reduce their onboard auxiliary engine power generation by 50 percent. The specified percentages will increase to 70 percent in 2017 and 80 percent in 2020. For vessel operators choosing the emission reduction equivalency alternative, the regulation requires a 10% reduction in OGV hotelling emissions starting in 2010 increasing in stringency to an 80% reduction by 2020.

Vessel Speed Reduction (VSR) Program
In May 2001, a Memorandum of Understanding (MOU) between the Port of Long Beach, the Port of Los Angeles, EPA Region 9, CARB, SCAQMD, the Pacific Merchant Shipping Association (PMSA), and the Marine Exchange of Southern California was signed. This MOU called for OGVs to voluntarily reduce speed to 12 knots at a distance of 20 nautical miles (nm) from Point Fermin. The term of this MOU expired in 2004; however, currently a significant number (roughly 89% in 2007 CY) of the OGVs operating at the Port are abiding by VSR speeds within 20 nm from Point Fermin.

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CAAP Measure-SPBP-OGV1; Vessel Speed Reduction (VSR) Program
The San Pedro Bay Ports Clean Air Action Plan adopted by the ports of Los Angeles and Long Beach require 90% VSR compliance for OGVs that call on the Port. Reduction in speed demands less power on the main engine, which in turn reduces NOx emissions and fuel usage.

Port of Long Beach Green Flag Program
The Port has committed as much as $2.2 million a year to encourage participation in the Voluntary Vessel Ship Speed Reduction Program. Vessels that dock at the Port of Long Beach earn a Green Flag Environmental Achievement Award when they attain 100% compliance with the voluntary vessel speed reduction program for a 12-month period. Carriers that achieve a 90% compliance rate in a 12-month period are eligible for a 15% reduction in dockage otherwise payable to the Port (Green Rate) in the following year.

CARB’s Low Sulfur Fuel for Marine Auxiliary Engines, Main Engines and Auxiliary Boilers
On July 24, 2008, CARB adopted low sulfur fuel requirements for marine main engines, auxiliary engines and auxiliary boilers within 24 nm of the California coastline. The regulation required the use of marine gas oil (MGO) with a sulfur content less than 1.5% by weight or marine diesel oil (MDO) with a sulfur content of equal to, or less than 0.5% by weight. For auxiliary engines, the requirements start immediately following when the regulation becomes legally effective (expected by early 2009), and in main engines and boilers by July 1, 2009. The use of MGO or MDO with a sulfur content of equal to or less than 0.1 % will be required in all engines and boilers by January 1, 2012. The use of low sulfur fuel will reduce emissions of NOx, DPM and SOx.

CAAP Measures-SPBP-OGV3 and 4; OGV Main & Auxiliary Engine Fuel Standards
This measure is designed to require the use of lower sulfur distillate fuels in the auxiliary and main engines of OGVs within 20 nm (later extending to 40 nm) of Point Fermin and while at berth. Upon lease renewal, this measure requires the use of distillate fuels that have a sulfur content of ≤0.2% S MGO. The ports are focusing these measures and SPBP-OGV4 (Main Engine Fuel Standards) to target fuel quality with the goal of synchronizing both the auxiliary and main engine fuels.
Low-Sulfur Vessel Fuel Incentive Program

In order to accelerate the emissions reductions from ocean-going vessels, the ports of Long Beach and Los Angeles have adopted an incentive program to encourage vessel operators to discontinue the use of highly polluting bunker fuel in favor of cleaner, ≤0.2 percent low sulfur distillate fuel. The program will pay eligible shipping lines the difference between the cost of bunker fuel and the more expensive low-sulfur distillate when used in main engines provided that the vessels use low-sulfur distillate fuel in their auxiliary engines while at berth and comply with SPBP-OGV1 (the Vessel Speed Reduction program). This program encourages and accelerates the use of cleaner fuels in ocean-going vessels prior to the implementation of lease-based low-sulfur fuel agreements and prior to the start of international treaties, and U.S. Environmental Protection Agency or California Air Resources Board regulation requiring low-sulfur fuel use. This program will end on June 30, 2009, upon the expected implementation of statewide low sulfur fuel regulation.

CARB’s Regulation Related to Ocean-going Vessel Onboard Incineration

This regulation was adopted by CARB’s board in 2005 and amended in 2006. As of November 2007, it prohibits all cruise ships and ocean-going vessels of 300 registered gross tons or more from conducting on-board incineration within three nautical miles of California coast. Enactment of this regulation will reduce toxics air contaminants such as dioxins and toxics metals exposure to public. It will also reduce PM and hydrocarbon emissions generated during incineration.

