

NORTHWEST PORTS CLEAN AIR STRATEGY (NWPCAS)

STRATEGY RENEWAL: DISCUSSION DOCUMENT #1

Summary

The Northwest Seaport Alliance (NWSA), the Port of Seattle (POS), the Port of Tacoma (POT) and the Vancouver Fraser Port Authority (VFPA) are **seeking input from stakeholders to help inform development of a new Northwest Ports Clean Air Strategy that will be complete in 2020 (2020 NWPCAS)**.

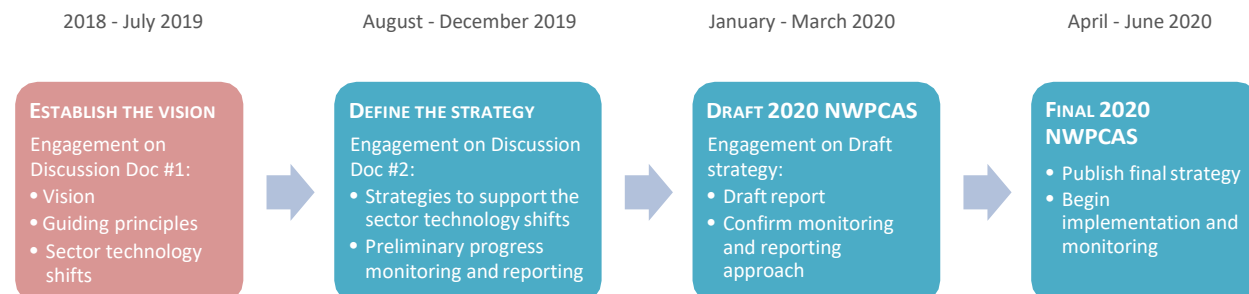
This Discussion Document #1 provides an overview of the strategy renewal process and the **port authorities are seeking feedback on a draft vision, guiding principles and possible technology shifts needed to put the ports on the path to achieving the vision for each seaport-related sector**. Look for the big red arrows throughout this Discussion Document #1. These arrows indicate the areas on which the port authorities are seeking input during this round of engagement.

For readers familiar with the previous two strategies (2008 NWPCAS and 2013 NWPCAS), this 2020 NWPCAS continues the spirit of collaboration between the port authorities and partner agencies, while presenting a new approach as follows:

- Establishing a longer-term vision for this century, while also identifying short, medium and long term approaches to support the vision.
- Establishing guiding principles that all participating ports agree to employ when implementing.
- Aligning the scope of emissions between the port emission inventories and the NWPCAS (previously some emission sources were not included in the NWPCAS – e.g. commercial fishing and recreational vessels at POS).
- Articulating types of technology shifts needed in each sector, recognizing different levels of technology readiness, business cases and port authority influence.
- Broadening the scope of the Administration sector to include Tenant Facilities.

NWPCAS Renewal Process and Timeline

Development of the new strategy will take place through June 2020. During this time, port authorities will seek input from representatives of industry, government, non-governmental organizations, First Nations, Tribal governments, and community groups to inform key elements of the strategy. The following diagram shows the planned project process, and highlights opportunities for engagement:





Contents of Discussion Document #1:

1 – **The first decade of the NWPCAS:** This section gives a brief history of the strategy, highlights progress toward previous emission goals, and highlights initiatives undertaken at the ports that supported the NWPCAS goals.

2 – **Context:** This section outlines the regulatory and policy context in which this strategy is being developed, provides justification for ports' and partners' actions, introduces the maritime air emission "sectors" that are captured in this strategy, and highlights the port authorities' roles in advancing clean air initiatives to reduce contributions to air pollution and climate change.

3 – **The new strategic direction:** After 10 years of implementation, the port authorities together with partners, are putting forward a new direction for the Strategy that includes a long-term vision and guiding principles.

→ **Port authorities are seeking input on the Draft Vision and Guiding Principles**

4 – **Preliminary sector technology shifts:** This section provides more context about each sector, and puts forward possible technologies needed to achieve the vision in each of the sectors.

→ **Port authorities are seeking input on the Preliminary Sector interim and end state technologies identified**

Terminology

Vision: Joint statement that provides a common direction and impetus for acting on air pollution and climate change across all participating ports.

Guiding principles: A set of common values to guide the selection and prioritization of action toward achieving the vision that will be used by all participating ports.

Sector technology shifts: An illustration of the types of clean technologies that are likely needed to achieve the vision, specific to each sector, and the types of technologies that may be employed in the interim. These are being developed through broad engagement across port stakeholders. Outlining these technologies will inform the development of sector-specific strategies for achieving the vision (for example, these could inform areas where port authorities need to advocate for stronger government policies or new incentive programs). There are two components of these shifts:

End state: the technology types identified to be necessary to achieve the vision.

Interim state: the technologies types that will be adopted, or should be adopted, before the end state that reduce emissions in the interim, before the end state can be fully implemented, and puts ports on the path to achieve the end state vision.

Greenhouse gas (GHG) emissions: gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface, the atmosphere itself, and by clouds.¹ GHGs included

¹ https://www.ipcc-data.org/guidelines/pages/glossary/glossary_fg.html

in port inventories are carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). Emissions are reported using carbon dioxide equivalent units (CO₂e).

Air pollutants: natural and man-made substances in the air we breathe that negatively impact human or environmental health. In the 2020 NWPCAS, air pollutants include particulate matter, ozone-forming pollutants (nitrogen oxides and volatile organic compounds) and sulfur oxides.

Black carbon (BC): sometimes referred to as soot, black carbon is mostly formed by the incomplete combustion of fossil fuels, biofuels, and biomass but it also occurs naturally. It stays in the atmosphere only for days or weeks. It is the most strongly light-absorbing component of particulate matter (PM) and has a net warming effect by absorbing heat when suspended in the atmosphere and reducing the albedo after being deposited on ice or snow.²

Renewable energy: any form of energy from solar, geophysical, or biological sources that is replenished by natural processes at a rate that equals or exceeds its rate of use.³ Examples include sunlight, wind, rain, tides, waves, geothermal heat and some hydroelectricity.

Low emission electricity: Electricity derived from natural processes that have no or very low emissions. Sources may include solar, wind, geothermal, hydropower, among others. In the region served by the northwest ports, electricity is almost exclusively provided by low emission hydroelectricity.

