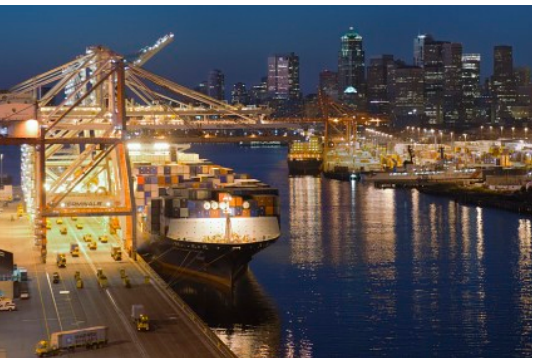
Northwest Ports Clean Air Strategy

2013 Update (DRAFT) | June 2013



Port of Seattle

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EXECUTIVE SUMMARY

The Port of Seattle, Port of Tacoma, and Port Metro Vancouver are continuing their collaborative efforts on the **Northwest Ports Clean Air Strategy** to reduce emissions from shipping and port operations in the Georgia Basin–Puget Sound airshed. In developing and implementing the 2007 Strategy and this 2013 **Strategy Update**, the three ports partnered with government agencies including: Environment Canada and Metro Vancouver in Canada, and the U.S. Environmental Protection Agency, Washington State Department of Ecology, and Puget Sound Clean Air Agency in the United States. Collectively, the ports and government agencies are referred to as the Strategy partners.

The voluntary actions in this Strategy Update are intended to complement regulations and, together with the regulations, achieve the following emission reductions relative to a 2005 baseline:

- **Reduce diesel particulate matter (DPM) emissions per ton of cargo by 75% by 2015 and 80% by 2020**, to decrease immediate and long-term health effects on adjacent communities.
- **Reduce greenhouse gas (GHG) emissions per ton of cargo by 10% by 2015 and 15% by 2020**, to limit contributions to climate change and reduce associated environmental, health, and economic impacts.

These goals account for changing levels of port activity and focus on increasing efficiency per ton of cargo moved through the ports.

Since adopting the first Strategy in 2007, the Strategy partners have evaluated data and lessons learned from implementation efforts, advances in emission-reduction technology, and changes in the regulatory landscape. This experience to date informs the Strategy Update and its key elements:

- Goals for reducing port-related emissions in the Georgia Basin–Puget Sound airshed.
- Performance targets for 2015 and 2020 for reducing emissions in each covered sector.
- Pilot studies and demonstration projects to assess how new emission-reduction technologies can help meet the emission-reduction goals.

The ports developed inventories of port-related air emissions in 2005 and updated their emissions inventories in 2010 and 2011. The recent inventories show considerable progress in reducing emissions since 2005, and they provide data to identify areas for continued improvement going forward. The emissions inventories and the Strategy Update cover the following sectors of port-related operations:

1. Ocean-going vessels
2. Harbor vessels
3. Cargo-handling equipment

4. Trucks
5. Locomotives and rail transport
6. Port administration

Table 1 summarizes the actions and performance targets in each sector of the Strategy Update as presented in later chapters. Together, these performance targets are designed to achieve the airshed emission-reduction goals by 2015 and 2020. The Strategy partners also committed to conducting pilot studies and demonstration projects to advance innovative approaches to reduce emissions from these sectors.

Table 1. Summary of Actions and Performance Targets by Sector for 2015 and 2020

Sectors and Actions	2015 Targets	2020 Targets	Reduces DPM	Reduces GHG
Ocean-Going Vessels				
OGV-1 **Vessels surpass Emission Control Area (ECA) requirements**	**Early compliance with 2015 ECA 0.1% fuel-sulfur level** (or equivalent) while hotelling before 2015	**Ports track number of vessels** with Tier 3 marine engines, shore power use, cleaner fuel, or other emission-reduction technologies	✓	✓
OGV-2 **Ports and vessels participate in port-designed or third-party certification** programs that promote continuous improvement (such as Environmental Ship Index, Green Marine, Clean Cargo Working Group, or others)	**Ports and 10% of vessel calls**	**Ports and 40% of vessel calls**	✓	✓
Harbor Vessels				
Harbor-1 **Strategy partners conduct annual outreach** to port-related harbor vessel companies and **recognize best practices and engine upgrades**	**Partners** conduct outreach and **50% of harbor vessel companies** report best practices and engine upgrades	**Partners** conduct outreach and **90% of harbor vessel companies** report best practices and engine upgrades	✓	✓
Harbor-2 **Ports and harbor vessels participate in port-designed or third-party certification** programs that promote continuous improvement (such as Environmental Ship Index, Green Marine, Clean Cargo Working Group, or others)	**Ports and 10% of harbor vessels**	**Ports and 40% of harbor vessels**	✓	✓

Continued >

Table 1. Summary of Actions and Performance Targets by Sector for 2015 and 2020 *(continued)*

Sectors and Actions	2015 Targets	2020 Targets	Reduces DPM	Reduces GHG
Cargo-Handling Equipment				
CHE-1 **CHE meets Tier 4 interim** (T4i) emission standards or equivalent	**50% of equipment**	**80% of equipment**	✓	
CHE-2 **Ports and terminals have fuel-efficiency plans** in place that promote continuous improvement	**Ports and 50% of terminals**	**Ports and 100% of terminals**	✓	✓
Trucks				
Truck-1 **Trucks meet or surpass U.S. EPA emission standards** or equivalent for model year 2007	**80% of trucks**	**100% of trucks** (by 2017)	✓	
Truck-2 **Ports, terminals, and trucks have fuel-efficiency plans** in place that promote continuous improvement	**Ports**	**Ports, terminals, and 50% of trucks**	✓	✓
Locomotives				
Rail-1 **Switcher locomotive owners/operators participate in a fuel-efficiency program**	**100% of owners/operators** institute a program	**100% of owners/operators** achieve performance objectives of chosen program	✓	✓
Rail-2 **Switcher locomotive owners/operators upgrade or replace unregulated engines** (engine replacements will be Tier 2 or better)	**10% of unregulated locomotive engines**	**20% of unregulated locomotive engines**	✓	✓

Continued >

Table 1. Summary of Actions and Performance Targets by Sector for 2015 and 2020 *(continued)*

Sectors and Actions	2015 Targets	2020 Targets	Reduces DPM	Reduces GHG
Port Administration				
Admin-1 **Ports own and operate cleaner vehicles and equipment and have fuel-efficiency plans** in place that promote continuous improvement	**Ports report** use of cleaner vehicles and equipment and other relevant information	**Ports increase use** of cleaner vehicles and equipment	✓	✓
Admin-2 **Ports apply clean construction standards** to engines used on port-led construction projects (such as American Association of Port Authorities, U.S. EPA Best Practices for Clean Diesel Construction, or equivalent best management practices)	**Ports institute clean construction best practices** for port-led projects, including idle-reduction and **Tier 2** engine emission requirements	**Ports apply clean construction best practices f**or port-led projects, including idle reduction and **Tier 4** engine emission requirements	✓	✓
Admin-3 **Ports facilitate energy studies and conservation projects** at port-operated and/or tenant facilities to identify and address energy conservation opportunities in building systems, operations, and yard lighting	**Each port conducts 3** energy studies	**Each port completes 3** energy conservation projects	✓	✓

STRATEGY OVERVIEW

The Port of Seattle, Port of Tacoma, and Port Metro Vancouver are continuing their collaborative efforts on the **Northwest Ports Clean Air Strategy** to reduce maritime and port-related emissions from global marine trade and port operations in the Georgia Basin–Puget Sound airshed (see **Figure 1**). In developing and implementing the 2007 Strategy and this 2013 Strategy Update, the three ports partnered with government agencies including: Environment Canada and Metro Vancouver in Canada, and the U.S. Environmental Protection Agency, Washington State Department of Ecology, and Puget Sound Clean Air Agency in the United States. Together, the three ports and five agencies constitute the Strategy partners.[1]

Ports are a critical part of the Pacific Northwest and North American economy, facilitating movement of people and goods and supporting living-wage jobs. With their tenants and customers, the three ports use diesel-powered ships, trains, trucks, and other equipment to move goods and passengers through the ports to other destinations.[2] The Strategy creates a harmonized approach to improving air quality and reducing port-related emissions in the shared airshed to safeguard public health and the environment while supporting economic growth.

The 2007 Strategy and this 2013 **Strategy Update** contain shared emission-reduction goals and targets for the three ports, with flexibility for how each port meets the targets through actions appropriate to its particular situation. The Strategy Update incorporates new emissions inventory data, regulatory changes, and emerging issues to set performance targets for 2015 and 2020. These targets build on previous actions and take additional steps to reduce emissions.

To reduce emissions in advance of and complementary to regulations, the Strategy Update focuses on voluntary actions to address three primary objectives:

1. Reduce port-related air quality impacts from **diesel particulate matter** (DPM) emissions to decrease immediate and long-term health effects on human health, the economy, and the environment in the airshed.

2. Reduce **greenhouse gas** (GHG) emissions to limit contributions to climate change and reduce associated environmental, health, and economic impacts.

3. Help meet air quality standards and objectives for the airshed.

The Strategy's success relies on significant contributions from port tenants, customers, and other stakeholders who manage port activities and equipment that produce air emissions, as well as regional transportation agencies that can influence freight movement. With their tenants and stakeholders, the three ports seek to manage future growth in a way that improves air quality and supports sustainable port operations.

1 The British Columbia Ministry of Environment and the American Recovery and Reinvestment Act provided additional technical and financial support toward emission-reduction initiatives related to the Northwest Ports Clean Air Strategy.

2 The Strategy Update uses "diesel" as a concise reference for fuel oils, including diesel, bunker fuel, and other heavy crude fuels.

Targeted Emissions and Inventories

The Strategy Update focuses on voluntary actions to reduce emissions of DPM and GHGs. Such actions often yield related benefits of decreasing other air pollutants, such as sulfur and nitrogen oxides, carbon monoxide, volatile organic compounds, and air toxics.