1.4.2 Harbor Craft

EPA’s Emission Standards for Harbor Craft Engines

On March 14, 2008, EPA finalized the latest regulation establishing new emission standards for new “Category 1 & 2” diesel engines rated over 50 horsepower (hp) used for propulsion in most harbor craft. The new Tier 3 engine standards phase in starting in 2009. The more stringent Tier 4 engine standards (based on the application of high-efficiency catalytic after-treatment technologies) would phase in beginning in 2014 and apply only to commercial marine diesel engines greater than 800 hp. The regulation also includes requirements for remanufacturing commercial marine diesel engines greater than 800 hp.
CARB’s Regulation to Reduce Emissions from Diesel Engines on Commercial Harbor Craft

As a part of the Diesel Risk Reduction Plan and Goods Movement Plan, CARB has adopted a regulation in November 2007 that will reduce DPM and NOₓ emissions from new and in-use commercial harbor crafts operating in Regulated California Waters (i.e., internal waters, ports, and coastal waters within 24 nm of California coastline). Under CARB’s definition, commercial harbor crafts include tug boats, tow boats, ferries, excursion vessels, work boats, crew boats, and fishing vessels. This regulation requires stringent emission limits from auxiliary and propulsion engines installed in commercial harbor crafts. All in-use, newly purchased, or replacement engines must meet EPA’s most stringent emission standards per a compliance schedule set by the CARB for in-use engines and from new engines at the time of purchase. In addition, the propulsion engines on all new ferries, with the capacity of more than 75 passengers, acquired after January 1, 2009, will be required to install control technology that represents the best available control technology in addition to an engine that meets the Tier 2 or Tier 3 U.S. EPA marine engine standards, as applicable, in effect at the time of vessel acquisition. For harbor craft with home ports in the SCAQMD, the compliance schedule is accelerated by two years (compared to statewide requirements) in order to achieve earlier emission benefits required in SCAQMD. The in-use emission limits only apply to ferries, excursion vessels, tug boats and tow boats. The compliance schedule for in-use engine replacement begins in 2009.

CARB’s 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 a sulfur content limit of 15 ppm and a lower aromatic hydrocarbon content. The use of lower sulfur and aromatic fuel has resulted in NOₓ and DPM reductions. In addition, the use of low sulfur fuel will facilitate retrofitting harbor craft with emissions control devices such as diesel particulate filters (DPFs) that have the potential to reduce PM by additional 85%.

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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, carbon monoxide (CO), DPM, and NOx. Tier 4 standards for non-road diesel powered equipment complement the 2007+ on-road heavy-duty engine standards which require 90 percent reductions in DPM and NOx compared to current levels. In order to meet these standards, engine manufacturers will produce new engines with advanced emissions control technologies similar to those already in place 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 NOx and PM standards in 2015. Currently, the interim Tier 4 standards include a 90% reduction in PM and a 60% reduction in NOx.

CARB’s Cargo Handling Equipment Regulation
In December 2005, CARB adopted a regulation designed 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 requires newly purchased, leased, or rented yard tractors to be equipped with a 2007 or later on-road engine or a Final Tier 4 off-road engine. Newly purchased, leased or rented non-yard tractors must be equipped with a certified on-road or off-road engine meeting the current model year standards in effect at the time the engine is added to the fleet. If the engine is pre-2004, then the highest level available VDEC must be installed within one year. In-use yard tractors are required to meet either 2007 or later certified on-road engine standards, Final Tier 4 off-road engine standards, or install verified controls that will result in equivalent or fewer DPM and NOx emissions than a Final Tier 4 off-road engine. In-use non-yard tractors must either install the highest level available VDEC and/or replace to an on-road or off-road engine meeting the current model year standards. For all CHE, compliance dates are phased-in beginning December 31, 2007, based on the age of the engine and number of equipment in each model year group.