Alternative fuels: Fuels or power sources other than diesel and gasoline that result in lower air pollution or climate change related emissions. Although not an exhaustive list, examples include: electricity, hydrogen, renewable diesel, biodiesel, renewable natural gas, natural gas (liquified or compressed), ammonia, methanol and other alcohols.

Engine tier: Emission milestones established by regulatory agencies (US Environmental Protection Agency, Environment and Climate Change Canada and Transport Canada) that are applicable to new non-road, locomotive and marine vessel engines sold in the US and Canada. In the US, these standards also apply to remanufactured locomotive and marine vessel engines. For example, the most recent requirements for non-road diesel equipment are to meet Tier 4 standards which significantly reduce particulate matter and nitrogen oxide emissions.

*[Other terms not yet defined: **goals, strategies** and/or **objectives** to be defined and reviewed in Discussion Document #2 – planned for Fall 2019. These will outline how ports will allocate resources to achieve the vision, and how they will track and report progress.]*

² https://www.ipcc-data.org/guidelines/pages/glossary/glossary_b.html

³ https://www.ipcc-data.org/guidelines/pages/glossary/glossary_r.html

1. The First Decade of the NWPCAS (2007 – 2017)

Ports are hubs of transportation activity serving trade through multiple modes – ships, rail, harbor vessels, trucks, non-road equipment. In providing these services, port activities contribute to air pollution and climate change through the extensive use of fossil fuels and through material management activities. Current projections indicate that global trade will continue to increase, and that the ports will also experience increased levels of activity to facilitate this trade.

Since 2007, NWSA, POS, POT and VFPA have worked collaboratively with government and industry partners through the NWPCAS to reduce seaport-related air emissions across the airshed. **Through this approach, participating ports have demonstrated significant national and international leadership and fostered collaboration for air quality and climate action.** The NWPCAS has provided a mechanism to ensure that through partnered action, environmental performance is not compromised but driven forward over and above competing interests.

Progress Toward Goals

Implementation of the first NWPCAS began in 2008. Since then, implementation reports have been released annually to provide a summary of progress made and activities undertaken.⁴ Over the last decade, the ports have seen significant emission intensity reductions for both diesel particulate matter (DPM) and greenhouse gas (GHG) emissions, and absolute (total) reductions in DPM. **Ports have met the emission reduction targets for DPM and GHG emissions for 2020 several years early.**

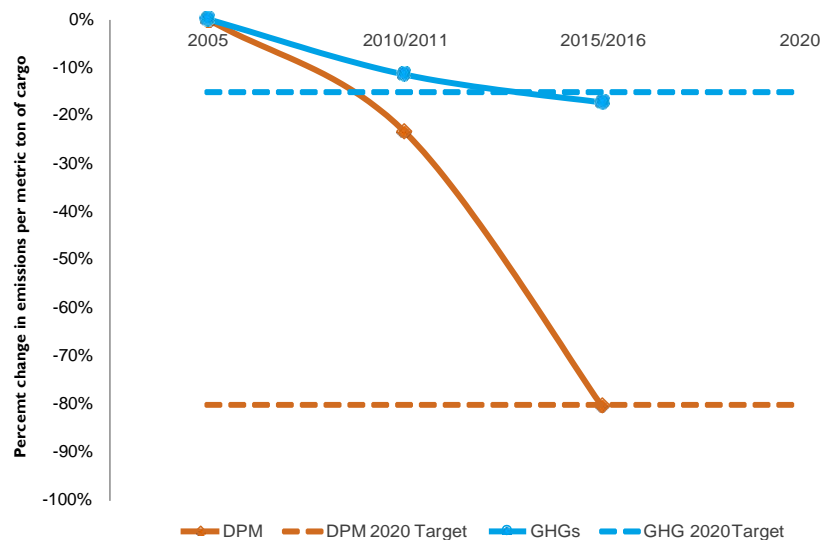


Figure 1: Changes in *emission intensity* between 2005 and 2015/16, relative to 2020 targets

These emission reductions are attributable to industry's implementation of cleaner technology and fuels, driven by national and international regulation, and are further complemented by port initiatives and voluntary efforts by port tenants and customers.

⁴ 2013 NWPCAS and previous Implementation Reports are available on each port's website: <https://www.nwseaportalliance.com/stats-stories/environmental-stewardship>, <https://www.portseattle.org/page/northwest-ports-clean-air-strategy>, <https://www.portoftacoma.com/community/environment/air>, <https://www.portvancouver.com/environment/air-energy-climate-action/port-wide/>



Policies and Port Programs

A significant driver of emission reductions from port related operations are regulations from international and federal governments. A few of the most impactful are listed below:

- ☐ North American Emission Control Area (ECA), which requires ocean-going vessels to use lower sulfur fuel and reduces DPM,
- ☐ Evolving federal (US and Canada) engine standards for new vehicles and equipment,
- ☐ Ultra-low fuel sulfur regulations (US and Canada) for on-road, non-road, rail and domestic marine diesel fuel, and
- ☐ Renewable fuel standards (Canada).

In addition to the significant emission reductions from IMO and government regulations, participating ports have been able drive environmental initiatives under the NWPCAS while remaining competitive. Example initiatives implemented over the last decade by ports and NWPCAS partner agencies, together with industry, include:

- ☐ Established **emission requirements for drayage trucks** accessing all container terminals in the region.
- ☐ Established a **fee program for older, higher-emission non-road equipment** at Port of Vancouver.
- ☐ Instituted **congestion-reduction measures** at all of the participating ports.
- ☐ Provided **financial assistance** (via grants, port funds and assistance from NWPCAS partner agencies) to install emission control devices and replace older, polluting trucks, locomotives and cargo-handling equipment at the Ports of Seattle and Tacoma.
- ☐ Undertaken **pilot projects and feasibility studies** at all participating ports, with assistance from NWPCAS partner agencies on some projects.
- ☐ Established **emission requirements for construction equipment** working on port projects at all ports.
- ☐ Implemented **building and facility energy efficiency** measures to reduce energy use.
- Provided **infrastructure for on-shore power supply to ships at berth** at the Port of Seattle's T91 Cruise Terminal, and at Port of Vancouver's Canada Place Cruise Terminal, and Deltaport and Centerm container terminals.
- ☐ Created **incentive programs** for ships and harbor vessels that go beyond regulations at the Ports of Seattle and Vancouver.
- ☐ Supported International Maritime Organization (IMO) efforts to **establish the North American Emission Control Area**.