Port Metro Vancouver updated its air emissions inventories in 2010 (*Landside Emissions Inventory* and *National Marine Emissions Inventory for Canada*) and the ports of Seattle and Tacoma updated their emissions data in 2011 (as part of the *Puget Sound Maritime Air Emissions Inventory*).[3] The recent inventories show considerable progress in reducing emissions since the previous 2005 inventories; they also highlight areas for continued improvement, which this Strategy Update addresses. **Appendix A** provides more information on the inventories.

Geographic Scope

The Port of Seattle, Port of Tacoma, and Port Metro Vancouver share a common airshed. This joint Strategy seeks to improve air quality around the three largest ports and maritime industry hubs in the Northwest, with benefits that extend throughout the Georgia Basin–Puget Sound airshed (see **Figure 1**). The airshed centers on the marine area known as the Salish Sea and includes the Strait of Juan de Fuca, greater Puget Sound area, Strait of Georgia, Haro Strait, Boundary Pass, Rosario Strait, and other nearby waterways.

Figure 1. Georgia Basin-Puget Sound Airshed Boundaries

Emissions inventory boundaries are delineated in the 2010 and 2011 inventories, as described in Appendix A. These reports estimate the quantity of emissions from maritime-related activities within the shared airshed. The emissions inventories for Port Metro Vancouver and Puget Sound (including the Port of Seattle and Port of Tacoma) were conducted independently and use different boundary delineations.

3 Starcrest Consulting Group, LLC, 2011 *Puget Sound Maritime Air Emissions Inventory,* September 2012; SNC-Lavalin, *Port Metro Vancouver 2010 Landside Emissions Inventory*, March 26, 2012; SNC-Lavalin, 2010 *National Marine Emissions Inventory for Canada*, March 31, 2012 (not yet published; available by request from Environment Canada).

Strategy Update Contents

The remainder of this Strategy Update includes the following chapters:

- **Airshed Emission-Reduction Goals**. The Strategy Update contains airshed-wide goals for reducing port-related DPM and GHG emissions. To develop these goals, the Strategy partners considered data collected through implementation since 2007, advances in emission-reduction technology, actions taken, and changes in the regulatory landscape.
- **Performance Targets by Sector**. The Strategy partners updated the previous 2015 performance *measures* (now called performance targets) and set new performance targets for 2020. The Strategy Update includes new and updated actions and performance targets for the following sectors:
    1. Ocean-going vessels
    2. Harbor vessels
    3. Cargo-handling equipment
    4. Trucks
    5. Locomotives and rail transport
    6. Port administration
- **Pilot Studies and Demonstration Projects**. The Strategy Update calls for pilot studies and demonstration projects designed to advance emission-reduction technologies for the maritime and port industry.
- **Performance Reporting**. Each year, the Strategy partners publish an implementation report that summarizes emission-reduction activities and tracks progress on performance targets. The annual report presents progress and compares results with previous years. Every five years, the ports will update their air emissions inventories and analyze progress toward emission-reduction goals.

Following the final **Conclusions and Next Steps** chapter, a **Glossary** provides explanations of terms and abbreviations used in the Strategy Update. **Appendix A** provides more information on the port emissions inventories, and **Appendix B** provides a comparison table of relevant air emission regulations in the United States and Canada.

AIRSHED EMISSION-REDUCTION GOALS

This Strategy Update is designed to reduce emissions at the three ports as well as complement and expand on regulatory requirements—by adopting measures early, achieving higher levels of emission reductions, and taking other voluntary steps to reduce emissions. The three ports established emission-reduction goals that reflect their commitment to improving the environment while fostering economic growth.

The voluntary actions in the Strategy Update are intended to complement regulations and, together with the regulations, achieve the following emission reductions relative to the 2005 baseline emissions inventories:

- **Reduce DPM emissions per ton of cargo by 75% by 2015 and 80% by 2020.**
- **Reduce GHG emissions per ton of cargo by 10% by 2015 and 15% by 2020.**[4]

These goals account for changing levels of port activity and focus on increasing efficiency per ton of cargo moved through the ports. The partners chose to set goals per ton of cargo throughput for consistency, recognizing that the ports have different growth projections.

While supply-chain efficiency can reduce emissions per ton of cargo, it is the *total* emissions of DPM and GHGs that affect overall air quality in the region and contribute to climate change. For **total DPM emissions**, technology advancements and regulatory requirements are expected to reduce the total DPM output, even as cargo throughput increases. In addition to expected DPM reductions due to phase-in of regulations and anticipated turnover of fleet vehicles and equipment, the Strategy partners will continue to seek additional reductions across all sectors. The three ports estimate that their *total* DPM emissions will be reduced by 70% by 2015 and 75% by 2020, relative to the 2005 baseline. Reduced diesel emissions will also decrease the associated immediate and long-term health effects on adjacent communities.

Total GHG emissions from the three ports combined are not currently anticipated to decrease over the 2015–2020 period due to expected port growth. Most GHG emissions from the ports are directly tied to fuel consumption. As a result, they tend to increase with growth in port operations, although efficiency gains can help offset increases. The Strategy partners recognize that, by 2015, work is needed both to implement projects that will reduce GHG emissions and to improve estimation and forecasting methods related to GHG reductions. Going forward, the Strategy partners will also reevaluate the 2020 GHG emissions goal as needed to align with broader GHG reduction targets established by state, provincial, and federal governments.[5] Throughout these efforts, the Strategy partners will seek ways to maximize efficiency gains across all sectors and to implement clean, low-carbon fuels in advance of, or surpassing, improvements already expected due to phase-in of regulations and anticipated turnover of fleet vehicles and equipment.

4 Although cruise line activities are included in each port's emissions inventory, the two ports with cruise passengers (Port Metro Vancouver and Port of Seattle) have not included cruise passengers in their cargo throughput metrics. In other words, cruise passengers are not accounted for in the "per ton of cargo" figures above.

5 For example, Washington State aims to reduce GHG emissions to 1990 levels by 2020, to 25% below 1990 levels by 2035, and to 50% below 1990 levels by 2050 (Chapter 70.235, *Revised Code of Washington—Limiting Greenhouse Gas Emissions*, apps.leg.wa.gov/RCW/default.aspx?cite=70.235.020, accessed May 2013). British Columbia aims to reduce GHG emissions by at least 33% below 2007 levels by 2020 and 80% below 2007 levels by 2050 (available online at www.env.gov.bc.ca/cas/legislation/index.html#GGRTA, accessed May 2013).

Although the Strategy focuses on emissions directly related to port operations, the Strategy partners recognize that the efficiency of freight movement—and the associated air emissions—are tied to transportation infrastructure and traffic systems. Since the ports cannot control the broader transportation system, neither the DPM nor GHG reduction goals assume significant gains from improvements in regional transportation. The Strategy partners, however, will continue to work with regional transportation departments on plans and projects to improve system efficiency and reduce emissions.

Table 2 summarizes the **2015 and 2020 goals** for DPM and GHG emission reductions per ton of cargo. To achieve these goals, the Strategy Update presents **actions** and **performance targets** for each sector, as described in the following chapter.

Table 2. Emission-Reduction Goals for DPM and GHGs by 2015 and 2020, from 2005 Baseline

Targeted Emissions	2015 Goals	2020 Goals	Measurement
Diesel particulate matter	**75%** reduction	**80%** reduction	Emissions per ton of cargo
Greenhouse gases	**10%** reduction	**15%** reduction	Emissions per ton of cargo

PERFORMANCE TARGETS BY SECTOR

Actions and performance targets for reducing emissions to reach the ports' emission-reduction goals for DPM and GHGs are organized by the following port-related emission source sectors:

1. **Ocean-going vessels** (OGVs)
2. **Harbor vessels**
3. **Cargo-handling equipment** (CHE)
4. **Trucks**
5. **Locomotives and rail transport**
6. **Port administration**

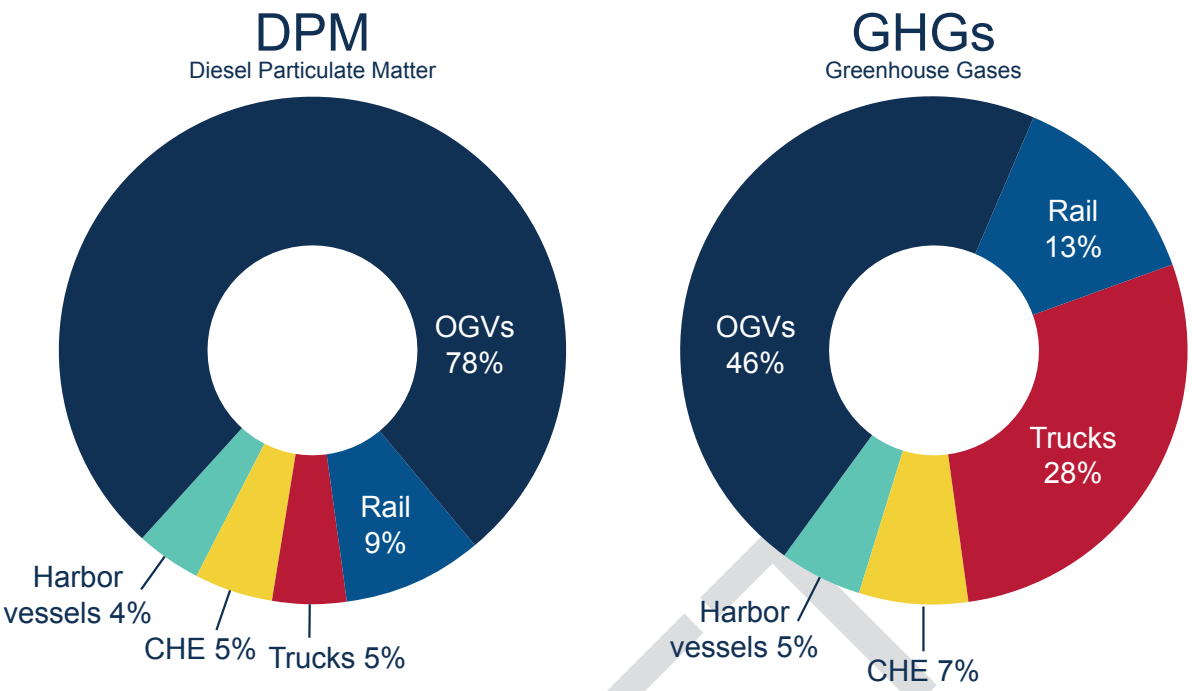
The following chapters summarize each sector, including covered activities, emissions, relevant regulations, progress, challenges, next steps, actions, and performance targets. Annual implementation reports provide additional information on these sectors and progress to date.[6]