CAAP Measures- SPBP-CHE1- Performance Standards for CHE
This measure calls for further CHE improvements at the time of terminal lease renewal. Beginning in 2007, all CHE purchases must meet the following performance standards of the cleanest available NOx alternative-fueled engine meeting 0.01 g/bhp-hr PM, available at time of purchase; or cleanest available NOx diesel-fueled engine meeting 0.01 g/bhp-hr PM, available at time of purchase. If there are no engines available that meet 0.01 g/bhp-hr PM, then must purchase cleanest available engine (either fuel type) and install cleanest VDEC available.
In addition, by the end of 2010, all yard tractors operating at the San Pedro Bay Ports must meet at a minimum the EPA 2007 on-road or Tier IV engine standards. By the end of 2012, all pre-2007 on-road or pre Tier IV off-road top picks, forklifts, reach stackers, RTGs, and straddle carriers <750 hp must meet at a minimum the EPA 2007 on-road engine standards or Tier IV off-road engine standards. By end of 2014, all CHE with engines >750 hp must meet at a minimum the EPA Tier IV off-road engine standards. Starting 2007 (until equipment is replaced with Tier IV), all CHE with engines >750 hp will be equipped with the cleanest available VDEC verified by CARB.

1.4.4 Railroad Locomotives

EPA’s Emissions Standards for New and Remanufactured Locomotives and Locomotive Engines-
Latest Regulation Finalized on 14 March 2008

In March 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, NOx, and DPM. Although the most stringent standard, Tier 2, results in over 40% reduction in NOx 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.

In March 2008, EPA adopted its final regulation – “Control of Emissions of Air Pollution from Locomotive and Marine Compression Ignited Engines Less than 30 Liters per Cylinder.” When fully implemented, this rule will cut PM emissions from these engines by as much as 90% and NOx emissions by as much as 80%.

The regulation introduces two tiers of standards – Tier 3 and Tier 4 – which apply to new locomotives as well as standards for remanufactured locomotives, as follows:

- **Newly-Manufactured Locomotives**: The new Tier 3 emission standards will achieve 50 percent reduction in PM beyond the Tier 2 standard and will become effective in 2012. The longer term Tier 4 emission standards which are based on the application of high efficiency catalytic after-treatment technologies for NOx and PM will become effective in 2015 and will achieve about 80 percent reduction in NOx and PM compared to Tier 2 standards.

- **Remanufactured Locomotives**: The regulation also establishes emission standards for remanufactured Tier 0, 1, and 2 locomotives which would achieve 50 to 60 percent reduction in PM and 15 to 20 percent reductions in NOx.

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16 See: [http://www.epa.gov/otaq/regs/nonroad/420f08004.htm](http://www.epa.gov/otaq/regs/nonroad/420f08004.htm).

17 EPA 2008.
CARB’s 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 the time within the 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 a sulfur content limit of 15 ppm and a lower aromatic content. The use of fuel with lower sulfur and aromatics will result in NOx and DPM reductions. In addition, use of low sulfur fuel will facilitate retrofitting locomotives with emissions control devices such as DPFs that have potential to reduce DPM by 85%.

Statewide 1998 and 2005 Memorandum of Understanding (MOU)

In order to accelerate the implementation of Tier 2 engines in the 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 the two railroads 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 sulfur 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+ On-road Heavy Duty Vehicles (HDV), which will ultimately result in 90% reductions in emissions of NOx and particulate matter (PM). This regulation will require HDV engine manufacturers to meet a 0.01 g/bhp-hr PM standard starting in 2007, which is 90% lower than the 2004 PM standard of 0.1 g/bhp-hr. The regulation requires a phase-in of a 0.2 g/bhp-hr NOx standard between 2007 and 2010. By 2010, all engines will be required to meet the 0.2 g/bhp-hr NOx standard, which represents a greater than 90% reduction compared to the 2004 NOx standard of 2.4 g/bhp-hr. It is expected that between 2007 and 2010, on average, manufacturers will produce HDV engines meeting a PM standard of 0.01 g/bhp-hr and a NOx standard of 1.2 g/bhp-hr. This latter is referred to as the 2007 interim standard.

CARB’s Heavy-Duty Vehicle On-Board Diagnostics (OBD) Requirement

In 2005, CARB adopted a comprehensive HDV On-Board Diagnostics (OBD) regulation, which ensures that the increasingly stringent HDV emissions standards being phased in are maintained throughout the vehicle’s useful life. The OBD regulation requires manufacturers to install a system in HDVs to monitor virtually every emissions related component on the vehicle. The OBD regulation will be phased in beginning with the 2010 model years with full implementation required by 2016.
CARB’s 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 sulfur by weight, beginning June of 2006, statewide. This ULSD fuel is needed in order for retrofit technologies, such as diesel particulate filters, to work successfully.

CARB’s Regulation for 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, in December of 2007, CARB board adopted a regulation to modernize the drayage truck fleet that operate at California’s ports. This objective is to be achieved in two phases:

1. By 31 December 2009, all pre-1994 model year (MY) engines are to be retired or replaced with 1994 and newer MY engines. Furthermore, all drayage trucks with 1994 – 2003 MY engines will be required to achieve an 85 percent PM emission reduction through the use of an ARB approved Level 3 verified diesel emission control strategy (VDECS).
2. By 31 December 2013, all trucks operating at California ports must comply with the 2007+ on-road heavy-duty truck engine standards.

CAAP Measures- SPBP-HDV1- Performance Standards for On-road Heavy-Duty Vehicles
Per the stated goals of the CAAP, the ports of Los Angeles and Long Beach approved a tariff plan which progressively bans older trucks from operating at the two ports. The ban is implemented in three phases as follows:

1. By 1 October 2008 – All pre-1989 trucks are banned from ports services.
2. By 1 January 2010 – All 1989-1993 trucks along with un-retrofitted 1994-2003 trucks are banned from ports services.
3. By 1 January 2012 – All trucks that do not meet 2007 and later on-road heavy-duty engine standards are banned from ports services.

1.4.6 Greenhouse Gases
Assembly Bill 32 (AB32), the California Global Warming Solutions Act of 2006, establishes a first-in-the world comprehensive program requiring the CARB to develop regulatory and market mechanisms that will ultimately reduce greenhouse gas (GHG) emissions to 1990 levels by the year 2020 and reduce emissions to 80 percent below 1990 levels by 2050. Mandatory caps will begin in 2012 for significant sources and ratchet down to meet the 2020 goals. In the interim, CARB will begin to measure the GHG emissions of industries determined to be significant sources of GHG emissions.
On October 25, 2007, CARB approved several emission reduction strategies to reduce GHG emissions as “early action measures.” Early action measures pertaining to goods movement activities for ships, port drayage trucks, cargo handling equipment and transport refrigeration units include:

- Green Ports (Ship Electrification)
- SmartWay Truck Efficiency
- Tire Inflation Program
- Anti-idling Enforcement
- Refrigerant Tracking, Reporting, and Recovery Program
- Low Carbon Fuel Standard

In October 2008, CARB released a proposed Climate Change Scoping Plan to achieve the reductions in greenhouse gas (GHG) emissions mandated in AB32. The AB32 Scoping Plan contains the main strategies California will use to reduce the GHGs that cause climate change. Several of these measures are targeted at goods movement, including ports and are expected to achieve a combined 3.7 million metric tons of carbon dioxide equivalent. Proposed measures in the Scoping Plan include:

- T-5: Ship electrification at ports (previously adopted as regulation in December 2007)
- T-6: Goods movement efficiency measures

The recently adopted CARB regulations, the anticipated CARB rulemakings, and the measures in the CAAP will provide a vital and complementary combination of measures that support the overall effort to meet both the State and San Pedro Bay Ports air quality improvement goals.
Non-regulatory grant funding programs are also helping to significantly reduce emissions from sources including those associated with ports. An example of these types of programs 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, higher emitting 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 also includes a fleet modernization component. 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. In addition to the Carl Moyer Program, Proposition 1B (the Highway Safety, Traffic Reduction, Air Quality and Port Security Bond Act of 2006), passed by voters in November 2006, has authorized $1 billion in bond funding over 4 years for incentives to reduce diesel emissions associated with goods movement. Under this Program, CARB will work in partnership with local public agencies (i.e., air quality management districts and ports) to identify and fund qualified projects. Local agencies would request funding from the CARB to provide financial incentives to owners of equipment used in goods movement in order to upgrade to cleaner technologies. In August of 2008, the ports received $98 million from this program which is leveraged by $145 million from the ports to help truckers who frequently service the ports to modernize their existing trucks.

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 2007 Inventory of Air Emissions (2007 EI) is to develop emission estimates based on activities that occurred in calendar year 2007.

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 ($\text{NO}_x$)
- Oxides of sulfur ($\text{SO}_x$)
- Total hydrocarbons (HC)
- Carbon monoxide (CO)
- Carbon dioxide (CO$_2$)
- Methane (CH$_4$)
- Nitrous oxide (N$_2$O)
Most port-related sources of GHG involve fuel combustion, thus CO₂, CH₄ and N₂O are included in the list of pollutants for this inventory. The other GHG, such as fluorinated gases (i.e. high-global warming potential gases) are not included since they are mainly caused by industrial processes not typically found at ports or in the maritime industry.