2. Context: Regulation and Policy, Role of Port Authorities and Overview of Sectors

Regulation and Policy Context

The ports operate within a broader context that includes jurisdictional targets, policies and regulations relevant to trade activities. This broader context includes, but is not limited to, targets, policies and regulations outlined below. These demonstrate the urgency with respect to reducing pollutants that impact human health and contribute to climate change.

KEY POLICIES AND REGULATIONS ACROSS JURISDICTIONS RELATING TO THE NWPCAS

Federal – Canada:

- ☐ GHG Target: reduce emissions 30% by 2030, from 2005
- Canadian Ambient Air Quality Standards (PM_{2.5} 24-hour: 28µg/m³)
- ☐ Engines standards match EPA (on-road, non-road, locomotives, harborvessels)
- ☐ Ultra-Low Sulphur Diesel for all sectors except ocean-going vessels

International:

Climate

- Paris agreement aims to keep global temperature rise well below 2°C, and pursue efforts to limit to 1.5°C
- IPCC Special Report (2018) highlights significant impacts at 2°C beyond those at 1.5°C
- IMO GHG target: 50% below 2008 by 2050
- IMO vision: phase out emissions from shipping this century

Air quality

- IMO 2020 sulfur rule: limits ship fuel sulfur to 0.5%
- IMO 2015 ECA: limits ship fuel sulfur to 0.1% in the North American ECA
- ☐ IMO 2016 new engine rule: new engines to be Tier III

British Columbia and Metro Vancouver:

- GHG Target: 80% below 2007 by 2050
- Renewable fuel standard: increase to 10% by 2020
- Carbon tax: increase to \$50/tonne by 2021
- Air Quality Objectives (PM_{2.5} 24-hour: 25µg/m³ in Metro Vancouver)
- VANCOUVER

US Port GHG Targets:

- SEATTLE Scope 1 and 2 (port authority owned or controlled):
- TACOMA ☐ Carbon neutral or carbon negative by 2050 from 2005
- Scope 3 (port wide):
- 80% below 2007 by 2050

Washington State:

- ☐ GHG Target: 80% below 1990, by 2050
- ☐ Renewable fuel rule for port authorities

Federal – United States:

- National Ambient Air Quality Standards (PM_{2.5} 24-hour: 35µg/m³)
- ☐ EPA engine standards (on-road, non-road, locomotives, harborvessels)
- ☐ Ultra-Low Sulphur Diesel for all sectors except ocean-going vessels



Role of Port Authorities

The participating port authorities are primarily “landlord ports” and therefore they do not own or operate the vast majority of vehicles, equipment and vessels that result in emissions included in the scope of this strategy. However, the port authorities can play an important role in facilitating action by establishing targets and programs to incentivize desired outcomes, planning and installing infrastructure to support clean technology, and aligning funding and investment among government and industry. Port authorities have different levels of influence and investment in port activities, depending on the nature of the business relationship with the companies that own and operate the vehicles, equipment and vessels. Not all sectors are relevant to each port authority. These are introduced in the overview of sectors section that follows.

Overview of Sectors

The strategy addresses air emissions across six maritime sectors as outlined below:



Cargo-handling equipment (CHE): CHE moves goods on marine terminals between ships, railcars and trucks. The types of CHE included vary by each port’s lines of business and how the emission inventories are developed. Examples of CHE include: straddle carriers, rubber-tired gantry (RTG) cranes, reach stackers, top and side picks, forklifts, skidloaders and yard tractors / yard trucks.

CHE activities take place on lands under management by the port authorities, though nearly all of the actual equipment is owned and operated by private companies that have leases with the ports.



Trucks: The truck sector includes heavy-duty trucks that move cargo to and from marine terminals. Trucks include drayage (container) trucks and other heavy-duty trucks that move other types of cargo.

Heavy-duty trucks serving the port are owned and operated by private companies. Truck companies are provided access to port terminals by port authorities and terminal operators. These trucks spend the majority of their time operating off of port terminals on the local road network.



Ocean-going vessels (OGVs): Ocean-going vessels include container ships, cruise ships, tanker ships, roll-on/roll-off ships, bulk cargo ships and breakbulk cargo ships.

These vessels are owned and operated by international and domestic shipping lines. Vessels transit through international and domestic waters, docking at port terminals to load and unload cargo.



Harbor vessels: Harbor vessels in the port emission inventories vary according to the ports’ lines of business, and primarily include harbor and ocean tugs. At the Port of Seattle, commercial fishing fleets and recreational vessels mooring at marinas under lease with the port are also included.

Tug companies are independently owned and hired by shipping lines to escort ships in/out of the harbor or to move barges and goods in the region. Some tug companies are tenants of ports.



Rail: Locomotives and rail transport includes locomotives that move railcars within a rail yard (switching or yard locomotives, also known as "switchers") or locomotives that haul trains across the airshed and beyond (line-haul locomotives).

Tenant-controlled rail cargo switching occurs on port-owned lands. Cross-continent railways service the port but are independently owned and governed, have little to no direct relationship with port authorities, and largely operate off of port property.



Port administration and tenant facilities: Port administration includes the port authority-owned or leased vehicles and vessels, office buildings and support facilities needed for the administration of port activities.

Tenant facilities include leased building energy use and lighting located on port land but operated by tenants.



3. The New Strategic Direction

After 10 years of collaborating on the NWPCAS, the four port authorities are conducting a comprehensive review of the entire strategy. The ports are asking the tough questions – Why are we working together? What do we want to achieve together? What principles will guide the ports as they work toward a common vision?

This section outlines a draft new direction that will inform the ports' emission reduction actions over the years to come.

NWPCAS Scope

The 2020 NWPCAS will continue to use the **ports' emission inventory boundaries**. This allows ports to report progress using the most recent emission inventories.

Activities:

The new strategy will include **all seaport-related activities that are included in the ports' emission inventories** (e.g. cruise, bulk, break bulk, container, fishing industry, commercial and recreational marinas). These vary among the ports depending on each port's lines of business.