Figure 2 shows the contributions of each sector to the combined DPM and GHG emissions from the Port of Seattle, Port of Tacoma, and Port Metro Vancouver.[7] Because these figures include emissions from port-related travel throughout the airshed, ship movements from the ocean entrance of the Strait of Juan de Fuca to and from the three ports contribute to the large share of emissions from ocean-going vessels. Emissions from these ships are expected to decrease significantly due to implementation of international emission regulations beginning in 2012. Within the ports themselves, cargo-handling equipment contributes a major portion of emissions. **Appendix A** provides more information on the port emissions inventories, and **Appendix B** summarizes relevant air emission regulations in the United States and Canada.

6 Northwest Ports Clean Air Strategy Implementation Reports, available online via all three ports: www.portoftacoma.com/nwpcas, www.portmetrovancouver.com/en/environment/initiatives/Air.aspx, and www.portseattle.org/Environmental/Air/Seaport-Air-Quality/Pages/NWPorts-Clean-Air.aspx, all accessed May 2013.

7 Starcrest Consulting Group, LLC, *2011 Puget Sound Maritime Air Emissions Inventory*, September 2012; SNC-Lavalin, *Port Metro Vancouver 2010 Landside Emissions Inventory*, March 26, 2012; SNC-Lavalin, *2010 National Marine Emissions Inventory for Canada*, March 31, 2012 (not yet published; available by request from Environment Canada). A working group of the Strategy partners analyzed data from these inventories to develop estimates of combined emissions across the three ports.

Figure 2. Port-Related DPM and GHG Emissions by Sector from the Three Ports, 2010–2011



Meeting the sector-specific performance targets will enable the ports to achieve the Strategy Update's emission-reduction goals for DPM and GHGs and to reduce port-related emissions throughout the airshed. Because the size and characteristics of each sector vary across the three ports, the Strategy Update does not set emission-reduction goals by sector. The performance targets apply to all three ports but will be implemented separately by the individual ports. Each port can determine the appropriate balance of actions to achieve the emission-reduction goals.

Because the ports do not directly control many of the activities that produce emissions, the Strategy's success relies on significant contributions from port tenants, customers, and other stakeholders who own and operate port-related vessels and equipment. Tools for implementation include regulations, port procedures and requirements (such as licensing systems, registrations, fees, tariffs, and lease conditions), incentives, grants, recognition programs, pilot studies, demonstration projects, and other methods to encourage voluntary action and behavior change. While regulations are also addressing emissions from these sectors, the voluntary actions in this Strategy Update complement and go beyond these regulations to further reduce emissions.

1. OCEAN-GOING VESSELS

Activities and Emissions

Ocean-going vessels (OGVs or ships) include container ships, tankers, bulk carriers, and cruise ships. These ships typically use large Category 3 marine diesel engines for propulsion and may also have one or several auxiliary engines. Ships burn fuel and generate emissions during *transit* to and from ports (the emissions inventories include transit between local ports and the Pacific Ocean), *maneuvering* into or out of port, and *hotelling* to meet ship power demands while docked or at anchor. OGVs have historically produced relatively high emissions due to their large engines, lack of emission-control devices, and use of high-sulfur fuel—although they remain a relatively efficient form of transport compared to other modes.

The three ports combined receive more than 5,000 calls annually from nearly 2,000 unique vessels. Each port serves multiple different container and cruise lines. In addition, many different bulk, break-bulk, and tanker vessels call at the three ports.[8] OGVs produced approximately 78% of DPM emissions and approximately 46% of GHG emissions from activities related to the three ports, as identified in their emissions inventories.[9]

Regulations

Ships move between jurisdictions, and most are registered with countries other than the United States or Canada. The International Maritime Organization (IMO) sets international standards to prevent pollution from ships. In 2010, the IMO designated the North American Emission Control Area (ECA), which includes waters 200 nautical miles or less from the coasts of British Columbia and Washington State and contains the entire Georgia Basin–Puget Sound airshed. All vessels within the ECA must burn lower-sulfur fuel or achieve an equivalent emission reduction. The maximum fuel sulfur limit recently decreased to 1%; and in January 2015, the limit goes down to 0.1% sulfur in fuel.[10] **Appendix B** provides more detail on emission regulations for ocean-going vessels.

New regulations are expected in 2013 following amendments to the International Convention on the Prevention of Pollution from Ships (MARPOL) Annex VI regulations, which address energy-efficiency for ships of 400 gross tonnage and above. This new chapter makes mandatory the Energy Efficiency Design Index (EEDI), which requires new ships to be more energy-efficient. The regulations are non-prescriptive, as long as the required energy-efficiency level is attained, so ship designers and builders are free to use the most cost-efficient solutions for each particular ship.

8 Bulk carriers transport uniform materials such as grain or gravel. Break-bulk, or general cargo, consists of materials not transported in containers, such as goods in bags, boxes, crates, drums, barrels, or pallets. Tanker vessels transport petroleum products or other liquids.

9 Starcrest Consulting Group, LLC, *2011 Puget Sound Maritime Air Emissions Inventory*, September 2012; SNC-Lavalin, *Port Metro Vancouver 2010 Landside Emissions Inventory*, March 26, 2012; SNC-Lavalin, *2010 National Marine Emissions Inventory for Canada*, March 31, 2012 (not yet published; available by request from Environment Canada). A working group of the Strategy partners analyzed data from these inventories to develop estimates of combined emissions across the three ports.

10 International Maritime Organization, "Information on North American Emission Control Area (ECA) under MARPOL Annex VI," May 13, 2010, www.imo.org/blast/blastDataHelper.asp?data_id=29099&filename=723.pdf, accessed May 2013. The United States implemented the ECA in August 2012, and Canada began enforcement in May 2013. Transport Canada, "Regulations Amending the Vessel Pollution and Dangerous Chemicals Regulations," www.tc.gc.ca/eng/mediaroom/backgrounders-vessel-pollution-regulations-7162.html, accessed May 2013.

The new regulations also require all ships to have a Ship Energy Efficiency Management Plan (SEEMP), which is a fuel-conservation plan involving speed optimization, weather routing, or hull maintenance. By 2025, new vessels must be 30% more energy-efficient, and all vessels must have energy-efficiency plans. These new standards are expected to reduce overall GHG emissions from ships by 9% annually by 2025. The United States and Canada are in the process of adopting strict environmental regulations to comply with and implement these international standards.

Progress, Challenges, and Next Steps

Successful emission reductions have already been achieved through providing shore power and incentives for using lower-sulfur fuels while in port. The annual implementation reports provide more details on existing efforts to date.[11] As ECA implementation moves forward, it will significantly reduce emissions from ships.

The ports have limited control over visiting ships and their emissions. Vessels travel all over the world, and some may call at a particular port only once in a year. The ports have the greatest influence over ships when they are maneuvering in port and hotelling at the dock. Current efforts to reduce emissions include ECA implementation, shore power, financial incentives to burn cleaner fuel at berth, and stricter emission regulations for marine engines. In addition, this Strategy Update encourages vessel owners and operators to participate in green certification programs and to reduce emissions further—such as through efficient ship design and adoption of green operations and practices.

Cost and availability of ECA-compliant fuels may pose challenges for shipping lines, but use of lower-sulfur fuel will significantly reduce DPM emissions. The ports are committed to helping ships surpass the ECA standards for lower-sulfur fuels and assisting with early adoption of the ECA's 2015 fuel sulfur limit, with specific emphasis on hotelling operations. The ports will measure progress through port-designed programs and third-party certification. Such systems encourage best practices and continuous improvement and may also result in lower operating costs. The ports will track and report annually on the number of vessels using Tier 3 marine engines, shore power, cleaner fuels, and other emission-reduction technologies. The result should be decreases in both DPM and GHG emissions.

11 Northwest Ports Clean Air Strategy Implementation Reports, available online via all three ports: www.portoftacoma.com/nwpcas, www.portmetrovancouver.com/en/environment/initiatives/Air.aspx, and www.portseattle.org/Environmental/Air/Seaport-Air-Quality/Pages/NWPorts-Clean-Air.aspx, all accessed May 2013.

Table 3 summarizes actions and performance targets for 2015 and 2020 for the OGV sector.

Table 3. Actions and Performance Targets for Ocean-Going Vessels, for 2015 and 2020

Actions	2015 Targest	2020 Targets	Reduces	
			DPM	GHG
OGV-1 **Vessels surpass Emission Control Area (ECA) requirements**	**Early compliance with 2015 ECA 0.1% fuel-sulfur level** (or equivalent) while hotelling before 2015	**Ports track number of vessels** with Tier 3 marine engines, shore power use, cleaner fuel, or other emission-reduction technologies	✓	✓
OGV-2 **Ports and vessels participate in port-designed or third-party certification** programs that promote continuous improvement (such as Environmental Ship Index, Green Marine, Clean Cargo Working Group, or others)	**Ports and 10% of vessel calls**	**Ports and 40% of vessel calls**	✓	✓

2. HARBOR VESSELS

Activities and Emissions

Harbor vessels are an important part of the Northwest economy. This sector includes assist and escort tugs, harbor and ocean tugs, ferry vessels, excursion vessels, government vessels, work boats, some commercial fishing vessels, and tank barges. Harbor vessels generate air emissions from burning fuels as they move and work in the ports.

