Emission reduction initiatives in the Puget Sound region
Puget Sound Maritime Air Forum partners have implemented a number of air pollution prevention projects and programs. We also are exploring innovative pilot projects to test new technologies. The following is a selection of initiatives implemented or underway.

### Regulations, Standards and Policies

<table>
<thead>
<tr>
<th>Agency</th>
<th>Program</th>
<th>Targeted Pollutants</th>
<th>Years Effective</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>International Maritime Organization (IMO)</strong></td>
<td>NOx emission standard for marine engines</td>
<td>NOx</td>
<td>2011: Tier 2 2016: Tier 3 for ECA only</td>
<td>Auxiliary and propulsion engines over 130 kW output power on newly built vessels</td>
</tr>
<tr>
<td></td>
<td>Emissions Control Area (ECA), low sulfur fuel requirements for marine engines</td>
<td>DPM, PM, SOx</td>
<td>Pre ECA: 3.5% max sulfur 2012 ECA: 1% max sulfur 2015 ECA: 0.1% max sulfur</td>
<td>Low sulfur fuel use in ECA significantly reduced emissions</td>
</tr>
<tr>
<td>Environmental Protection Agency (EPA)</td>
<td>Energy Efficiency Design Index (EEDI) for international shipping</td>
<td>CO2 and other pollutants</td>
<td>2013</td>
<td>Increased ship design efficiency related to energy and emissions</td>
</tr>
<tr>
<td></td>
<td>Emission standards for marine diesel engines above 30 liters per cylinder; aligns with IMO marine engine NOx standards and low sulfur requirement</td>
<td>DPM, PM, NOx, SOx</td>
<td>2011: Tier 2 2016: Tier 3</td>
<td>Auxiliary propulsion category 3 engines on US-flagged new vessels and low sulfur fuel use required</td>
</tr>
<tr>
<td></td>
<td>Emission standards for harbor craft engines</td>
<td>All</td>
<td>2009: Tier 3 2014: Tier 4 for 800 hp or greater</td>
<td>Commercial marine diesel engines with displacement less than 30 liters per cylinder</td>
</tr>
<tr>
<td></td>
<td>Emission standards for non-road diesel-powered equipment</td>
<td>All</td>
<td>2008 through 2015</td>
<td>All non-road equipment</td>
</tr>
<tr>
<td></td>
<td>Emission standards for new and remanufactured locomotives and engines</td>
<td>DPM, NOx</td>
<td>2011 through 2013: Tier 3 2015: Tier 4</td>
<td>All new and remanufactured locomotive engines</td>
</tr>
<tr>
<td></td>
<td>Air pollution emission controls from non-road diesel engines and fuel</td>
<td>SOx, PM</td>
<td>2010</td>
<td>All locomotive engines</td>
</tr>
<tr>
<td></td>
<td>Emission standards for new 2007+ on-road heavy-duty vehicles</td>
<td>NOx, PM</td>
<td>2007 2010</td>
<td>All new on-road heavy-duty vehicles</td>
</tr>
</tbody>
</table>
## Other Emission Reduction Strategies

<table>
<thead>
<tr>
<th>Agency</th>
<th>Program</th>
</tr>
</thead>
</table>
| Burlington Northern Santa Fe Railway (BNSF) | Replaced older locomotives with new fuel-efficient models  
Installed idle-control mechanisms on switch engines  
Reduce train resistance through low torque bearings  
Implemented rail lubrication to increase fuel efficiency  
Perform opacity tests on locomotives  
Optimize train operations and fuel savings  
Installed electrically-powered wide-span cranes  
Installed semi-automated gate system for trucks |
| Tacoma Rail | Repowered older locomotives with cleaner fuel-efficient engines  
Acquired fuel-efficient low-emission genset locomotive  
Installed fuel-efficient fuel injectors on existing locomotives  
Installed idle-reduction equipment on existing locomotives |
| Union Pacific Railroad | Limit train speeds and shut down idle locomotives to save fuel  
New locomotives have anti-idling devices  
Pioneered genset locomotive technology that reduces emissions |
| Washington State Ferries | Replaced older ferries with new ones  
Repowered existing ferries with newer engines  
Connect to shore power during tie-up at night |
| Port of Everett | Purchased new Gottwald mobile harbor crane with Tier 4 engine  
Purchased new reach stackers with Tier 4 engines  
Obtained state grant to retrofit marine boom truck  
Obtained CMAQ grant to provide electrical shore power infrastructure for vessels and cranes  
Use electric mounted gantry cranes |
| Port of Seattle and The Northwest Seaport Alliance (NWSA) North Harbor | Provided shore power at Terminal 91 cruise terminal for cruise and commercial fishing fleet  
Retrofitted some cargo-handling equipment with diesel oxidation catalysts  
Encourage cleaner vehicle purchases  
Adopted Clean Truck Program and Drayage Truck Registry  
Implemented truck scrappage and replacement program  
Installed drayage truck traffic monitoring systems to reduce idling  
Encouraged equipment modernization program  
Participated in regional anti-idling effort  
Installed idle-reduction equipment on cargo-handling equipment  
Equipped switching locomotives with idle-reduction equipment  
Provided electric ship-to-shore cranes for cargo terminals  
Repowered harbor vessel engines with new cleaner engines  
Provided emission control system maintenance training and assistance  
Replacing existing yard truck with new cleaner one  
Offered financial incentives for ships to burn cleaner fuel at berth |
Puget Sound Maritime
2016 Air Emissions Inventory