Pollutants:

The ports will continue to focus on **diesel particulate matter emissions** and increase the focus on **greenhouse gas emissions** in the 2020 NWPCAS. In addition, the ports will prioritize efforts that simultaneously address other pollutants, including: **black carbon, ozone-forming pollutants (nitrogen oxides and volatile organic compounds), and sulfur oxides**. For example, efforts that eliminate both greenhouse gas and air pollutants will be prioritized. Lifecycle GHG emissions will be considered where appropriate.

Timeframe:

The 2020 NWPCAS will establish a **long-term vision** (this century), and will include the following **time periods**:

- ☐ Short-term (present to 2025),
- ☐ Medium-term (2025 to 2030), and
- ☐ Longer-term (2030 and beyond).





NWPCAS Vision – Draft



The Ports will collaborate with stakeholders and governments to phase out emissions from seaport-related activities as early as possible this century, supporting cleaner air for local communities and aligning with the international response to limit global climate change.

Guiding Principles – Draft



The following principles will guide the efforts undertaken by participating ports in relation to the scope of this strategy. The principles serve the dual purpose of guiding how participating ports work together, and how each port will work independently toward achieving the strategy's vision:

- ❑ **Collaboration:** The ports will work closely with governments, Tribes, First Nations, industry and local communities to understand constraints, identify opportunities and facilitate investment.
- ❑ **Urgency:** The ports recognize the urgency of action to limit global climate change and improve community health and will seek early achievement of the vision.
- ❑ **Community health:** The ports recognize the importance of reducing port-related air pollutants that affect public health and will prioritize opportunities that reduce diesel particulate matter emissions and directly improve air quality in local communities.
- ❑ **Advocacy and leadership:** The ports will take a leadership role to align, facilitate and advocate across all levels of government and international organizations to support policy and actions that achieve the vision.
- ❑ **Accountability:** The ports will provide clear, transparent and timely progress updates.
- ❑ **Innovation and continuous improvement:** The ports will identify and advance innovative technologies, policies and practices that demonstrate continuous improvement.
- ❑ **Focused resources:** Resources will be focused in the areas where the port authorities are likely to have most success and highest potential impact, recognizing the limitations of our operational control and influence.
- ❑ **Sustainability:** The ports will employ triple-bottom line lenses of social, environmental and economic/financial performance to evaluate and prioritize strategies.
- ❑ **Evidence-based decisions:** The ports will continually strive to improve the science and technical practices used to better understand emission sources and impacts, and use this information to inform decisions.

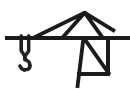
4. Sector-Based Technology Shifts

What will it take to achieve the new NWPCAS vision? Cleaner fuels and technology for the maritime sectors are rapidly evolving, but to embrace and benefit from these innovations it will be essential to have substantial collaboration, coordination and investment across industry sectors, governments, communities and port authorities.

In this section, the ports outline **preliminary concepts and ideas** to achieve interim emission reductions and eventually phase out emissions in each of six sectors. Ports and partners are interested in obtaining input from stakeholders on the interim and end state technologies described here in order to inform the development of strategies to achieve the vision over the short, medium and longer terms.

Port authorities play an important but limited role in facilitating and supporting the transition needed to implement interim solutions and over time, to phase out emissions. Most of the technology shifts identified here will need **significant innovation coupled with an evolution of government policies** to ensure that these technologies become cost competitive with conventional fuels, enabling their widespread adoption. By articulating the types of technology shifts needed, the 2020 NWPCAS can send signals to manufacturers and governments to help spur needed innovation in technologies, government policies and investments. By advocating for and facilitating innovation in technology, government policies and investment in a strategic and coordinated way, the ports will enable progress toward the vision and strengthen their competitiveness in an evolving global trade system.

Cargo-Handling Equipment (CHE)



Cargo-handling equipment moves goods on marine terminals between ships, railcars, and trucks. The types of CHE included vary by each port's lines of business and how the emission inventories are developed. Examples of CHE include: straddle carriers, rubber-tired gantry (RTG) cranes, reach stackers, top and side picks, forklifts, skid loaders, yard tractors / yard trucks, and various other non-road equipment. At this time, the vast majority of CHE operates on diesel fuel, some smaller equipment operates on propane, and some equipment is electric.

Table 1. Number of terminals with CHE, and number of units in 2017

Port	Number of CHE ⁵	Number of terminals with CHE	Total number of terminals
NWSA	741	13	15
Seattle	63	3	3
Tacoma	0	0	1
Vancouver	1,510	27	27 and other operations

Examples of port authority influence in this sector:

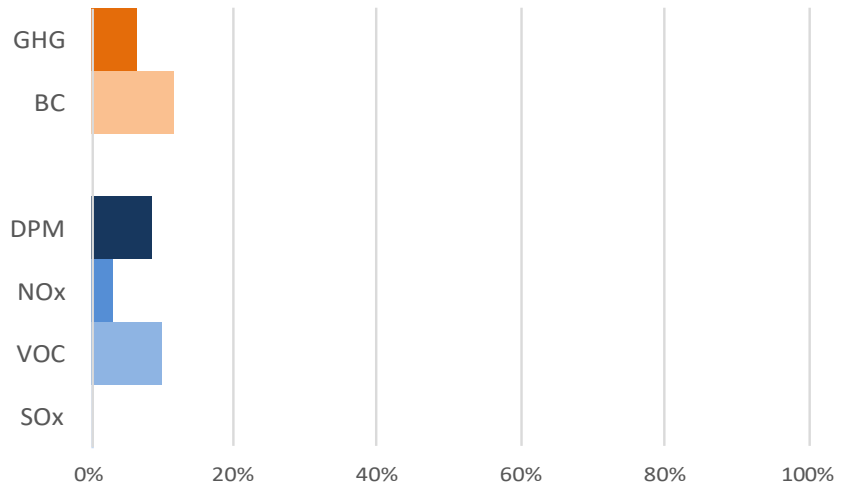
CHE activities take place on lands under management by the port authorities, though nearly all the actual equipment is owned and operated by private companies that have leases with the ports.

- ☐ Through lease agreements, the ports may have some level of influence on emission performance of CHE that is privately operated on lands leased from the port.
- ☐ The ports can also influence the CHE sector through voluntary incentives, such as grant funding facilitation.
- ☐ In cases where the ports own and/or operate equipment, ports have direct control of purchasing, maintenance, and fueling.