Fewer than 200 of the approximately 1,000 harbor vessels operating in and near the three ports are directly related to port activity. These port-related harbor vessels are owned and operated by about a dozen companies. Port-related harbor vessels, including tugs and port-owned vessels, account for approximately 4% of DPM emissions and 5% of GHG emissions from activities related to the three ports, as identified in their emissions inventories.[12] Recreational vessels and other non-port-related harbor vessels contribute additional emissions but are not covered in this Strategy Update.

Regulations

Starting in 2012, fuel regulations in the United States and Canada effectively required harbor vessels to use ultra-low-sulfur diesel (ULSD) fuel. Both countries also require new harbor vessel engines to meet stricter emissions standards and specify the installation of upgrade kits during engine overhauls for applicable existing engines. **Appendix B** provides more information on emission regulations for harbor vessels.

Progress, Challenges, and Next Steps

The ports have not been directly involved in harbor vessel-related projects to date, although use of lower-sulfur fuel by some harbor vessel operators ahead of regulatory requirements has reduced emissions from harbor vessels. The Puget Sound Clean Air Agency has received several grants over the last few years from Ecology, U.S. EPA, and the U.S. Department of Transportation's Maritime Administration for diesel reduction projects on harbor vessels. In partnership with vessel owners, these grants have upgraded engines on a fishing boat, helped investigate exhaust retrofits to reduce DPM emissions, and will repower two tugs. Ferries in Washington State and British Columbia have also undertaken multiple efforts to reduce their fuel use and emissions. Annual implementation reports provide additional information regarding harbor vessels.[13]

Ports have little influence over harbor vessels because they do not have direct business relationships with most harbor vessel owners and operators. The most effective way to reduce emissions from harbor vessels is to replace the vessels or repower them (replace their engines),

12 Starcrest Consulting Group, LLC, *2011 Puget Sound Maritime Air Emissions Inventory*, September 2012; SNC-Lavalin, *Port Metro Vancouver 2010 Landside Emissions Inventory*, March 26, 2012; SNC-Lavalin, *2010 National Marine Emissions Inventory for Canada*, March 31, 2012 (not yet published; available by request from Environment Canada). A working group of the Strategy partners analyzed data from these inventories to develop estimates of combined emissions across the three ports.

13 Northwest Ports Clean Air Strategy Implementation Reports, available online via all three ports: www.portoftacoma.com/nwpcas, www.portmetrovancouver.com/en/environment/initiatives/Air.aspx, and www.portseattle.org/Environmental/Air/Seaport-Air-Quality/Pages/NWPorts-Clean-Air.aspx, all accessed May 2013.

but these efforts are expensive. Exhaust retrofits to reduce DPM emissions are available for some engines. Although exhaust retrofits are a fraction of the cost of repowers, they are still expensive, have limited applications, and do not reduce fuel use (and thus they do not decrease GHG emissions or fuel costs).

The Strategy Update focuses on port-related harbor vessels and does not address emissions from non-port-related harbor vessels—which include ferries, recreational vessels, and non-port-related tugs. The Strategy partners believe promoting increased vessel fuel efficiency and best practices is the best way to work with this sector. Accordingly, the Strategy partners will identify activities that increase fuel efficiency and reduce emissions, and they will share this information with harbor vessel owners and operators to foster adoption of best practices.

Table 4 summarizes actions and performance targets for 2015 and 2020 for harbor vessels.

Table 4. Actions and Performance Targets for Harbor Vessels, for 2015 and 2020

Actions	2015 Targest	2020 Targets	Reduces	
			DPM	GHG
Harbor-1 **Strategy partners conduct annual outreach** to port-related harbor vessel companies and **recognize best practices and engine upgrades**	**Partners** conduct outreach and **50% of harbor vessel companies** report best practices and engine upgrades	**Partners conduct outreach and 90% of harbor vessel companies report best practices and engine upgrades**	✓	✓
Harbor-2 **Ports and harbor vessels participate in port-designed or third-party certification** programs that promote continuous improvement (such as Environmental Ship Index, Green Marine, Clean Cargo Working Group, or others)	**Ports and 10% of harbor vessels**	**Ports and 40% of harbor vessels**	✓	✓

3. CARGO-HANDLING EQUIPMENT

Activities and Emissions

Cargo-handling equipment (CHE) moves goods to and from ships, railcars, and trucks. The equipment addressed in this Strategy Update includes, but is not limited to, the following equipment operated on marine terminals: straddle carriers, rubber-tired gantry (RTG) cranes, reach stackers, top and side picks, forklifts, skid loaders, yard tractors and trucks, wharf cranes, and conveyor belts. The performance targets for CHE apply to equipment operating more than 100 hours per year with greater than 25 brake horsepower (bhp).

The three ports combined are using an estimated 3,000 pieces of cargo-handling equipment, the majority of which are diesel-powered. Much of this equipment is owned and operated by port tenants and other users, rather than the ports themselves. The CHE sector contributes 5% of DPM emissions and 7% of GHGs from activities related to the three ports, as identified in their emissions inventories.[14]

Regulations

New engines on cargo-handling equipment in both the United States and Canada are subject to federal air quality regulations, which establish tiers of emission standards based on engine output capacity and year of manufacture. **Appendix B** provides more information on emission regulations for cargo-handling equipment.

Progress, Challenges, and Next Steps

Using a variety of federal, state, local, and port grant funds, terminal operators have been working with the Strategy partners to upgrade, repower, or retrofit existing CHE with cleaner engines or best-available control technology for reducing emissions. The ports have conducted pilot studies of retrofits and cleaner-fueled equipment, including electric or hybrid-electric CHE. These studies have provided valuable operational experience to inform future efforts. The terminal operators have provided in-kind contributions for project oversight, implementation, and maintenance costs associated with emission-control technology and equipment. They have also purchased newer, cleaner equipment. Annual implementation reports provide additional information regarding cargo-handling equipment.[15]

Replacement, repowering, or exhaust retrofits can reduce emissions from cargo-handling equipment, although the high cost of replacement engines and failure of one type of exhaust control for DPM have hampered emission-reduction efforts. Relatively few options for retrofit-eligible equipment are available, and replacing equipment before the end of its useful life can be cost-prohibitive. Although retrofits can reduce emissions and fuel use, they may increase other

14 Starcrest Consulting Group, LLC, *2011 Puget Sound Maritime Air Emissions Inventory*, September 2012; SNC-Lavalin, *Port Metro Vancouver 2010 Landside Emissions Inventory*, March 26, 2012; SNC-Lavalin, *2010 National Marine Emissions Inventory for Canada*, March 31, 2012 (not yet published; available by request from Environment Canada). A working group of the Strategy partners analyzed data from these inventories to develop estimates of combined emissions across the three ports.

15 Northwest Ports Clean Air Strategy Implementation Reports, available online via all three ports: www.portoftacoma.com/nwpcas, www.portmetrovancouver.com/en/environment/initiatives/Air.aspx, and www.portseattle.org/Environmental/Air/Seaport-Air-Quality/Pages/NWPorts-Clean-Air.aspx, all accessed May 2013.

operating and maintenance costs. Equipment powered on cleaner fuels, such as compressed or liquefied natural gas (CNG or LNG), propane, or electricity holds promise for emission reductions. However, fuel availability, additional infrastructure cost, reduced cargo capacity, and shortened run times before refueling pose challenges for integrating such equipment into existing systems.

Through pilot studies undertaken since 2008, Strategy partners and equipment operators have gained extensive knowledge about the technology and operational challenges of the current generation of low-emission CHE. As technology and fueling infrastructure improve, the ports will aggressively evaluate cleaner and renewable energy—including electricity, propane, CNG, LNG, and biofuels—to reduce both DPM and GHG emissions from cargo-handling equipment. Use of these cleaner fuels will be counted as meeting the Tier 4 interim target below.[16] More efficient use of equipment will also help reduce emissions.

Table 5 summarizes actions and performance targets for 2015 and 2020 for cargo-handling equipment.

Table 5. Actions and Performance Targets for Cargo-Handling Equipment, for 2015 and 2020

Actions	2015 Targest	2020 Targets	Reduces	
			DPM	GHG
CHE-1 **CHE meets Tier 4 interim (T4i)** emission standards or equivalent	**50%** of equipment	**80%** of equipment	✓	
CHE-2 **Ports and terminals have fuel-efficiency plans** in place that promote continuous improvement	**Ports and 50%** of terminals	**Ports and 100%** of terminals	✓	✓

16 Tier 4 refers to a set of emission requirements established by the U.S. EPA to reduce emissions of particulate matter, nitrogen oxides (NOx), and air toxics from new, non-road diesel engines. Tier 4i, or interim, refers to the New Source Performance Standards for emissions that became effective on January 1, 2011, for all new, high-horsepower diesel generator engines. The Tier 4i standard significantly cuts NOx emissions.

4. TRUCKS

Activities and Emissions

The truck sector covers on-road heavy-duty trucks that move cargo to and from marine terminals. Trucks deliver cargo and containers to and from local and national destinations, and they also transfer loads between terminals, distribution centers, and intermodal loading facilities. Most of these trucks are Class 8 heavy-duty vehicles, with gross vehicle weights of more than 33,000 pounds.

Approximately 9,000 heavy-duty trucks transport cargo to and from the three ports, accounting for an estimated 6 million roundtrips through the terminal gates each year. Trucks account for 5% of DPM emissions and 28% of GHGs from activities related to the three ports, as identified in their emissions inventories.[17]

Regulations

In both the United States and Canada, the federal government regulates fuels, emission-control components, and emission standards for heavy-duty trucks. Truck emission standards address particulates, hydrocarbons, nitrogen oxides, and carbon monoxide. GHG emission standards for heavy-duty vehicles take effect starting with model year 2014 engines. **Appendix B** provides more information on emission regulations for trucks.

Progress, Challenges, and Next Steps

The three ports have established their own approaches to achieving air quality requirements for heavy-duty trucks entering their marine terminals. Annual implementation reports describe efforts to date.[18] The ports achieved their 2010 target for heavy-duty trucks calling at marine terminals to meet the model year 1994 engine emissions standard or equivalent. The ports adopted requirements for trucks entering their container terminals to be enrolled in either a truck licensing system or a truck registry, which documents that trucks meet the emission requirements. Model year 1994 engines are 2.5 to 6 times cleaner than pre-1994 truck engines for DPM emissions.[19]

Typically, heavy-duty trucks are not owned by the ports, marine terminals, or shippers. Most trucks are either independently owned and operated or owned by transport companies. The most effective methods to reduce DPM emissions are to replace the vehicles or repower them (replace their engines). Both of these measures are costly, and truck owners may need to spread the costs of their investments over long time spans.

17 Starcrest Consulting Group, LLC, *2011 Puget Sound Maritime Air Emissions Inventory*, September 2012; SNC-Lavalin, *Port Metro Vancouver 2010 Landside Emissions Inventory*, March 26, 2012; SNC-Lavalin, *2010 National Marine Emissions Inventory for Canada*, March 31, 2012 (not yet published; available by request from Environment Canada). A working group of the Strategy partners analyzed data from these inventories to develop estimates of combined emissions across the three ports.

18 Northwest Ports Clean Air Strategy Implementation Reports, available online via all three ports: www.portoftacoma.com/nwpcas, www.portmetrovancouver.com/en/environment/initiatives/Air.aspx, and www.portseattle.org/Environmental/Air/Seaport-Air-Quality/Pages/NWPorts-Clean-Air.aspx, all accessed May 2013.

19 The U.S. EPA emission standard for particulate matter for model year 1988–1993 engines was 0.25 to 0.60 grams per brake horsepower-hour (bhp-hr). For model year 1994 engines, it was 0.1 grams/bhp-hr; and for model year 2007 engines, 0.01 grams/bhp-hr. (DieselNet, "Emission Standards: Heavy-Duty Truck and Bus Engines," www.dieselnet.com/standards/us/hd.php#y2007, accessed May 2013.)

The next phase of the ports' clean truck programs calls for trucks to meet 2007 emission standards over the 2015–2017 timeframe. A 2007 engine is ten times cleaner than a 1994 engine for DPM emissions.[20] These newer trucks are more expensive to purchase and more costly to maintain, however.

Because engine emission standards addressing GHGs do not take effect until the 2014 model year, performance targets to reduce GHG emissions are focused on improving efficiency and reducing fuel use; such efforts will also reduce DPM emissions. Emission standards for post-2007 model year engines do not significantly reduce DPM emissions. Instead, they focus on reducing other pollutants and improving fuel economy, which reduces GHG emissions. A potential future target (beyond the year 2020) may be for trucks entering ports to meet the 2014 emission standards.

Recognizing that the broader transportation system greatly influences the efficiency of truck movement outside of port terminals, the ports will continue to work with regional transportation departments and air agencies to adopt programs such as faster freight corridors, priority treatment, and freight-only capacity expansions to move freight more quickly on roads and rail facilities.

Table 6 summarizes actions and performance targets for 2015 and 2020 for the truck sector.

Table 6. Actions and Performance Targets for Trucks, for 2015 and 2020

Actions	2015 Targest	2020 Targets	Reduces	
			DPM	GHG
Truck-1 **Trucks meet or surpass U.S. EPA emission standards** or equivalent for model year 2007	**80% of trucks**	**100% of trucks** (by 2017)	✓	
Truck-2 **Ports, terminals, and trucks have fuel-efficiency plans** in place that promote continuous improvement	**Ports**	**Ports, terminals, and 50% of trucks**	✓	✓

20 DieselNet, "Emission Standards: Heavy-Duty Truck and Bus Engines," page 18, www.dieselnet.com/standards/us/hd.php#y2007, accessed May 2013.

5. LOCOMOTIVES AND RAIL TRANSPORT

Activities and Emissions

The port-related rail sector consists of locomotives that move railcars within a rail yard (switching or yard locomotives, also known as "switchers") or move trains across the airshed and beyond (line-haul locomotives). Some switchers are operated by port tenants; others are operated by regional and national rail companies working at or near port properties. Switcher locomotives are typically lower horsepower engines that do not leave the yard and travel an average of 6 miles per day.

Operators of line-haul locomotives are typically regional or national rail carriers. Line-haul locomotives use higher-horsepower engines and carry freight long distances across state lines and around the United States and Canada.

Several hundred locomotives operate at or near the three ports. Locomotive emissions contribute approximately 9% of DPM emissions and 13% of GHGs from activities related to the three ports, as identified in their emissions inventories.[21]

Regulations

Federal fuel regulations in both countries effectively required locomotives to use ultra-low-sulfur diesel (ULSD) fuel beginning in 2012. The U.S. Environmental Protection Agency also sets emissions standards for new and remanufactured locomotive engines. U.S. EPA requires upgrades during overhauls on certain existing engines and requires idle-reduction technology on all new engines and required engine upgrades. Canadian targets to reduce GHG emissions and criteria air pollutants align with U.S. EPA's emission standards for locomotives. Appendix B provides more information on emission regulations for the rail sector.

Progress, Challenges, and Next Steps

The ports have not been directly involved in locomotive projects to date. The Puget Sound Clean Air Agency and Washington State Department of Ecology have conducted several grant-funded projects to reduce emissions, including the repower of three local switcher locomotives under a U.S. EPA grant and the installation of idle-reduction technology on several other locomotives. As a result of 2012 federal fuel regulations requiring the use of ULSD, the rail sector has substantially reduced DPM and sulfur emissions, and some rail operators began using lower-sulfur fuel prior to the regulations. Under its SmartWay Program, EPA developed the Rail Carrier FLEET tool to enable rail carriers to establish baseline emissions per ton-mile and then track emission reductions.[22]

Several tenants that operate switchers are using newer low-emission models, some of which

21 Starcrest Consulting Group, LLC, *2011 Puget Sound Maritime Air Emissions Inventory*, September 2012; SNC-Lavalin, *Port Metro Vancouver 2010 Landside Emissions Inventory*, March 26, 2012; SNC-Lavalin, *2010 National Marine Emissions Inventory for Canada*, March 31, 2012 (not yet published; available by request from Environment Canada). A working group of the Strategy partners analyzed data from these inventories to develop estimates of combined emissions across the three ports.

22 SmartWay Transport Partnership, U.S. Environmental Protection Agency, Rail Carrier 2.0.12 Tool: Getting Started Guide—2012 Data Year—United States Version (Part 1), www.epa.gov/smartway/documents/partnership/rail/partnership/420b13010.pdf, accessed June 2013.

incorporate automatic idle-shutdown technology or hybrid-electric engines. Additionally, Port Metro Vancouver and rail service providers have developed a collaborative supply-chain agreement to improve operational efficiency that resulted in a 30% reduction in dwell times to less than three days. Annual implementation reports provide more information for the rail sector.

Because the national, regional, and yard locomotive companies operate differently, the ports will tailor their emission-reduction approaches. The ports have very little influence over line-haul locomotives or most switchers, which are operated by major rail companies working throughout the United States and Canada. The Strategy partners will focus on reducing emissions from locally managed switcher locomotives operating at or near the ports.

Many locomotives in operation have engines that were installed before 1973, and regulations apply only to newer locomotive engines (life expectancy of a locomotive is approximately 50 years). Additionally, U.S. EPA does not certify retrofit kits for locomotive engines manufactured prior to 1973. Emission-reduction efforts, such as participating in EPA's voluntary SmartWay program and installing idle-reduction technologies, provide some financial incentive for rail companies to reduce emissions.

Recognizing that the broader transportation system influences the efficiency of rail movement outside of port terminals, the ports will continue to work with regional transportation departments and air agencies to adopt programs such as faster freight corridors, priority treatment, and freight-only capacity expansions to move freight more quickly on both rail facilities and roads.

Table 7 summarizes actions and performance targets for 2015 and 2020 for locomotives and rail transport.

Table 7. Actions and Performance Targets for Locomotives and Rail Transport, for 2015 and 2020

Actions	2015 Targest	2020 Targets	Reduces	
			DPM	GHG
Rail-1 **Switcher locomotive owners/operators participate in a fuel-efficiency program**	**100% of owners/ operators** institute a program	**100% of owners/ operators achieve** performance objectives of chosen program	✓	✓
Rail-2 **Switcher locomotive owners/operators upgrade or replace unregulated engines** (engine replacements will be Tier 2 or better)	**10% of unregulated locomotive engines**	**20% of unregulated locomotive engines**	✓	✓

6. PORT ADMINISTRATION

Activities and Emissions

While most port-related emissions come from vehicles or equipment that the ports themselves do not operate, the Strategy partners recognize that the ports have their own administration-related emissions that can be reduced. The administration sector covers sources that are governed directly by the ports such as port-owned vehicles and vessels, office buildings, support facilities, and employee functions. The associated activity-related emissions include fleet fuel use, facility energy consumption, employee commuting, materials use, waste management, and maintenance and construction projects.

Regulations

Most of the emission-reduction efforts in the port administration sector are voluntary. In Washington State, large employers are required to implement employee commute trip reduction programs.

Progress, Challenges, and Next Steps

The ports are committed to seeking ways to reduce their own emissions, in addition to facilitating emission reductions by their tenants, customers, and other stakeholders. Some examples of port initiatives include purchasing cleaner-fueled vehicles, constructing LEED-certified buildings, diverting solid waste from landfills, conducting energy audits, conserving energy, retrofitting HVAC systems in buildings, conducting corporate (administrative) carbon footprints, and purchasing offsets for greenhouse gas emissions.

