



Puget Sound Maritime Air Emissions Inventory



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 underway or planned.

Ocean-going vessels (includes cargo and cruise ships, tankers, etc.)

- *NorthWest CruiseShip Association use of low sulfur fuel* – In 2002 Celebrity Cruise Line introduced ships with gas turbine engines; on Nov. 14, 2003 the member lines of the NorthWest CruiseShip Association (NWCA) committed to procure and use low sulfur fuel while in Washington, British Columbia and Alaska waters. During the 2005 cruise season the average sulfur content of fuel procured in Seattle was approximately 1.6 percent. NWCA member lines will continue to procure and burn low sulfur fuel while operating in the Pacific Northwest.
- *Cruise vessel seawater scrubber study* - The Holland America Line's *MS Zaandam*, which home ports in Vancouver, B.C., will test seawater scrubbing equipment to demonstrate the feasibility of using this technology to reduce emissions from large ocean-going vessels. This study is a collaborative effort made possible with the generous assistance of a grant from the EPA/West Coast Diesel Collaborative and contributions from the Puget Sound Clean Air Agency and the Port of Seattle. Other funding partners in the study include: BP, Environment Canada, B.C. Ministry of the Environment, B.C. Clean Air Research Fund, and the Vancouver-Fraser Port Authority (Canada).
- *Cruise vessel shore power project* - Most Princess Cruises and Holland America Line cruise ships home ported in Seattle now turn off their engines and “plug in” while calling to the Terminal 30 Cruise Facility, effectively reducing emissions to zero while at the dock. Princess Cruises and Holland America Line have each built shore side electrical infrastructure on the terminal and retrofitted vessels to be shore power compatible. Juneau, Alaska is the only other cruise port in the world that offers shore power to cruise ships. Princess Cruises and Holland America Line partnered with the Port of Seattle, Puget Sound Clean Air Agency, EPA and Seattle City Light to implement these cutting-edge projects.
- *Shore power provided 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. Additionally, when the cruise terminal moves from its current location at Terminal 30 up to Terminal 91, the dock-side shore power infrastructure will be moved as well to accommodate the cruise ships when they are at dock.
- *Use of biodiesel* - Royal Caribbean / Celebrity Cruise Lines are using a 99-percent biodiesel blend in their gas turbine ships that visit Seattle. Biodiesel has only trace amounts of sulfur, and creates much lower diesel particulate matter emissions during combustion.
- *Fuel water emulsion system* – Norwegian Cruise Line’s *Norwegian Pearl* is equipped with a fuel water emulsion system which is designed to reduce the amount of NO_x by as much as 20 percent.

- *American President Lines* has committed to burning lower sulfur fuels in their vessel's auxiliary engines while at dock. This change should cut emissions of toxic diesel particles from APL ships while 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.
- “*K*” *Line* has committed to burning lower sulfur fuels in their vessel's auxiliary engines while at dock.
- *Totem Ocean Trailer Express Terminal* uses redesigned RoRo vessels that are powered by diesel-electric motors in series achieving a 30-percent fuel saving and significant emission reductions.
- *Evergreen goes 'green'*. The first of Evergreen's “green” ships is now calling in Tacoma. In addition to numerous other environmentally friendly design features, the vessels produce less diesel emissions.
- *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 NOx emissions by over 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 initiatives such as catalytic converters.
- *Orient Overseas Container Line's (OOCL)* newbuilding vessels are installed with environmentally-friendly propulsive engines and auxiliary engines, certified for nitrogen oxide-control (NOx). These engines are also equipped with certified advanced slide fuel injection valves to reduce NOx emissions.

Cargo-handling equipment (includes cranes, straddle carriers, forklifts, etc.)

- *Port of Seattle* purchased 169 diesel oxidation catalysts to retrofit cargo handling equipment. This represents all eligible cargo-handling equipment that is operated on all Port of Seattle container terminals.
- In 2005, the Port of Tacoma purchased and installed diesel oxidation catalysts on 30 straddle carriers (“strads”). The Port of Tacoma received a \$75,000 EPA grant to help fund this project. The catalysts reduced per-vehicle particulate emissions by at least 20 percent – from 0.143 tons per year to less than 0.114 tons per year. Per-vehicle NOx emissions, meanwhile, were reduced from 4.71 tons per year to less than 2.35 tons per year.
- The *Evergreen Group*, the leaseholder at Pierce County Terminal, purchased lighter straddle carriers that use 30 percent less fuel, and equipped new Tier 2, fuel efficient onroad engines for the entire new cargo handling equipment fleet. This voluntary action conserves energy and reduces both the greenhouse gases and diesel exhaust emission by 30 percent. Evergreen was also the first leased terminal operator to mandate the on-terminal use of ULSD.
- *SSA and APL* switched their operations from high sulfur off-road diesel fuel to a 20 percent biodiesel and 80 percent low sulfur diesel blend at the Port of Seattle.
- Since March 2006, *Husky Terminal & Stevedoring* has been using biodiesel fuel for all diesel-operated vehicles and container handling equipment. Husky uses a blend of 50-percent biodiesel, 50-percent ultra-low sulfur diesel during warmer months, and B20 during colder months.
- *MTC* switched their operations to ultra-low sulfur diesel fuel.
- *APM Terminals* in Pierce County is using low-emission “onroad” diesel engines in 55-percent of its yard tractor fleet.
- The *Port of Everett* has more than 20 percent of its cargo handling equipment (14 of 62 pieces) on non-diesel fuels, including six electric fork lifts, five propane fork lifts, and three gasoline fork lifts
- Of the *Port of Tacoma's* 54 forklifts, 22 are powered by propane.
- *Washington United Terminal* has been using ultra-low sulfur diesel for all terminal operations at the Port of Tacoma since December 2006.