⁵ Number of CHE excludes equipment that is exclusively electric (e.g. conveyor belts and ship-to-shore cranes), but includes electric equipment that could operate on other fuels. Note that Vancouver data includes other non-road equipment.

Emissions (2015/2016):

Across all ports, emissions from CHE represent 6% of GHG emissions, 11% of black carbon, 8% of DPM, 3% of nitrogen oxides, 10% of volatile organic compounds, and <1% sulfur oxides.


Existing regulations and policies:

- ❑ The US EPA and Canada both implemented Tier 4 requirements for new compression ignition engines in 2014.
- ❑ VFPA runs a Non-Road Diesel Emission program that charges fees for Tier 1 and older equipment operating on port lands, and offers rebates if that equipment is retired, or, replaced or retrofitted to meet Tier 2 or equivalent emissions of particulate matter or better.
- ❑ NWSA has language in all of its recently signed leases stipulating that all newly purchased CHE meet Tier 4 emission requirements at a minimum.


Technology shifts to phase out emissions in the CHE sector:

The **end state** of the CHE sector is expected to be powered by renewable electricity (e.g. battery electric, hydrogen fuel cells, grid electricity).

Electric CHE technology is rapidly evolving and at various stages of commercialization. Particularly for equipment with larger engines and/or long duty cycles, the technology may not be available in the short term, may be expensive in the short to mid-terms, and will require significant investment in new infrastructure to operate at scale. In this region, electricity is almost exclusively sourced by low emission hydroelectricity, though distribution upgrades may be needed to serve future demand.

In the **interim**, emission reductions can be achieved in the CHE sector by focusing on improving efficiency (e.g. installing anti-idling technology), purchasing electric or hybrid electric equipment as available, purchasing the cleanest diesel equipment available (Tier 4), using lower emission fuels (e.g. biodiesel, renewable diesel), and planning for and installing infrastructure needed to support the end state.



Trucks



The truck sector includes heavy-duty trucks that move cargo to and from marine terminals. Trucks include drayage (container) trucks and other heavy-duty trucks that move other types of cargo.

Table 2: Number of container terminals, truck companies and trucks in 2017

Port	Number of container terminals	Number of truck companies	Number of trucks
Northwest Seaport Alliance	10	129	4,149
Seattle	n/a	n/a	n/a
Tacoma	n/a	n/a	n/a
Vancouver	4	123	1,847

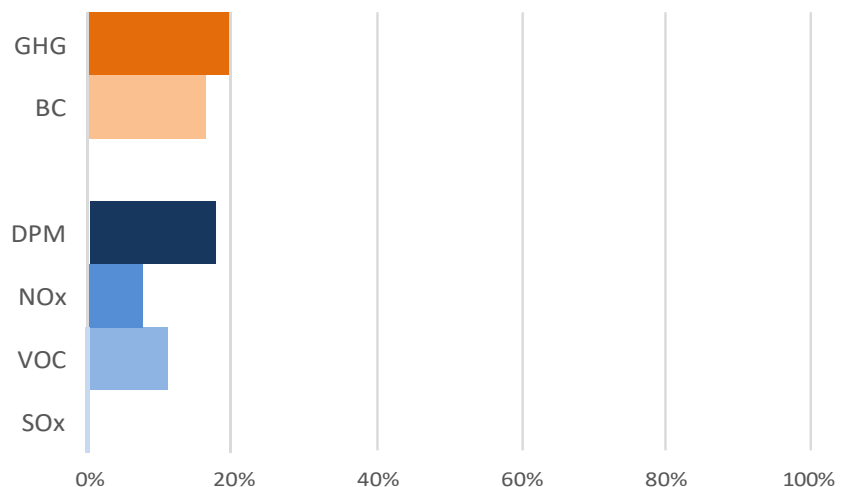
Examples of port authority influence in this sector:

Heavy-duty trucks serving ports are owned and operated by private companies. Truck companies are provided access to port terminals by port authorities and terminal operators. These trucks spend the majority of their time operating off of port terminals on the local road network.

- The ports work with terminal operators and drayage operators to improve supply chain efficiency through technology and infrastructure improvements.
- The ports can influence the types and model year of trucks that access terminals (e.g. NWSA Clean Truck Program, VFPA Truck Licensing System).
- More broadly, ports can participate in the coordination of regional infrastructure planning to improve gateway efficiency.

Emissions (2015/2016):

Across all ports, emissions from trucks represent 20% of GHG emissions, 17% of black carbon, 17% of DPM, 8% of nitrogen oxides, 11% of volatile organic compounds, and 1% of sulfur oxides.





Existing regulations and policies:

- The US and Canadian federal governments set emission standards for heavy-duty diesel engines. In 2007, the allowed PM emissions dropped to 0.01 grams/brake horsepower-hour, 1/10th of the 1994 to 2006 standard for PM emissions.
- VFPA operates the Truck Licensing System (TLS) that limits access to the port based on the age of the truck. All container trucks that access the Port must be registered through the TLS. Currently, trucks must be a minimum 2010 model year or newer to be added to the TLS, and as of August 1, 2019, they must be 2014 or newer. As of 2022, there will be a 10-year rolling truck age requirement. In addition, there is a reservation system in place to manage congestion.
- NWSA's Clean Truck program requires trucks at international container terminals to be model year 2007 or equivalent (includes about 4000 compliant trucks). Approximately 120 CARB/EPA certified retrofit devices are used to meet the requirement.



Technology shifts to phase out emissions in the Trucks sector:

The **end state** for trucks is expected to be electric drive, using available clean technology (battery and/or hydrogen fuel cells powered by renewable energy or low emission electricity).

The population of drayage trucks tends to be second-hand with low residual value, which makes the financial gap with new clean technologies more significant. For shorter daily distances, electric trucks may be available in the near term, though may not be cost competitive with diesel. For longer daily distances, electric trucks may not be available in the short term, may have longer payback periods (due to high capital costs), and will require significant investment in new infrastructure throughout the region and across the continent.

In the **interim**, the truck sector can continue to reduce emissions by focusing on efficiency (gateway efficiency to reduce congestion, technology such as on-board monitoring, aerodynamic designs, anti-idling), purchasing electric or hybrid electric equipment when feasible, purchasing newer diesel trucks that are subject to new fuel efficiency requirements, converting to lower emission fuels for longer trips (e.g. natural gas "near-zero" technology), and/or using lower carbon fuels (e.g. biodiesel, renewable diesel).

Ocean-Going Vessels (OGV)



Ocean-going vessels include container ships, cruise ships, tanker ships, roll-on/roll-off ships, bulk cargo ships and breakbulk cargo ships. The following table outlines how many vessels visited each port in 2017, and the total number of calls (because many ships visit more than once per year).

Table 3: Number of ocean-going vessel calls at the Ports in 2017

Port	Number of vessels	Number of vessel calls
Northwest Seaport Alliance	413	1,857
Seattle	81	287
Tacoma	69	71
Vancouver	1,675	3,278

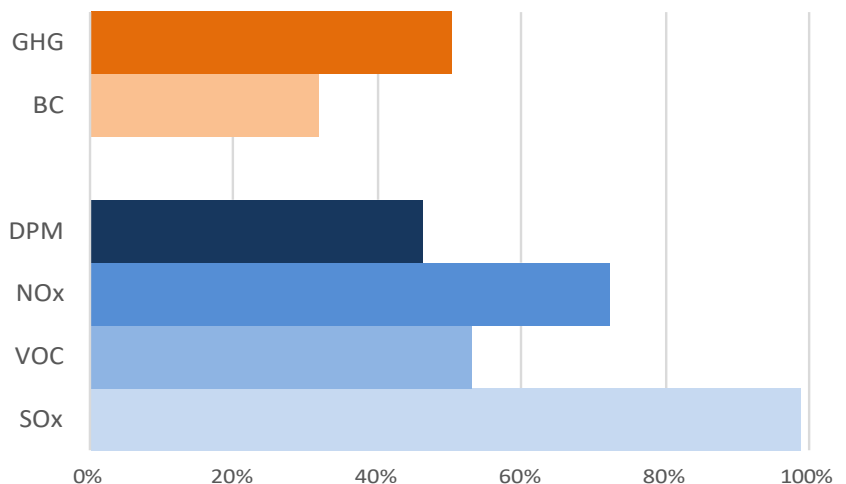
Examples of port authority influence in this sector:

OGVs include vessels owned and operated by international and domestic shipping lines. Vessels transit through international and domestic waters, docking at port terminals to load and unload cargo.

- ☐ Ports can influence vessel operators through voluntary programs, most notably financial incentives (e.g. VFPA EcoAction program).
- ☐ As the landlord, the ports can provide terminal infrastructure for reducing environmental impacts while at berth (i.e. shore power).
- ☐ The ports can facilitate and/or support vessel bunkering, including for alternative fuels.
- ☐ The International Maritime Organization (IMO), a United Nations agency, establishes regulation for international vessels, including ship emissions, to be enforced by flag states and through the Port State Control System. Ports can influence these policies through involvement in rulemaking committees and collaborative groups that influence these entities, but do not have the final say.

Emissions (2015/2016):

The OGV sector contributes the most emissions of any sector across all ports. OGV represents 50% of GHG emissions, 32% of black carbon, 46% of DPM, 72% of nitrogen oxides, 53% of volatile organic compounds, and 99% of sulfur oxides.





Existing regulations and policies:

- ❑ IMO target to reduce GHG emissions by 50% by 2050.
- ❑ IMO North American ECA regulations currently in place limit fuel sulfur to 0.1%; and on January 1, 2020, the 2020 Sulfur rule will come into effect for ships operating outside of ECAs reducing the limit for sulfur to 0.5%.
- ❑ IMO Tier 3 engine regulations reduce NOx emissions from 2016 and new vessels.
- ❑ Energy Efficiency Design Index (EEDI) to optimize fuel consumption in new ships (container, oil and gas tankers, bulk carriers, general cargo, refrigerated cargo).
- VFPA offers incentives to OGVs through the EcoAction Program reducing harbour dues for vessels that go beyond requirement to reduce air emissions and underwater noise; VFPA also offers an “arrive on time” incentive for container vessels.
- ❑ NWSA bestows the North Star Environmental Stewardship Award to recognize customers and stakeholders doing business in the Tacoma/Seattle gateway for their contribution to the economic and environmental vitality of the region.
- ❑ Shore power for cruise and container at VFPA, POS and NWSA.



Technology shifts to phase out emissions in the OGV sector:

In the **end state**, seaports are expected to be equipped to support the OGV sector with the provision of renewable energy and low emission electricity while at berth and at anchor, and vessels are expected to be equipped with shore power capability. The vessels are expected to be significantly more efficient in their design and operation reducing the amount of energy needed to transit. Emissions from vessels underway will be phased out through technologies that remain nascent and undefined (e.g. electric propulsion with hydrogen, renewable fuels, synthetic fuels.)

In response to recently established policies and targets, coupled with the increasing cost of fuel, ship owners are investing in significantly more efficient designs for new vessels and more efficient operation of all vessels. However, ships have long lifespans and it will take decades to turn over the fleet. There are currently no commercially available zero emission fuels for use in vessels transiting the ocean, though significant investment is being made in research to address this need. With respect to shore power, electricity distribution upgrades may be needed to serve future demand.

In the **interim**, OGVs can adopt shore power more broadly, incorporate more efficient hull designs, engine technologies and operating practices (e.g. slow steaming), improve the efficiency of the supply chain (e.g. fewer but larger vessels) and shift toward alternatively fueled propulsion, primarily liquefied natural gas, but may also include renewable natural gas, methanol, ammonia, hydrogen, hybrid electric making use of battery storage and fuel combustion or fuel cells.



Harbor Vessels



Harbor vessels in the port emission inventories vary according to the ports' lines of business, and primarily include harbor and ocean tugs.

Table 4: Number of harbor tug companies and vessels at the ports in 2017

Port	Number of harbor tug companies	Number of vessels
Harbor tugs		
NWSA, POS, POT combined	3	37
Vancouver	17	129
Commercial fishing and Recreational vessels⁶		
POS: Commercial fishing vessels	n/a	395
POS: Recreational vessels	n/a	1,686

Examples of port authority influence in this sector:

Tug companies are independently owned, and are hired by shipping lines to escort ships in/out of the harbor or to move barges and goods in the region. Some tug companies are tenants of ports. At the Port of Seattle, commercial fishing fleets and recreational vessels mooring at marinas under lease with the port are also included.