Port of Tacoma and The Northwest Seaport Alliance (NWSA)
South Harbor
- Installed diesel particulate filters on port and terminal equipment
- Repowered existing diesel forklifts with cleaner engines
- Installed diesel oxidation catalysts on terminal equipment
- Adopted Clean Truck Program and Drayage Truck Registry
- Implemented truck scrappage and replacement program
- Installed drayage truck traffic monitoring systems to reduce idling
- Participated in regional anti-idling effort
- Installed idle-reduction equipment on cargo-handling equipment
- Encouraged equipment modernization program
- Provided shore power at TOTE Terminal
- Provided shore power for tugboats
- Equipped switching locomotives with idle-reduction equipment
- Electric ship-to-shore cranes for cargo terminals

Port of Olympia
- Retrofitted equipment with grant
- Installed electric vehicle charging station

Results

<table>
<thead>
<tr>
<th>Percentage Change 2005 - 2016</th>
<th>NOx</th>
<th>VOCs</th>
<th>CO</th>
<th>SO2</th>
<th>PM10</th>
<th>PM2.5</th>
<th>DPM</th>
<th>BC</th>
<th>CO2e</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocean-going vessels</td>
<td>-27%</td>
<td>-36%</td>
<td>-20%</td>
<td>-97%</td>
<td>-87%</td>
<td>-85%</td>
<td>-87%</td>
<td>-69%</td>
<td>-29%</td>
</tr>
<tr>
<td>Harbor vessels</td>
<td>8%</td>
<td>26%</td>
<td>104%</td>
<td>-99%</td>
<td>-15%</td>
<td>-15%</td>
<td>-16%</td>
<td>-16%</td>
<td>21%</td>
</tr>
<tr>
<td>Recreational vessels</td>
<td>35%</td>
<td>-32%</td>
<td>-22%</td>
<td>-91%</td>
<td>-31%</td>
<td>-31%</td>
<td>-17%</td>
<td>-9%</td>
<td>23%</td>
</tr>
<tr>
<td>Locomotives</td>
<td>-55%</td>
<td>-49%</td>
<td>-33%</td>
<td>-99%</td>
<td>-52%</td>
<td>-52%</td>
<td>-52%</td>
<td>-51%</td>
<td>-27%</td>
</tr>
<tr>
<td>Cargo-handling equipment</td>
<td>-56%</td>
<td>-67%</td>
<td>-88%</td>
<td>-100%</td>
<td>-65%</td>
<td>-65%</td>
<td>-65%</td>
<td>-67%</td>
<td>-36%</td>
</tr>
<tr>
<td>Heavy-duty vehicles</td>
<td>-48%</td>
<td>-54%</td>
<td>-50%</td>
<td>-88%</td>
<td>-46%</td>
<td>-45%</td>
<td>-46%</td>
<td>-75%</td>
<td>16%</td>
</tr>
<tr>
<td>Fleet vehicles</td>
<td>-77%</td>
<td>-67%</td>
<td>-71%</td>
<td>-91%</td>
<td>-84%</td>
<td>-85%</td>
<td>-89%</td>
<td>-88%</td>
<td>-70%</td>
</tr>
<tr>
<td>Total</td>
<td>-23%</td>
<td>-29%</td>
<td>-21%</td>
<td>-97%</td>
<td>-72%</td>
<td>-69%</td>
<td>-72%</td>
<td>-41%</td>
<td>-10%</td>
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</tbody>
</table>
For more information
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Puget Sound Maritime Air Forum Partners:

Prepared by: