



Sound Clean Air Agency, and Ecology, launched a Truck Scrappage Program in 2011. The goal of the program is to replace 135 regional trucks with newer low-emission engine trucks.

- Purchased bigger cranes, including six Super Post-Panamax ZPMC cranes, to load and unload more efficiently, so ships are at the dock for less time.
- Partnered in a regional anti-idling effort.

Port of Tacoma

- Collaborated with Ecology on a voluntary idle-reduction program that reduces diesel engine idle time for vehicles and equipment operating on Port property.
- Horizon Lines replaced 30 model year 2000 drayage trucks with a fleet of 30 new Tier 4 Class 8 trucks, reducing diesel particulate emissions by more than 85 percent.
- Developed a truck staging area to ease traffic congestion on public roads.
- APM Terminals extended gate hours to minimize pre-gate idling and implemented Web-based truck booking technology to reduce truck congestion at gates. APM also switched to ULSD for on-terminal equipment.
- WUT added labor shifts and started a staggered lunch break program to reduce truck gate wait times.
- Added five Super Post-Panamax cranes to two terminals to add efficiency for working vessels.
- Four marine terminal truck gates and one railyard are equipped with optical character recognition system for efficient gate transactions.

Freight mobility

Both the Port of Seattle and Port of Tacoma have implemented a number of strategies to improve the efficiency of freight mobility and reduce air pollution. Some of these are highlighted below.

Port of Seattle

- Terminal operators have initiated cargo-handling equipment fleet modernization programs and are encouraged to purchase equipment with 2007 on-road standard engines.
- Coordinated draw bridge openings with truckers so they can route accordingly to minimize idling.
- Piloted computer tracking systems at cargo terminals to quickly locate containers and reduce truck wait times.
- Provided electric plug-ins instead of diesel units for refrigerated containers on the docks.

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Cover images courtesy Port of Tacoma and Port of Seattle.



Emission reduction projects in the Puget Sound region

Puget Sound Maritime Air Forum partners have implemented a number of air pollution prevention projects and programs. They are also exploring innovative pilot projects to test new technologies. The following is just a sampling of projects currently under way or planned.

Ocean-going vessels

(includes tankers, cargo and cruise ships)

North West and Canada Cruise Association (NWCCA) at Port of Seattle

Cruise vessel shore power project

Most Princess Cruises and Holland America Line cruise vessels home ported in Seattle now turn off their engines and “plug in” at berth, effectively eliminating emissions at the dock. As of August 2012, the NWCCA member lines use fuel with a sulfur content of 1 percent or less, in compliance with the North American Emission Control Area. Some cruise lines participate in the Port of Seattle’s ABC Fuels program and burn fuel with 0.5 percent or lower sulfur content at berth.

Cruise vessel seawater scrubber study

Holland America Line and Krystallon conducted a seawater scrubber technology demonstration project, which served as an important test-bed

for demonstrating the viability of seawater scrubbing in removing sulfur dioxide and particulate matter from marine diesel engines. Both Holland America Line and Krystallon are proud to have been a part of this effort, which moved scrubber technology a long way to form a potentially important development to meet goals of emission control areas.

Port of Seattle

At-Berth Clean Fuels (ABC Fuels)

Through ABC Fuels, the Port, in collaboration with the Puget Sound Clean Air Agency, provides incentives to shipping and cruise lines that burn reduced sulfur distillate fuel while at berth. Since 2009, this program has eliminated 626 metric tons of sulfur emissions. Out of 791 “frequent caller” vessel calls in 2011, 73 percent used cleaner fuels or shore power while at berth.

Green Gateway Partners Awards

Now in its third year, the annual Green Gateway Partner Awards recognize selected cruise and container lines who demonstrate environmental

stewardship, innovation and leadership above and beyond existing regulations. Awardees must participate in either the ABC Fuel program or plug into shore power prior to applying.

Shore power at Terminal 91

At Port of Seattle's Terminal 91, shore power is provided to the various vessel types that berth there, such as the large commercial fishing vessels that process fish in Alaska and make return trips to the area, as well as cruise ships. The Port was the first in North America to have the infrastructure allowing two cruise ships to plug in simultaneously.

Maersk Line using slide fuel valves

In cooperation with the engine manufacturer MAN B&W, Maersk uses a slide fuel injection valve which cuts particulate matter (PM) and nitrogen oxide (NOx) emissions by more than 25 percent. Other recent initiatives include the adoption of common rail technology and electronically controlled engines, which further reduce NOx emissions through optimal combustion. Maersk is continuing to test ways of reducing NOx emissions with such initiatives as catalytic converters.



Image courtesy Maersk Line

American President Lines (APL) burning lower sulfur fuels in their vessels' auxiliary engines while at dock

This should cut emissions of toxic diesel particles from APL ships in port by roughly 3.5 tons a year — a 75 percent reduction. While in Seattle, the ships will burn roughly 250,000 gallons of the cleaner fuel in a year. APL also uses a seawater scrubber for the auxiliary engines of the APL England, an emission control technology in which seawater is used to scrub the contaminants from the exhaust emissions. The scrubber is expected to reduce SOx emissions by 99 percent; NOx by 10 percent; and both PM and VOCs by 80 percent.

Port of Tacoma

- Since 2004, vessels operated by ocean carriers Evergreen and K-Line have voluntarily used low sulfur distillate in the auxiliary engines while at berth. Approximately 50 ship calls have routinely used low sulfur fuel, which reduces diesel particulate emission by approximately 60 percent.
- Totem Ocean Trailer Express Terminal (TOTE) partnered with the Port in 2010 to provide ship-side retrofits and install shore power infrastructure at the TOTE Tacoma Terminal. The partners received a \$1.5 million U.S. EPA grant and leveraged funds through in-kind contributions from the Port and direct matching funds from TOTE. TOTE also uses redesigned roll-on/roll-off vessels powered by diesel-electric motors in series, achieving a 30 percent fuel savings and significant emission reductions. TOTE is planning to convert the ships that call in Tacoma to run on cleaner-burning liquefied natural gas.
- Evergreen's "green" ships call in Tacoma. In addition to numerous other environmentally friendly design features, the vessels produce fewer diesel emissions.



Image courtesy Port of Seattle

Port of Seattle

- Adopted requirements for drayage trucks entering port terminals to have 1994 or newer engines as of Jan. 1, 2011. All trucks entering port terminals must be enrolled in the Port's Drayage Truck Registry, which documents newer, cleaner trucks that serve Seattle container terminals. Model year 1994 trucks are 2.5 to 6 times cleaner than older trucks. By 2015, 80 percent of all trucks entering Port of Seattle facilities must meet emission standards for engine-year 2007; by 2017 100 percent of trucks must meet 2007 emission standards.
- In partnership with the Puget Sound Clean Air Agency and Cascade Sierra Solutions, the Port implemented a financial incentive program to replace 280 drayage trucks in 2009-2011. Through this buy-back, scrap and replacement effort, and other fleet turnover, all pre-1994 engine trucks retired from the fleet as of January 2011.
- Launched a program to replace Clean Truck Program stickers with radio frequency identification (RFID) tags to give trucks access to the Port's container terminals. The RFID tags will help the Port gather information on truck access to terminals and better focus efforts to reduce emissions, and may enable terminals to speed up truck check-in at gates.

- Two of the heavy-duty diesel vehicles used by Seaport Maintenance operate with diesel oxidation catalysts to reduce air emissions. These retrofits were made possible by a grant from Ecology.
- The Seaport Maintenance fueling station installed Stage 2 vapor recovery equipment.
- Seaport Environmental Program staff replaced fleet minivans with hybrid and plug-in hybrid vehicles.
- Implemented an award-winning employee trip-reduction program.
- Maintain bike and pedestrian paths across and adjacent to terminals.
- Educated Port employees, tenants and customers regarding actions they can take to protect air quality.

Port of Tacoma

- The Clean Drayage Truck Program was established in 2008 to eliminate old diesel drayage trucks from serving Port marine terminals. In 2010, pre-1994 drayage trucks were banned from Port terminals reducing emissions between 1-2 tons per year. The Port is currently working with the trucking community to eliminate pre-2007 trucks by 2017. In a complementary effort, the City of Tacoma, in collaboration with the Port of Tacoma, the Puget



Image courtesy Port of Tacoma

- Tacoma Rail partnered with EPA and Puget Sound Clean Air Agency to retire three circa 1950s locomotives and replaced them with remanufactured locomotives equipped with EPA Tier 2 and Tier 3 compliant diesel engines. The repower project reduces NOx by 30 tons per year, CO by 25 tons per year, PM by 2 tons per year and hydrocarbons (HC) by close to 7 tons per year.
- Locomotives have run on ultra-low sulfur diesel since 2006 for switching operations at the Port of Tacoma. In the port sector, D5000 use in switching operation is the norm, eliminating 99.7 percent of sulfur oxides emissions from yard switching operations.

Union Pacific

- Union Pacific limits train speeds and shuts down idling locomotives to save fuel. The locomotive shutdowns can save 15-24 gallons of fuel per locomotive, per day.
- All new locomotives have automatic stop-start equipment that eliminates unnecessary idling, and the company also is retrofitting older locomotives with this technology. More than 70 percent of Union Pacific's locomotive fleet is now outfitted with automatic stop-start equipment.
- Union Pacific is performing additional aerodynamic tests and evaluations of the Aero Wedge, an aerodynamic structure placed on the top of the first rail car of a double-stack container train. Preliminary results from wind tunnel, computer and test track analyses are promising for fuel savings and corresponding emissions reductions.
- Union Pacific created and pioneered genset locomotive technology and has 165 genset locomotives in its system-wide fleet at present.

Heavy-duty and fleet vehicles

Port of Everett

- In 2006, the Port purchased and took delivery of an electric vehicle for use by the Harbor Attendant in marina operations, replacing a fossil-fuel vehicle. The Global Electric Vehicle is ideally suited for slow-speed, stop-and-go type travel.
- Also in 2006, the Port obtained a local government heavy-duty diesel retrofit grant from Ecology to retrofit a fleet vehicle with emission control technology. The Port retrofitted its boom truck with this grant.
- In 2008, the Port purchased five Ford Escape hybrid fleet vehicles. These hybrids are primarily used by Security personnel, providing an environmentally friendly and efficient vehicle to perform their duties.
- All diesel-equipped fleet vehicles were ULSD compatible by 2008.

Port of Olympia

- Purchased two electric vehicles and one hybrid vehicle.
- Installed an electric vehicle charging station adjacent to the seaport.
- Through the commute trip reduction policy, the Port offers alternative work schedules; partial reimbursement on monthly public transit tickets and in accordance with the Bicycle Commuter Benefits Act, the Port provides a monetary benefit to employees who bike to work.
- To encourage non-vehicle transportation, the Port purchased one men's and one women's bicycle for the use of interoffice commuting and running errands. Bicycle racks are available around the public facilities.
- Built a 1.2 mile pedestrian path (East Bay Trail) adjacent to the seaport that connects restaurants, the Swantown Marina, Swantown Boatworks and other facilities.

Cargo-handling equipment

(includes cranes, straddle carriers and forklifts)

Port of Everett

- Operates more than 20 percent of its cargo-handling equipment (14 of 62 pieces) on non-diesel fuels, including six electric forklifts, five propane forklifts and three gasoline forklifts.
- Specified the use of an electric rail-mounted gantry crane for cargo at the Rail/Barge Transfer facility instead of a diesel-powered crane.
- Operates two electric gantry cranes at Pacific Terminal.
- Transitioned all diesel cargo-handling equipment to operate on ultra-low sulfur diesel (ULSD).
- In 2009 purchased the last of three Linde Reach Stackers and a 20-ton Hyster Forklift, all of which are equipped with diesel oxidation catalysts (DOC) and ULSD compatible.

Port of Seattle

- More than half of all eligible pieces of cargo-handling equipment used to move containers on port facilities have been retrofitted with exhaust controls that significantly reduce emissions.

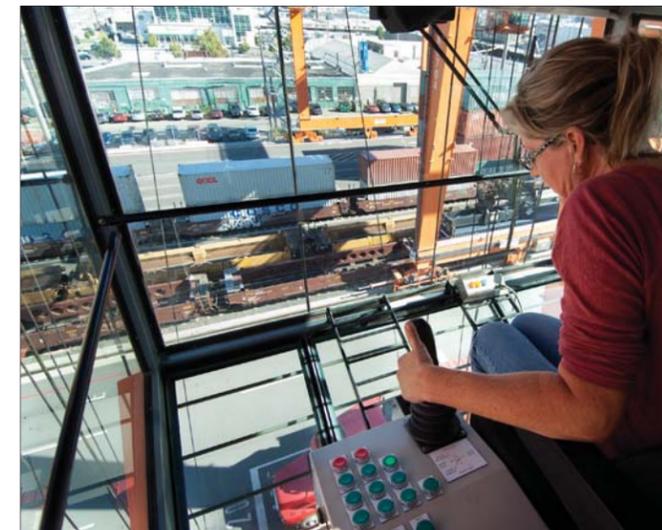


Image courtesy Port of Seattle

- With federal Diesel Emission Reduction Act (DERA) funding and matching funds from the Puget Sound Clean Air Agency and Port of Seattle, 13 pieces of cargo-handling equipment were retrofitted with diesel particulate filters.
- Under the same DERA grant, with Clean Air Agency and Port matching funds, 10 Tier 1 yard trucks with Tier 1 engines were replaced with newer yard trucks, reducing particulate matter from engines by an estimated 98 percent.
- In partnership with the Puget Sound Clean Air Agency and Washington State Department of Ecology, the Port is implementing a grant-funded pilot program to install idle-reduction equipment on cargo-handling equipment.
- Educated equipment owners/operators on strategies for reducing emissions.

Port of Tacoma

- In 2011, installed EPA-verified diesel particulate filters (DPF) on 13 port-owned and -operated straddle carriers with \$490,000 in state Clean Diesel Grant funding. The DPFs reduce emissions by more than 85 percent.
- From 2007-2011, terminal operators received more than \$525,000 in EPA and Ecology grant funding to install EPA-verified DPFs on 22 heavy-duty diesel cargo-handling equipment, reducing emissions by more than 85 percent, and 65 diesel oxidation catalysts, reducing emissions by 25 percent.
- Since 2005, Port of Tacoma terminal operators have installed EPA-verified diesel oxidation catalysts on more than 100 heavy-duty diesel cargo-handling equipment, reducing diesel particulate emissions by more than 25 percent.
- Of the Port's 102 forklifts, 42 are powered by propane and three are electric.
- TOTE is currently conducting a DPF retrofit trial on one diesel yard truck. Demonstration of a successful Level 3 retrofit on its equipment is expected to lead to further installations of DPFs on the fleet of more than 30 yard trucks.

- Evergreen Marine, the leaseholder at Pierce County Terminal, installed DPFs on two side picks, reducing diesel particulate emissions by more than 85 percent. Evergreen also purchased lighter straddle carriers that use 30 percent less fuel and equipped new Tier 2 fuel-efficient on-road engines in the equipment fleet. This voluntary action conserves energy and reduces greenhouse gas and diesel exhaust emissions by 30 percent in 2005. Evergreen was also the first leased terminal operator to mandate the on-terminal use of ULSD.
- APM Terminals retired the majority of its older non-tiered engine cargo-handling equipment and replaced new yard trucks with on-road engines. APM Terminals, with assistance from a Puget Sound Clean Air Agency grant and an Ecology Clean Diesel Grant, retrofitted 36 pieces of heavy-duty cargo-handling equipment with diesel oxidation catalysts, reducing diesel particulate emissions by 25 percent. The terminal also uses low-emission on-road diesel engines in 55 percent of its yard tractor fleet.
- Husky Terminal & Stevedoring has installed DPFs on seven top picks and one yard truck, reducing diesel particulate emissions by more than 85 percent. Since March 2006, Husky also has used biodiesel fuel for all diesel-operated vehicles and container-handling equipment. Husky uses a blend of 50 percent biodiesel (B50), 50 percent ultra-low sulfur diesel during warmer months and B20 during colder months.
- Washington United Terminals (WUT) retrofitted four reach stackers, two top picks and 10 yard trucks with DPFs. The terminal also replaced an additional six yard trucks and one top pick with low emission EPA Tier 4 units. WUT operates an additional eight rubber-tired gantry cranes, 24 yard trucks that are factory-equipped to meet EPA Tier 4 emission standards. WUT is conducting an idle-reduction equipment trial expected to significantly reduce diesel equipment idling and emissions from equipment cold starts. The terminal has used ultra-low sulfur diesel for all terminal operations at the Port of Tacoma since December 2006.