- The *Port of Everett* has specified the use of an electric rail mounted gantry crane for cargo at the Rail/Barge Transfer facility, instead of a diesel-powered crane. Two electric gantry cranes currently operate on Pacific Terminal.
- In 2006, the *Port of Everett* purchased two electric Linde Reach Stackers for use in the Terminals.
- The Maintenance Department staff at *Port of Everett* is conducting a biodiesel test project to determine its operating efficacy for strads and other Port-operated equipment. The use of biodiesel has potential to further lower SO_x and diesel particulate matter emissions.
- Grain terminal operator *TEMCO* has implemented a successful anti-idling operational policy that conserves energy and reduces both greenhouse gases and diesel exhaust emissions by a total of 35 percent.

Harbor vessels (tugboats, ferries, recreational vessels, etc)

- Port of Seattle has made biodiesel available at the Shilshole Bay Marina Fuel Dock.
- *Washington State Ferries* (WSF) initiatives:
 - In 2003 WSF began an ongoing process of evaluating, and adopting when practicable, the use of cleaner fuels in the ferry fleet.
 - 2003 - Conducted preliminary operational and emissions tests of low sulfur diesel, ULSD and biodiesel.
 - 2004 - Converted entire ferry fleet to low sulfur diesel.
 - 2004 and 2005 - Undertook pilot test of B20 biodiesel (in partnership with Puget Sound Clean Air Agency and Seattle City Light).
 - 2004 and 2005 - Undertook pilot test of ULSD (in partnership with the Puget Sound Clean Air Agency and the EPA).
 - 2006 - Partnering with Puget Sound Clean Air Agency and Seattle City Light on a biodiesel research project and second biodiesel pilot test.
 - 2006 - Started conversion of the ferry fleet to ULSD.
 - In 2002, WSF initiated engine equipment upgrades. WSF has upgraded or replaced existing fuel-system equipment with more fuel-efficient main engines, ship-service generators, and fuel-injectors on many vessels of the fleet. To date, 56 engines have been upgraded and 30 generators have been replaced. This has included replacing 624 of the fuel injectors with new emissions-reducing injectors.
 - *Operational Fuel Conservation Measures.* The majority (89%) of the WSF fleet power down their main and auxiliary engines, and connect to shore-power during tie-up at night.
 - *Ongoing Initiatives.* A WSF working group, focused on fleet-wide fuel conservation efforts, is exploring the following initiatives:
 - Route profiling, identifying optimum speeds to meet schedules and save fuel;
 - Positive restraint system while vessel is in dock, reducing the demand on the engines while loading/unloading;
 - Reducing to two engine operation on certain vessel classes;
 - Reducing on-board fuel storage to minimize weight load;
 - Installation of heat recovery systems that would alleviate need for heating boilers.

Rail

Tacoma Rail

- Since July 2006, ultra-low sulfur diesel has been used in the locomotives for switching operations at the Port of Tacoma. In the port sector, D5000 use in switching operation is the norm; this practice eliminates 99.7 percent sulfur oxides emission from the yard switching operations.
- Tacoma Rail received a total of \$100,000 from the Olympic Region Clean Air Agency, the Puget Sound Clean Air Agency, and the Washington Department of Ecology, and matched that with \$100,000, to retrofit four of its locomotives with technology that will reduce emissions. The anti-idling system will protect the engines in cold weather and also improve air quality, save fuel that locomotives use at about three to four gallons an hour at idle, and reduce engine noise.

BNSF Railway

- BNSF is reducing emissions on locomotives by:
 - installing idle control mechanisms on switch engines including auxiliary power units (APU), diesel-driven heating system (DDHS), and automatic start-stop technology on locomotives.
 - implementing the idling reduction program on locomotives.
 - increasing the number of cleaner-burning locomotives.
 - implementing a locomotive visible emissions-reduction program.
 - reducing train resistance (drag) through low torque bearings.
 - adjusting train speeds
 - implementing the wheel/rail lubrication (especially on curved track and turnouts) to reduce friction and aerodynamic drag –(Rail lubrication extends rail and wheel life and increases fuel efficiency)
- BNSF is also reducing emissions at Intermodal yards by:
 - improvement in lift efficiencies at intermodal yards through electrification of lift equipment and improved traffic flows;
 - implementing RFID (radio frequency identification) system at intermodal yards to increase productivity/efficiency by reducing queue times for trucks;
 - initiating cargo handling equipment diesel emissions reduction program; and
 - planning implementation of CARB/EPA verified diesel retrofit technologies.
- BNSF **GenSet Switchers**- BNSF has acquired new **three Genset locomotives**, which are powered by three truck diesel engines. These locomotives are currently providing services in BNSF switch yards.
- 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 performs routine stack opacity tests on locomotives to ensure engines are in good operating condition. The program helps reduce visible emissions and helps improve air quality and locomotive efficiency.