The ports have not routinely reported on status of the vehicles, equipment, and vessels in their fleets as part of the annual implementation reports on the Northwest Ports Clean Air Strategy. In future implementation reports, the ports will describe the number and type of engines in use each year; the number and type of emission-related retrofits installed; the quantity and types of fuels used; and other information relevant to air emissions.

The ports will also continue to report progress on various administrative initiatives to reduce air emissions and help protect the climate. Two new focus areas include reducing emissions from on-road, non-road, and marine engines used on port-led construction projects as well as facilitating energy conservation at both port-operated and tenant facilities.

Table 8 summarizes actions and performance targets for 2015 and 2020 for port administration.

Table 8. Actions and Performance Targets for Port Administration, for 2015 and 2020

Actions	2015 Targest	2020 Targets	Reduces DPM	Reduces GHG
Admin-1 **Ports own and operate cleaner vehicles and equipment and have fuel-efficiency plans** in place that promote continuous improvement	**Ports report use** of cleaner vehicles and equipment and other relevant information	**Ports increase use** of cleaner vehicles and equipment	✓	✓
Admin-2 **Ports apply clean construction standards** to engines used on port-led construction projects (such as American Association of Port Authorities, U.S. EPA Best Practices for Clean Diesel Construction, or equivalent best management practices)	**Ports institute clean construction best practices** for port-led projects, including idle-reduction and **Tier 2** engine emission requirements	**Ports apply clean construction best practices** for port-led projects, including idle reduction and **Tier 4** engine emission requirements	✓	✓
Admin-3 **Ports facilitate energy studies and conservation projects** at port-operated and/or tenant facilities to identify and address energy conservation opportunities in building systems, operations, and yard lighting	**Each port conducts 3** energy studies	**Each port completes 3** energy conservation projects	✓	✓

PILOT STUDIES & DEMONSTRATION PROJECTS

Pilot studies and demonstration projects are important for advancing new and existing emission-reduction technology for the maritime industry. To achieve the objectives of this Strategy Update, the Strategy partners have and will continue to invest in pilot studies and demonstration projects that advance emission reductions in the Georgia Basin–Puget Sound airshed.

The Strategy partners define pilot studies and demonstration projects as follows:

- A **pilot study** is a small-scale preliminary study conducted to evaluate feasibility, time, cost, adverse events, and other factors in an effort to predict and improve upon the study design prior to conducting a full-scale project. Pilot studies are carried out before large-scale projects in an effort to avoid wasting time and money on an inadequately designed project. Pilot studies can provide quantitative support that a system has the potential to succeed on a full-scale basis or help identify design changes to yield better results.

- A **demonstration project** is a small-scale implementation project that tests feasibility and effectiveness of a technology or change in operation in a real-world application.

Examples of pilot studies and demonstration projects conducted at the three ports appear below.

- **Marine liquefied natural gas study**. Port Metro Vancouver has partnered with industry to study the feasibility of liquefied natural gas as a cleaner fuel for the marine sector. The study will assess the opportunities and barriers to introducing LNG infrastructure and will be completed in late 2013.

- **Container terminal clean energy**. Port Metro Vancouver conducted a study in 2011 to assess the feasibility for cleaner energy sources at two container terminals, focusing on electrification and hybridization of rubber-tired gantry cranes (RTGs). Preliminary engineering designs and cost estimates were produced, which could inform a potential demonstration project.

- **Idle-reduction for cargo-handling equipment.** The Puget Sound Clean Air Agency is implementing a demonstration project to install idle-reduction technology on cargo-handling equipment at the ports of Seattle and Tacoma. This project is funded by a grant from the Washington State Department of Ecology.

- **Radio-frequency truck tags.** The Port of Seattle conducted a pilot study with Stevedoring Services of America to equip more than 1,000 trucks with radio-frequency identification (RFID) tags and install RFID readers at a terminal. Following completion of the pilot, the port developed plans to implement RFID technology at its four container terminals to reduce gate times and improve terminal efficiency.

- **Yard truck diesel particulate filter retrofit**. The Husky terminal at Port of Tacoma participated in a diesel particulate filter (DPF) retrofit pilot study with support from U.S. EPA, Puget Sound Clean Air Agency, Port of Seattle, and Port of Tacoma. The purpose of the study was to demonstrate an active DPF system that would be successful on a yard truck subject to significant idling.
- **Pluggable hybrid-electric terminal truck.** The Capacity truck company of Texas provided a hybrid-electric yard truck for demonstration and evaluation at the Port of Tacoma. Three terminals evaluated the equipment over two weeks.

Each port will evaluate or engage in at least one pilot study or demonstration project each year to advance their knowledge of port-related emissions and status of performance targets. The ports will convene workshops, webinars, or meetings among relevant stakeholders to share information and results. Findings from pilot studies and demonstration projects will be summarized in the annual implementation reports.

PERFORMANCE REPORTING

The Strategy partners will participate in ongoing collaboration, including planning, implementing, reviewing, and improving the actions undertaken to meet emission-reduction goals. The approach is voluntary and strategic and will be conducted through collaborative relationships with owners and operators of ocean-going and harbor vessels, cargo-handling equipment, trucks, and locomotives. Strategy implementation uses the following approach to foster continuous improvement:

- **Plan**: Each port will develop specific implementation initiatives to meet the emission-reduction goals and performance targets outlined in the Strategy Update.
- **Do**: As initiatives are conducted, the Strategy partners will measure performance and share information among participants working to achieve results.
- **Check**: Collectively, the Strategy partners will assess results, analyze trends, and report progress each year.
- **Act**: Based on results, the Strategy partners will make changes to foster continuous improvement and reinforce activities that achieve results.

Implementation Reports and Emissions Inventories

The ports will track and report progress toward achieving each performance target for 2015 and 2020. The Strategy partners will also evaluate the number and outcomes of pilot studies and demonstration projects conducted each year as well as workshops held with Strategy partners.

Each year, the Strategy partners will publish an **implementation report** documenting progress toward emission-reduction goals and performance targets. Each port will collect and manage data within its own tracking system or database.[23]

After 2015 and 2020 (every five years), the Strategy partners will report estimates of DPM and GHG emissions reduced as a result of these activities, in conjunction with the preparation of updated **air emissions inventories**.

23 In some cases, such as certain harbor craft categories and non-container heavy-duty trucks, the government agencies will be responsible for data collection.

CONCLUSIONS AND NEXT STEPS

This Strategy Update presents airshed-wide goals for reducing port-related emissions of DPM and GHGs as well as 2015 and 2020 performance targets for each sector. Meeting the performance targets will achieve the goals for emission reductions in the airshed. Each year, the ports will track progress and present efforts to date in an implementation report.

Movement of goods and passengers at the ports is so intertwined that each organization can contribute only part of the solution. The Strategy partners acknowledge that the success of this effort relies on the significant contributions of port tenants, customers, and other stakeholders who may be directly responsible for the equipment and operations addressed by the emission-reduction actions outlined in this Strategy Update. New and upcoming regulations—such as the Emission Control Area, MARPOL Annex for GHGs, and 2014–2018 standards for GHG emissions from trucks—will help reduce port-related emissions. To complement and go beyond these regulations, the Strategy partners will undertake initiatives to engage stakeholders in voluntary efforts to further reduce emissions and support a sustainable maritime economy throughout the Georgia Basin–Puget Sound region.

GLOSSARY

AAPA.....American Association of Port Authorities

B.C. .....British Columbia

Bhp.....Brake horsepower

Bhp-hr.....Brake horsepower-hour

CHE.....Cargo-handling equipment

CNG.....Compressed natural gas

CO .....Carbon monoxide

CO_2.....Carbon dioxide, a greenhouse gas

CO_2e.....Carbon dioxide equivalent

DPM.....Diesel particulate matter

ECA.....Emission Control Area

Ecology.....Washington State Department of Ecology

EEDI .....Energy Efficiency Design Index

EPA .....United States Environmental Protection Agency

GHG .....Greenhouse gas

Goals.....Airshed-wide objectives for reducing port-related diesel particulate matter and greenhouse gas emissions

HVAC.....Heating, ventilation, and air-conditioning

IMO.....International Maritime Organization

LEED.....Leadership in Energy and Environmental Design

LNG.....Liquefied natural gas

MARPOL.....International Convention for the Prevention of Pollution from Ships

NOx.....Nitrogen oxides

OGVs.....Ocean-going vessels

Performance targets.....Sector-specific actions for achieving emission reductions

PM .....Particulate matter

$PM_{2.5}$ ..... Particulate matter less than 2.5 microns in diameter (fine particulates)

PM_{10} ..... Particulate matter less than 10 microns in diameter (coarse particulates)

Ports ..... Port of Seattle, Port of Tacoma, and Port Metro Vancouver

PSCAA ..... Puget Sound Clean Air Agency

Repower ..... Replacing the engine in a vehicle, vessel, or piece of equipment with a newer, cleaner-running engine

RFID ..... Radio-frequency identification

RTG ..... Rubber-tired gantry

Sectors ..... Port-related emission source categories: ocean-going vessels, harbor vessels, cargo-handling equipment, trucks, locomotives and rail transport, and port administration.

SEEMP ..... Ship Energy Efficiency Management Plan

SO_2 ..... Sulfur dioxide

SO_x ..... Sulfur oxides

Strategy ..... Northwest Ports Clean Air Strategy (originally adopted in 2007), a plan implemented by the three ports and government agencies to reduce port-related emissions that affect air quality and climate change in the Pacific Northwest through a collaborative approach led by the Port of Seattle and Port of Tacoma in Washington State and Port Metro Vancouver in British Columbia.