The greenhouse gases, CO₂, CH₄ and N₂O have been estimated based on emission factors presented in the corresponding source category sections and/or appendices. Each greenhouse gas differs in its ability to absorb heat in the atmosphere. Sometimes, estimates of greenhouse gas emissions are presented in units of carbon equivalents which weight each gas by its global warming potential (GWP) value. To normalize these values into a single greenhouse gas value, the GHG emissions estimates can be multiplied by the following values and then added together resulting in a single greenhouse gas value (CO₂ equivalent). The values are as follows¹⁸:

- CO₂ – 1
- CH₄ – 21
- N₂O – 310

### 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

Examples of the five sources include the containerships, tankers, and cruise ships that call on the Port; the assist tugs and tugboats that assist vessels in the harbor; the cranes and forklifts that may move cargo within the terminals; the railroad locomotives that haul cargo; and the on-road diesel trucks visiting the terminals that also transport cargo. 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.

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1.5.3 Geographical Extent

The 2007 EI includes tenant source category emissions from Port-related goods movement activities that occur on Port-owned and privately-owned land within the Port of Long Beach Harbor District. An overview of the geographical extent is provided below for each of the source categories.

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. The portion of the study area outside the Port’s breakwater is four-sided, and geographically defined by the following coordinates:

- NW corner: 34°02'42.4” north (N) latitude by 118°56'41.2” west (W) longitude
- SW corner: 33°00'00.0” N latitude by 119°30'00.0” W longitude
- SE corner: 32°30'00.0” N latitude by 118°30'00.0” W longitude
- NE corner: 33°23'12.7” N latitude by 117°35'46.4” W longitude

Figure 1.5 shows the geographical extent of the study area for marine vessels in dark blue.

Figure 1.5: OGV and Harbor Vessel Out of Port Geographical Extent
The geographical scope for cargo handling equipment is the terminals and facilities on which they operate. Figure 1.6 shows the land area of active Port terminals in 2007.

Figure 1.6: 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 1.7 shows the SoCAB boundary for rail and HDV in relation to the location of the Port. Since the ports of Long Beach and 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 POLB.

Figure 1.7: South Coast Air Basin Boundary
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
- South East Resource Recovery Facility
- Tidelands Oil Production Company
- THUMS Oil Operations
- Long Beach Generation

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 2006\(^\text{19}\). Stationary sources are not included in this inventory.

1.6 General Methodology

The basic approach to developing an activity-based EI is through data collection efforts with Port tenants, who own, operate and maintain equipment and own or charter vessels. Port tenants and shipping lines play an essential role in the development of an EI by providing the most accurate activity and operational information available. The activity and operational data collected is input into a database for storage. Emissions estimates are developed for each of the various source categories in a manner consistent with the latest estimating methodologies agreed upon by the Port and the participating regulatory agencies. The information gathered, analyzed, and presented in this EI continues to improve the understanding of the nature and magnitude of Port-related 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.

In general, emissions estimates are quantified by multiplying units of activity (estimated using the activity and operational information described above) by an emission factor. Emission factors are standard values that express the mass of emissions in terms of a unit of activity. For example, some emission factors are 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 estimates can be calculated, then, by

\(^{19}\) Long Beach Gas and Oil Air Emissions Inventory, prepared by Starcrest Consulting Group, LLC, October 2006.
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 a result 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, and fuel correction factors may need to be applied.

### 1.6.1 Ocean-going Vessels

The basic methodology for estimating emissions from the various types of ocean-going vessels that call on the Port relies on 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 and information from the Jacobsen Pilots. In addition, the Port has undertaken a Vessel Boarding Program (VBP) 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 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 based on 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.

### 1.6.2 Harbor Craft

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

- Assist tugboat
- Tugboats
- Ferries
- Excursion vessels
- Crew boats
- Work boats
- Government 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).

### 1.6.3 Cargo Handling Equipment

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 estimation methodology for this category followed CARB’s CHE emissions estimation methodology based on CARB’s OFFROAD\(^{20}\) model methodology plus additional modifications\(^{21}\) made by CARB’s staff for CHE. Equipment operators and owners were asked to supply updated information such as activity hours, size and model year of all of their CHE used at the port.

### 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.

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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.

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 Los Angeles, 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. 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.

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.

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1.7 Report Organization

This report presents the 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 2007 emissions to 2005 emissions

The report also includes:

- Appendix A – Ocean-going vessels
- Appendix B – Harbor craft
- Appendix C – Cargo handling equipment
- Appendix D – Heavy-duty vehicles