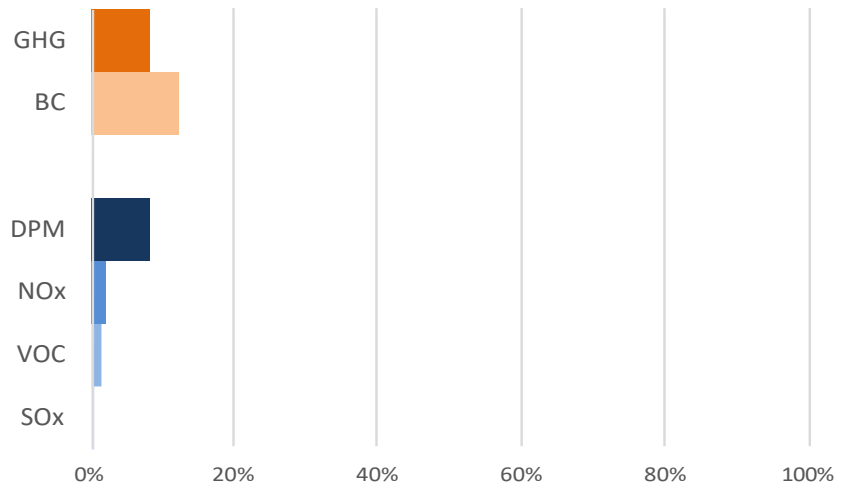
- At the Port of Vancouver, the port can incentivize emission reductions through reductions in harbor dues (e.g. VFPA EcoAction program).
- Where ports have no business relationship with tug operators, voluntary measures can be employed by the ports to facilitate emission reductions (e.g. financial incentives and facilitation of grant funding for engine repowers and replacements).
- Where harbor vessel companies are tenants on port property, ports can support or provide shore power infrastructure and bunkering services.
- Where commercial and recreational vessels are moored at Port of Seattle marinas, the port provides shore power infrastructure and bunkering services.

⁶ Commercial fishing vessels are provided for all of Puget Sound and Recreational vessels are based on slip counts at marinas leased from POS, as identified in the 2016 Puget Sound Emissions Inventory.



Emissions (2015/2016):

Across all ports, emissions from harbor vessels represent 8% of GHG emissions, 12% of black carbon, 8% of DPM, 2% of nitrogen oxides, 1% of volatile organic compounds, and <1% of sulfur oxides.



Existing regulations and policies:

- Since 2012, regulations have required the use of ultra-low sulfur diesel (ULSD) fuel.
- The U.S. and Canadian federal governments set emission standards for marine engines. Current marine engine standards are: Tier 3, and Tier 4 (>600kW) MYs 2014-2017. In Canada this applies to new engines, in the US this applies to new and remanufactured engines.
- VFPA offers discounted fees to harbor vessel companies meeting environmental criteria through the EcoAction Program.
- US companies have received grants to repower and replace engines, with support from Puget Sound Clean Air Agency.



Technology shifts to phase out emissions in the Harbor vessel sector:

In the **end state**, harbor vessels are expected to be very efficient in design and operation, relying on renewable and low emission electric shore power when at berth. Emissions while underway are expected to be phased out through technologies that remain nascent and undefined (e.g. electric propulsion with battery electric, hydrogen fuel cells, renewable fuels, or other zero emission options developed in future.)

New harbor vessels available as hybrid electric, and some are currently testing hydrogen fuel cell technology; however, there are no commercially available zero emission tugs at this time. Harbor tugs have long lifespans, must be able to operate under heavy loads, and when on-duty, must be ready for immediate deployment. These factors indicate that zero emission technology is not expected to be ready for tug operations in the near to mid-term.

In the **interim**, harbor vessels can improve efficiency through technology (engine replacements and upgrades) and operational improvements, by retrofitting or purchasing new hybrid tugs, employing lower carbon fuels as available (renewable natural gas, biodiesel, renewable diesel), or converting to liquified natural gas. Commercial fishing vessels and recreational vessels at POS marinas are expected to continue to connect to shore power while at berth.

Rail



Locomotives and rail transport includes locomotives that move railcars within a rail yard (switching or yard locomotives, also known as "switchers") and locomotives that haul trains across the airshed and beyond (line-haul locomotives).

Table 5: Number of locomotive operators and switcher locomotives at the ports in 2017

Port	Number of switcher locomotive	Number of switcher locomotives
Northwest Seaport Alliance	4	40
Seattle	1	2
Tacoma	1	3
Vancouver	16	22

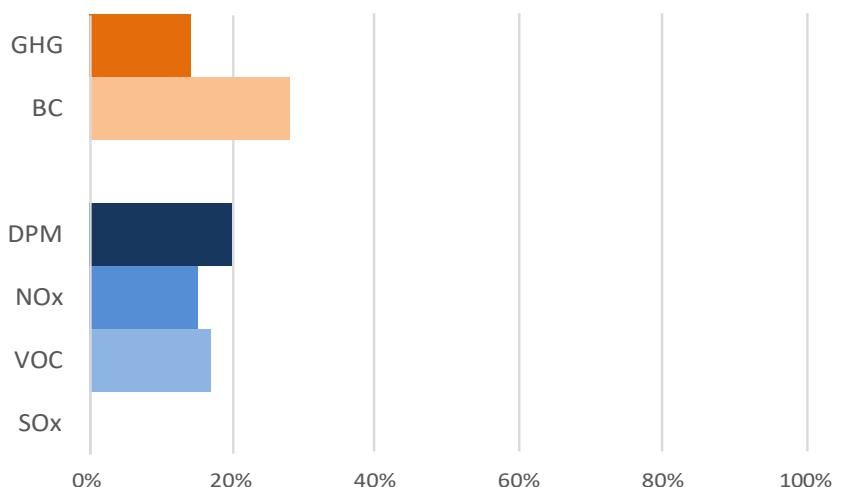
Examples of port authority influence in this sector:

Tenant-controlled rail cargo switching occurs on port-owned lands. Cross-continent railways (line haul) service the port but are independently owned and governed, have little to no direct relationship with port authorities, and largely operate off port property.

- The ports may facilitate financial incentives (i.e. through grants) to replace or repower old engines.
- The ports may institute fee programs for operating older, higher emission switchers owned by tenants with rebates for replacing with cleaner equipment (e.g. VFPA Non-Road Diesel Emission Reduction Program).
- The ports may influence terminal switching operations via lease agreements, though this may be low feasibility where there are limited number of switching operators.
- Large scale change in fueling of line haul locomotives will need to occur nationally. The ports can advocate with federal governments for efficiency and emission reductions for line-haul rail.