Strategy partners ..... Port of Seattle, Port of Tacoma, and Port Metro Vancouver; Environment Canada; Metro Vancouver; U.S. Environmental Protection Agency; Washington State Department of Ecology; and Puget Sound Clean Air Agency

Strategy Update ..... Northwest Ports Clean Air Strategy—2013 Update

T4i ..... U.S. EPA Tier 4 interim emissions standards for non-road engines

ULSD ..... Ultra-low-sulfur diesel

U.S. ..... United States

U.S. EPA ..... United States Environmental Protection Agency (also EPA)

VOC ..... Volatile organic compound

APPENDICES

- **Appendix A.** Port Emissions Inventories
- **Appendix B.** Air Emission Regulations in the United States and Canada

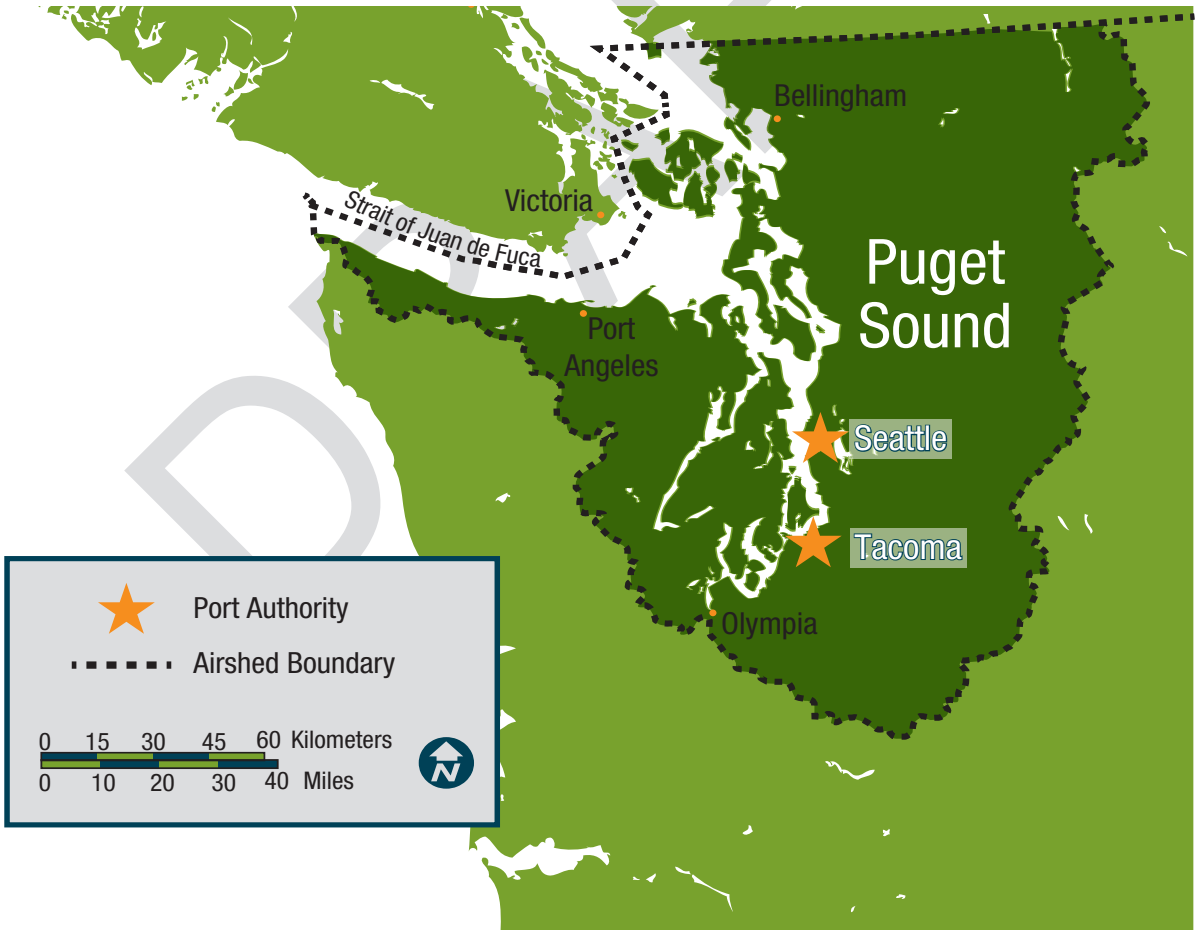
APPENDIX A. PORT EMISSIONS INVENTORIES

Port-related activities are a significant source of air emissions. In recognition that air emissions are not constrained by jurisdictional boundaries and freely cross borders, the three ports and regional, provincial, state, and federal air quality management programs collaborated on the development of the emissions inventories and the Northwest Ports Clean Air Strategy. The ports' emissions inventories guide the direction of this Strategy Update, and they form the basis of the airshed emission-reduction goals and sector-specific performance targets. The 2010–2011 emissions data illustrate the considerable progress made since the 2005 baseline inventories, through actions of ports and other stakeholders as well as implementation of regulations to reduce emissions.

Puget Sound Maritime Air Emissions Inventory 2011

The 2011 Puget Sound Maritime Air Emissions Inventory covers port-related activities in the area shown in **Figure A-1**, bounded by the black dotted lines. The Puget Sound emissions inventory includes separate inventories for the Port of Seattle and Port of Tacoma as well as other Puget Sound ports.

Figure A-1. Puget Sound Maritime Emissions Inventory Boundaries



Air emissions from the Port of Seattle and Port of Tacoma in 2011 are summarized in Table A-1 and Table A-3, respectively. Following the summary of total emissions for each port, Table A-2 and Table A-4 show emission reductions from 2005 to 2011 for each port. For more details, please refer to the full emissions inventory report for 2011.[24]

Table A-1. Port of Seattle—2011 Emissions Inventory for Puget Sound Airshed (tons)

	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	DPM	CO_2e
OGV, hotelling & maneuvering	748	26	66	600.51	47.69	38.15	38.62	54,479
OGV, transit	4,106	158	366	3,150.77	264.57	211.66	257.71	202,078
Harbor vessels	418	24	82	0.25	16.43	15.15	16.23	25,048
Recreational vessels	57	62	614	0.11	1.36	1.27	0.40	7083
Locomotives	680	42	111	6.15	24.85	22.85	24.85	41,870
Cargo handling equipment	306	18	158	0.30	16.70	16.20	16.70	34,561
Heavy-duty vehicles	1,270	83	390	1.81	25.27	22.55	25.27	206,887
Terminal fleet vehicles	3	1	12	0.02	0.03	0.03	0.02	1,053
Total	**7,588**	**414**	**1,799**	**3,759.93**	**396.90**	**327.86**	**379.80**	**573,059**

Table A-2. Port of Seattle—Changes in Port Airshed Emissions from 2005 to 2011

% Change	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	DPM	CO_2e
OGV, hotelling & maneuvering	-13%	-7%	-8%	-39%	-35%	-35%	-34%	-10%
OGV, transit	-27%	-20%	-21%	-11%	-21%	-21%	-21%	-11%
Harbor vessels	-22%	-8%	-14%	-100%	-27%	-26%	-27%	-16%
Recreational vessels	-20%	-60%	-41%	-93%	-57%	-56%	-26%	-15%
Locomotives	-34%	-19%	-15%	-93%	-14%	-14%	-14%	-13%
Cargo handling equipment	-27%	-64%	-74%	-99%	-40%	-40%	-39%	-9%
Heavy-duty vehicles	-16%	10%	-16%	-96%	-53%	-53%	-53%	8%
Terminal fleet vehicles	-43%	-70%	-60%	20%	67%	60%	-19%	-25%
Total	**-25%**	**-29%**	**-38%**	**-21%**	**-27%**	**-28%**	**-27%**	**-5%**

Note: Negative numbers indicate reductions in emissions, and positive numbers indicate increases in emissions.

24 Starcrest Consulting Group, LLC, 2011 Puget Sound Maritime Air Emissions Inventory, May 2013 update, www.pugetsoundmaritimeairforum.org, accessed May 2013.

Table A-3. Port of Tacoma—2011 Emissions Inventory for Puget Sound Airshed (tons)

	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	DPM	CO_2e
OGV, hotelling & maneuvering	375	12	32	410.18	29.00	23.20	21.12	30,273
OGV, transit	3,257	122	280	2,561.76	216.39	173.12	202.75	153,472
Harbor vessels	291	10	44	0.16	11.82	10.88	11.82	17,485
Recreational vessels	520	33	80	3.87	18.05	16.45	18.05	30,030
Locomotives	206	13	88	0.20	10.00	9.70	10.00	22,486
Cargo handling equipment	895	51	229	1.24	17.37	15.48	17.37	141,618
Heavy-duty vehicles	3	1	14	0.02	0.04	0.04	0.02	1,429
Terminal fleet vehicles	3	1	12	0.02	0.03	0.03	0.02	1,053
Total	**5,546**	**241**	**768**	**2,977.43**	**302.68**	**248.86**	**281.13**	**396,792**

Table A-4. Port of Tacoma—Changes in Port Airshed Emissions from 2005 to 2011

% Change	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	DPM	CO_2e
OGV, hotelling & maneuvering	-42%	-41%	-41%	-39%	-38%	-38%	-38%	-36%
OGV, transit	-20%	-15%	-15%	-6%	-12%	-12%	-13%	-8%
Harbor vessels	4%	64%	17%	-99%	-3%	-3%	-3%	11%
Recreational vessels	-50%	-36%	-37%	-95%	-35%	-36%	-35%	-35%
Locomotives	-44%	-51%	-45%	-96%	-56%	-56%	-57%	-42%
Cargo handling equipment	-32%	-20%	-39%	-97%	-63%	-64%	-63%	-16%
Heavy-duty vehicles	-36%	-45%	-9%	33%	0%	-5%	-50%	-15%
Terminal fleet vehicles	-43%	-70%	-60%	20%	67%	60%	-19%	-25%
Total	**-28%**	**-23%**	**-30%**	**-16%**	**-25%**	**-26%**	**-26%**	**-18%**

Note: Negative numbers indicate reductions in emissions, and positive numbers indicate increases in emissions.