- Pacific Rail Service with assistance from a Department of Ecology grant retrofitted 11 pieces of heavy-duty cargo-handling equipment with diesel oxidation catalysts, reducing diesel particulate emissions by 25 percent.
- Northwest Container Services has retrofitted two reach stackers with DPFs, reducing diesel particulate emissions by more than 85 percent.

Harbor vessels

(tugboats, ferries and recreational vessels)

- The Port of Everett began providing ULSD at the Marina Fuel Dock in 2008.
- Washington State Ferries (WSF) initiatives to reduce air pollution and greenhouse gas emissions focus on reducing fuel use, improving efficiency and using alternative fuels. Current activities include:
 - Using ultra-low sulfur diesel and biodiesel (B5) in the ferry fleet.
 - Slowing vessels down to reduce emissions and fuel use.
 - Evaluating whether to retrofit ferries to use liquefied natural gas (LNG) instead of diesel.
 - Exploring positive restraint systems to eliminate “pushing the dock” while loading/unloading.



Image courtesy www.wsdot.wa.gov



Image by Kurt Clark

Rail

Burlington Northern Santa Fe Railway

Burlington Northern Santa Fe (BNSF) Railway has implemented a number of strategies system-wide to reduce emissions from rail operations. BNSF is committed to improving air quality across its system and has been aggressively acquiring new locomotives and retiring older and less efficient ones. Examples of these efforts are summarized below.

- Between 2005 and the end of 2011, BNSF acquired more than 2,000 Tier 2 cleaner-burning, fuel-efficient locomotives.
- Approximately 90 percent of the fleet now has idle control mechanisms on switch engines, including auxiliary power units (APU), diesel-driven heating system (DDHS) and automatic start-stop technology on locomotives.
- BNSF is adjusting train speeds and reducing train resistance (drag) through low torque bearings.
- Rail lubrication is being implemented to reduce friction and aerodynamic drag – which also extends rail and wheel life and increases fuel efficiency.
- An incentive program rewards locomotive engineers who save fuel (and emissions).

- BNSF is also working with major locomotive manufacturers to develop a hybrid high-horsepower locomotive that would capture and reuse the regenerative braking energy for traction.
- BNSF operates electrically-powered wide-span cranes at the Seattle International Gateway Intermodal Facility. These cranes produce zero emissions on site while generating power each time they lower a load. Additionally, the wide stance design of these new cranes also reduces the number of diesel trucks (hostlers) for shuttling containers within the intermodal facility, reducing emissions and improving fuel efficiency.
- BNSF has been installing an automated gate system for trucks as they enter and exit intermodal facilities, thereby reducing truck idling time and emissions by 50 percent.

Port of Everett

- In 2011-2012, the Port of Everett installed a rail access recovery line in its marine terminals. At approximately 3,200 lineal feet, this line allows cargo to be expedited in the case of a regional emergency.

Tacoma Rail

- Tacoma Rail partnered with regional air agencies in 2007 to install idle-reduction equipment on its locomotives. By 2011, Tacoma Rail reduced its fleet from 18 to 14 locomotives, and installed idle-reduction equipment on all but two locomotives. Tacoma Rail has saved more than 440,000 gallons of diesel fuel and reduced greenhouse gas emissions by 209 tons since 2007. An additional component of this project included installing onboard wheel flange lubrication technology on the three locomotives that were replaced, as well as five additional switcher locomotives owned and operated by Tacoma Rail. The wheel flange lubricator systems are designed to reduce wheel/rail friction, thereby improving fuel efficiency.