Emissions (2015/2016):

Across all ports, emissions from rail represent 14% of GHG emissions, 28% of black carbon, 20% of DPM, 15% of nitrogen oxides, 17% of volatile organic compounds, and <1% of sulfur oxides.





Existing regulations and policies:

- Since 2012, regulations have required the use of ultra-low sulfur diesel fuel.
- The US and Canadian federal governments set emission standards for marine engines. Current locomotive standards are: US – Tier 4 engine standards for new and remanufactured since 2015; Canada – Tier 4 engine standards for new engines only.
- VFPA administers a Non-Road Diesel Emission program that charges fees for Tier 1 and older equipment operating on port lands, and offers rebates if that equipment is retired, or, replaced or retrofit ted to meet Tier 2 or equivalent emissions of particulate matter or better. This applies to switcher locomotives operated by port tenants.
- US companies received grants to repower / replace engines, with support from Puget Sound Clean Air Agency, Washington State Department of Transportation and US Environmental Protection Agency.
- Switchers were retrofit with anti-idling equipment; use of gensets which are much more efficient; use of training simulator to reduce training runs.
- US Class 1 railways that are US EPA SmartWay partners include: BNSF and UP.



Technology shifts to phase out emissions in the Rail sector:

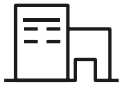
In the **end state**, switchers and line-haul locomotives are anticipated to phase out emissions through a combination of efficient operations and other technologies still being developed, particularly for locomotives travelling cross-continent. Technologies could include for example electrification using catenary systems or hydrogen fuel cells.

Rail is currently exclusively fueled by diesel in this region (both switching and line-haul). Locomotives have very long lifespans and are very capital-intensive investments to purchase new, and as a result, some locomotives operating in the region are several decades old. Electric catenary rail is an available clean technology, though this requires massive infrastructure investment. Other technologies are in development, including testing of hydrogen fuel cells – though these are years from being commercially available or cost-effective. The power source for line-haul rail must be compatible cross-continent to allow seamless operation, necessitating a broader conversation about the future of locomotives in the United States and Canada if the sector is to phase out emissions.

In the **interim**, rail activities can achieve emission reductions through efficiency measures (e.g. track sharing and maintenance agreements, intermodal facilities, automatic start-stop technology), replacement of old engines with Tier 4 engines and after-treatments, using low carbon fuels (renewable diesel, renewable natural gas), or using lower emission fossil fuel (liquefied or compressed natural gas).



Port Administration and Tenant Facilities



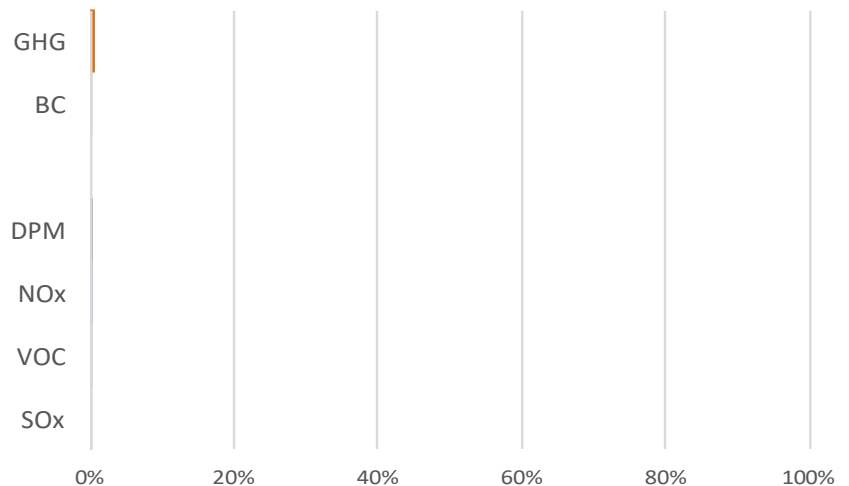
Port administration includes the port authority-owned or leased vehicles and vessels, office buildings, support facilities and employee functions that are needed for the administration of port activities. Tenant facilities include leased building energy use and lighting located on port land but operated by tenants. *Note that the inclusion of tenant facilities in this sector is new compared to previous strategies that only focused on port administration.*

Examples of port authority influence in this sector:

- Ports have direct control over port authority owned and operated facilities and fleets.
- Lease agreements and business relationships with tenants can include conditions relating to minimum energy efficiency.

Emissions (2015/2016):

Across all ports, emissions from port administration and tenant facilities represent a small portion of total port-related emissions. In this sector, GHG emissions are the dominant pollutant of concern due to the very low percentage of heavy-duty mobile emissions. Port administration and tenant facilities are responsible for approximately 1% of port-wide GHG emissions.



Existing regulations and policies:

- Vehicle fuels must include a small percentage of renewable fuel (as required by BC and Washington State laws).
- Building Codes include heightened requirements for energy efficiency.
- NWSA, POS and POT have adopted targets to be carbon neutral or carbon negative in port administration by 2050.
- POS has set goals to reduce overall GHG emissions and building energy use through its Century Agenda Long Range Plan.
- VFPA has been carbon neutral in port administration since 2010 through a combination of emission reduction efforts and the purchase of carbon offsets for all remaining emissions.

Technology shifts to phase out emissions in the Administration sector:

In the **end state**, port administration is expected to be carbon neutral. This includes net-zero energy buildings, efficient and zero emission vehicle and vessel fleets (also known as “Scope 1” and “Scope 2” emissions under the GHG Protocol Corporate Accounting and Reporting Standard). Tenant facilities are also expected to be net-zero energy and carbon neutral.

There are increasingly available and affordable technologies to achieve net-zero energy buildings and zero-emission light-duty vehicle fleets. Existing buildings will require significant investment in mechanical and lighting systems, a transition away from natural gas and conversion to clean electricity-powered heating systems.

In the **interim**, significant efficiency gains can be achieved through building retrofits, control upgrades and use of LED lighting. Fleets can be converted to full or hybrid-electric as suitable vehicles become available, and remaining fuels purchased can be renewable or low emission (renewable natural gas, biodiesel, renewable diesel).