Fleet vehicles

- Port of Seattle switched to a 99% biodiesel – ULSD fuel blend for its Seaport Maintenance fleet.
- The Port of Everett purchased and took delivery, in 2006, 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.
- Port of Seattle encourages cleaner vehicle purchases and has initiated an automobile purchase policy to replace retiring Port-owned vehicles with new gasoline-electric hybrid vehicles, where practical. These hybrid vehicles travel approximately 50 miles per gallon of regular unleaded gasoline. Today, the Port owns several hybrid vehicles.
- Port of Seattle installed Stage II Vapor Recovery Equipment, though not required, at the Seaport Maintenance refueling station.

Freight mobility/efficiencies

Port of Seattle

- Initiated a radio-frequency identification (RFID) pilot project with SSA to equip 1,200-1,500 trucks with RFID tags and Terminal 18 with RFID readers, which will reduce wait times at gates and improve terminal efficiency.
- Terminal operators have initiated cargo-handling equipment fleet modernization programs and are encouraged to purchase equipment that meets 2007 standards for heavy-duty onroad diesel engines.
- Redeveloped Seaport cargo terminals to increase efficiency, including improving nearby road networks.
- 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 thus reduce truck wait times.
- Provided electric plug-ins instead of diesel units for refrigerated containers on the docks.
- Purchased bigger 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

- *Totem Ocean Trailer Express Terminal* at Port of Tacoma implements the “Paperless Gate” that uses RFID technology to reduce truck gate congestion.
- *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.

Other innovative projects or pilots in the maritime industry

- *BNSF Railway*
 - Uses "**Green Goat®**," an environmentally-friendly hybrid switch engine, which has been in service for several years in the Los Angeles area. The cabless Green Goat® units are planned for use in Texas. The Green Goat® uses a relatively small, clean, and efficient diesel genset in conjunction with over 300 batteries to improve fuel economy and reduce pollution. Remanufactured from existing switcher locomotives, the Green Goat can reduce oxides of nitrogen (NO_x) and particulates while reducing greenhouse gases and diesel fuel consumption when compared to conventional yard switchers.
 - BNSF's Los Angeles Junction Railroad utilizes the four existing liquefied natural gas (LNG) locomotives in the nation servicing industry in the LA basin. The Green Goat® and LNG locomotives are part of BNSF's commitment to improving air quality across its system. The railway also is acquiring new locomotives and retiring older and less efficient ones. Between 1996 and 2004, BNSF acquired over 2000 cleaner-burning and fuel-efficient locomotives.
 - Currently researching Diesel Particulate Filters (DPF) and fuel cell technology on locomotives- which involves development and demonstration of a prototype fuel cell hybrid switcher locomotive. The vehicle integration will take place at BNSF Topeka shop.
- *Foss Maritime* announced plans to build the first hybrid tug. In addition to lower fuel consumption, it is estimated that emissions of particulate matter (PM) and NO_x will be reduced by 40 percent. Plans are for the tug to be operational at the Ports of Los Angeles/Long Beach in 2008.
- OOCL subsidiary *Terminal Systems Inc.* is joining with Railpower Technologies Corp. to test three hybrid Rubber Tired Gantry cranes at its terminal in the Port of Vancouver, BC. Long Beach Container Terminal, the OOCL subsidiary in Long Beach, announced plans last month for development and testing of hybrid yard tractors there.
- *Fuel Emulsification*: The world's eighth-largest container carrier, APL said it has teamed with the California Air Resources Board (CARB), the U.S. Environmental Protection Agency (EPA), the ports of Los Angeles and Long Beach, and four California air quality management boards, to test innovative fuel emulsification technology that could reduce emissions of nitrogen oxides from vessels by as much as 20 percent and become a shipping industry standard.
- *Flywheel Technology for Port Cranes*: Vycon Company sold its first six units for testing for \$150,000 each to the Long Beach Container Terminal in December. One is being used at the ITS Terminal at the same port, and another machine is being tested at Evergreen Marine's Seaside Transportation Services terminal at the neighboring Port of Los Angeles. The flywheel system collects energy as cargo containers are lowered and then releases it as containers are lifted. That reduces the power the diesel engine has to supply, cutting fuel consumption and the release of pollutants.

The Puget Sound Maritime Air Forum is a voluntary association of private and public maritime organizations, air agencies, and other parties with operational or regulatory responsibilities related to maritime industry air quality impacts. Forum members are committed to accurately identifying and quantifying maritime-related sources of air pollution and seeking ways to voluntarily reduce air pollution impacts from this transportation sector. For more information, visit www.maritimeairforum.org