Port Metro Vancouver Landside Emissions Inventory 2010

The Port Metro Vancouver emissions inventory covers port-related activities in the area shown in **Figure A-2**, bounded by the red box. The landside activities are reported in the updated *2010 Landside Emissions Inventory*,[25] and the marine activities are reported for the port's jurisdictional area, referred to as region 2 in Environment Canada's *2010 National Marine Emissions Inventory*. The combination of the two inventories provides valuable insight into emission sources and the effects of emission-reduction measures.

Port Metro Vancouver conducted emissions inventories in 2005 and 2010. The two inventories differ substantially, however, primarily due to the amalgamation in 2008 of the Fraser River Port Authority, the North Fraser Port Authority, and the Vancouver Port Authority. The 2010 inventory covers the combined Port Metro Vancouver and thus contains a great deal more activity. The 2005 and 2010 inventories for marine emissions were also conducted by different entities using significantly different methodologies. The total 2010 emissions are provided in **Table A-5**.

Figure A-2. Port Metro Vancouver—Emissions Inventory Boundaries

25 SNC-Lavalin, Port Metro Vancouver 2010 Landside Emissions Inventory, March 26, 2012, www.portmetrovancouver.com/en/environment/initiatives/air.aspx, accessed May 2013. SNC-Lavalin, 2010 National Marine Emissions Inventory for Canada, March 31, 2012 (not yet published; available by request from Environment Canada).

Table A-5. Port Metro Vancouver—2010 Emissions Estimates for Lower Fraser Valley Airshed (metric tons)

Source	Criteria Air Contaminants						GHGs
	NOx	VOC	CO	SOx	PM10	PM2.5	CO2
Ocean-Going Vessels [26]	7,932	582	750	4,604	568	522	430,178
Cargo-Handling Equipment [27]	643.4	83.4	773.8	0.8	40.9	39.7	65,624
Rail Locomotives[27]	2,853.1	111.0	290.7	15.0	92.7	85.4	161,934
Trucks and Terminal Fleet Vehicles[27]	822.6	38.1	219.5	1.0	12.5	9.7	97,935
Total	12,251	815	2,034	4,621	714	657	755,671

26 Ocean-going vessel emission estimates are sourced from the 2010 National Marine Emissions Inventory associated with region 2, the area within the marine inventory that corresponds to waters within the port's jurisdiction. SNC-Lavalin, 2010 National Marine Emissions Inventory for Canada, March 31, 2012 (not yet published; available by request from Environment Canada).

27 Cargo-handling equipment, rail locomotives, and trucks and terminal fleet vehicle estimates are sourced from the 2010 Landside Emissions Inventory. SNC-Lavalin, Port Metro Vancouver 2010 Landside Emissions Inventory, March 26, 2012, *www.portmetrovancouver.com/en/environment/initiatives/air.aspx*, accessed May 2013.

APPENDIX B. AIR EMISSION REGULATIONS IN U.S. AND CANADA

Table B-1 summarizes the relevant emission standards in the United States and Canada for the various sectors of port-related vessels, equipment, and vehicles.

Table B-1. Comparison of Air Emission Regulations in the United States and Canada

Regulated item	Canada	United States
	Ocean-Going Vessels (Marine Class C3)	
Fuel Standards inside ECA (200 nautical miles from shore)	After August 1, 2012 ≤ 1% sulfur or equivalent After January 1, 2015 ≤ 0.1% sulfur or equivalent	Phase I: After August 1, 2012 ≤ 1% sulfur or equivalent Phase II: January 1, 2015 ≤ 0.1% sulfur or equivalent
Engine Standards for Category 3 Engines Displacement (D) ≥ 30 liters per cylinder	Aligned with IMO MARPOL Annex VI requirements for NOx	2001 Tier 1 engine standards also applied to some 1990–2000 engines upon remanufacture implemented (NOx only) NOx standard is equivalent to the amendments adapted by the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI in 2008.[28] 2011 Tier 2 engine standards phased in 2016 Tier 3 engine standards phased in

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28 International Maritime Organization, "Information on North American Emission Control Area (ECA) under MARPOL Annex VI," May 13, 2010, www.imo.org/blast/blastDataHelper.asp?data_id=29099&filename=723.pdf, accessed May 2013.

Table B-1. Comparison of Air Emission Regulations in the United States and Canada *(continued)*

Regulated item	Canada	United States
	Harbor Vessels (Marine Class C2 and smaller)	
Fuel Standards	After June 2007 < 500 parts per million (ppm) sulfur After June 2012 ≤ 15 ppm sulfur (the sulfur limits are not applicable to residual fuels for sale for small and medium-sized vessels)	After June 2007 < 500 ppm sulfur After June 2012 ≤ 15 ppm sulfur (the sulfur limits are not applicable to residual fuels)
Category 1 Marine Engines (Displacement < 5–7 liters per cylinder*) Category 2 Marine Engines (5–7 liters [29] ≤ Displacement per cylinder < 30 liters) Category 1 and Category 2 engines typically range from 500kW–8000 kW.	New engines purchased on or after January 1, 2016, emission standards are aligned with U.S. EPA for Category 2 (displacement between 5 and 30 liters per cylinder) marine diesel engines (includes Tier 3 and Tier 4). Does not include EPA requirements for remanufacturing. No additional domestic standards in Canada for small marine diesel engines (Category 1, displacement under 7 liters per cylinder).	2004: Tier 1 engine standards apply (NOx only) [30] 2004–2007: Tier 2 engine standards phased in [30] 2009–2014 :Tier 3 engine standards phased in 2014–2017: Tier 4 engine standards for engines > 600 kW phase in 2008: Requirements to install available, certified, engine upgrade kits for engines 1973 –last Tier 2 model year and > 600 kW were implemented

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29 In the United States, the threshold is 5 liters per cylinder; in Canada, 7 liters is the threshold.
30 Tier 1 and Tier 2 standards only applies to engines ≥ 37 kilowatts. Engines < 37 kilowatts are subject to non-road standards.

Table B-1. Comparison of Air Emission Regulations in the United States and Canada *(continued)*

Regulated item	Canada	United States
	Cargo-Handling Equipment (non-road)	
Fuel Standards	2007: 500 ppm sulfur 2010: 15 ppm sulfur	2007: 500 ppm sulfur 2010: 15 ppm sulfur
Engine Standards 75kW–560 kw (typical range of CHE)	Emission standards aligned with U.S. EPA compression-ignition engine standards: 1996–2002: Tier 1 engine standards are phased in 2001–2006: Tier 2 engine standards are phased in 2006–2010: Tier 3 engine standards are phased in 2012–2014: Tier 4i engine standards are phased in 2014: Tier 4 engine standards are phased in Not aligned with EPA for spark-ignition engines *www.ec.gc.ca/lcpe-cepa/eng/regulations/detailReg.cfm?intReg=88*	U.S. EPA compression-ignition engine standards: 1996–2002: Tier 1 engine standards are phased in 2001–2006: Tier 2 engine standards are phased in 2006–2010: Tier 3 engine standards are phased in 2011–2013: Tier 4i engine standards are phased in 2014: Tier 4 engine standards are phased in *www.epa.gov/otaq/standards/nonroad/nonroadci.htm*
	Trucks (on-road)	
Fuel Standards	2006–2007: ≤ 15 ppm sulfur phased in	2006–2010: ≤ 15 ppm sulfur phased in
Engine Standards	Engine emission standards aligned with U.S. EPA for air pollutants 2004: New HDV engine PM standards ≤ 0.1 gram/bhp-hour 2007: New HDV engine PM standards ≤ 0.01 gram/bhp-hour 2010: New engine NOx standard ≤ 0.2 gram/bhp-hour 2014: New regulation requires HDV engine manufacturers to improve efficiency and reduce GHG emissions *www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=3FC39747-ABF2-470A-A99E-48CA2B881E97*	2004: New HDV engine PM standards ≤ 0.1 gram/bhp-hour 2007: New HDV engine PM standards ≤ 0.01 gram/bhp-hour 2010: New engine NOx standard ≤ 0.2 gram/bhp-hour 2014: New regulation requires HDV engine manufacturers to improve efficiency and reduce GHG emissions

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Table B-1. Comparison of Air Emission Regulations in the United States and Canada *(continued)*

Regulated item	Canada	United States
	Locomotives (rail)	
Fuel Standards	June 2007: ≤ 500 ppm sulfur June 2012: ≤ 15 ppm sulfur June 2014: ≤ 500 ppm sulfur is allowed for sales	June 2007: ≤ 500 ppm sulfur June 2012: ≤ 15 ppm sulfur
	Transport Canada is developing new emissions regulations under the Railway Safety Act that will align with U.S. EPA regulations, but there is currently no implementation date for these regulations.	2000: Tier 0 engines standards for all new and remanufactured locomotives 1973–2001 [31] 2000: Tier 1 engines standards for all new and remanufactured locomotives 2002–2004[31] 2000: Tier 2 engine standards for all new and remanufactured locomotives 2005 and newer [31] 2008 New Tier 0 engine standards required for all new and remanufactured 1973–1992 line-haul locomotives and 1973–2001 switch locomotives engines [31] 2008 New Tier 1 engine standards required for all new and remanufactured 1993–2004 line-haul locomotives and 2002–2004 switcher locomotives [31] 2008 New Tier 2 engine standards required for all new and remanufactured 2005–2011 line-haul locomotives and 2005–2010 switcher locomotives [31] 2008: Requirements to install available, certified, upgrade kits on remanufactured engines 1973 –last Tier 2 model year are implemented 2012: Tier 3 engine standards for all new locomotives and for remanufactured 2012–2014 line haul locomotives and 2011–2014 switcher locomotives 2015: Tier 4 engine standards for all new engines and for remanufactured 2015 locomotives

31 The first engine standards went into effect in 2000 based on the 1997 locomotive rule. Tier 0–Tier 2 engine standards were strengthened by the 2008 Inland Marine and Locomotive rule.