NORTHWEST PORTS CLEAN AIR STRATEGY 2020

PRE-ADOPTION DRAFT

PORT of vancouver

Port of Seattle

Port of Tacoma

THE NORTHWEST SEAPORT ALLIANCE

2020 Northwest Ports Clean Air Strategy At-A-Glance

The 2020 Northwest Ports Clean Air Strategy is a voluntary collaboration among four port authorities with a vision to reduce—and ultimately eliminate—seaport-related air pollutant and greenhouse gas emissions throughout the Georgia Basin-Puget Sound airshed. The Northwest Seaport Alliance, Port of Seattle, and Port of Tacoma in the U.S., and Vancouver Fraser Port Authority in Canada built this strategy through extensive engagement and it represents an important step to catalyze collaboration across the ports, industry, government, and community towards this collective vision.

Vision

Phase out emissions from seaport-related activities by 2050, supporting cleaner air for our local communities and fulfilling our shared responsibility to help limit global temperature rise to 1.5°C.

Guiding Principles

Community health | Climate urgency | Social equity | Innovation | Evidence-based decisions | Focused resources | Leadership | Accountability | Port competitiveness

Objectives

Efficiency, fleet modernization, and interim fuels

Implement programs that promote equipment efficiency, phase out old high-emitting equipment, and support lower-emission interim fuels

Infrastructure to support zero-emissions equipment

Facilitate collaboration to identify and address key infrastructure constraints by 2030

Adoption of zero-emissions equipment

Facilitate collaboration to advance commercialization of zero-emissions equipment and enable adoption before 2050

Collaborative Actions

Participating ports will dedicate resources to collaborative action, which may include pooling resources to conduct joint technology or infrastructure studies, hosting engagement workshops with industry, and/or executing parallel initiatives and sharing lessons learned to inform future actions.

Port-Specific Implementation Plans

Participating ports commit to develop and implement port-specific action plans that advance the vision and objectives outlined in the 2020 NWPCAS.

Monitoring and Reporting

Participating ports commit to annually review and report progress toward the collective NWPCAS vision and objectives, and to provide port-specific updates on actions undertaken, to share successes, failures, and challenges faced, and to adjust actions as needed.

OCEAN-GOING VESSELS (OGV)

HARBOR VESSELS

CARGO HANDLING EQUIPMENT (CHE)

TRUCKS

RAIL

PORT ADMINISTRATION AND TENANT FACILITIES

PORT of vancouver

Port of Seattle

Port of Tacoma

THE NORTHWEST SEAPORT ALLIANCE

PRE-ADOPTION DRAFT

Table of Contents

Glossary

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 (PM), ozone-forming pollutants (nitrogen oxides (NO_x) and volatile organic compounds (VOC)), sulfur oxides (SO_x), and carbon monoxide (CO).

Black carbon: 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 for a short time, but is a contributor to air pollution and climate change (as a short-term climate forcer).

Greenhouse gases (GHGs): Gases that trap heat in the atmosphere. GHGs included in port inventories are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Emissions are reported using carbon dioxide equivalent units (CO_2e).

Lifecycle emissions: Emissions that result from the extraction, processing, and transport of the fuel or technology prior to its final use, in addition to those that are emitted at the tailpipe.

Participating ports: The four port authorities that have collaborated to develop the NWPCAS and are committed to its implementation. They are described in section 1.4.

Particulate matter: A mix of solid particles and liquid droplets found in the air, e.g., dust, soot or smoke. Fine particulate matter ($PM_{2.5}$) measures 2.5 micrometers and smaller. Coarse particulate matter (PM_{10}) measures 10 micrometers and smaller. Diesel particulate matter (DPM) is particulate matter that results from burning diesel fuel.

Port network: Represents the broad mix of organizations that participate in or influence port business across the six sectors represented in this strategy, either directly or through policies, funding, and other aspects that influence port business.

Scope of emissions: The international Greenhouse Gas Protocol defines three scopes of emissions (1, 2, 3). This strategy includes emissions in all three scopes, focusing on scope 3 emissions across five sectors, and scope 1 and 2 emissions in the port administration sector.

Sector: Six groupings that are also used in port emission inventories to estimate emissions by source, including: ocean-going vessels, harbor vessels, cargo-handling equipment, trucks, rail, and port administration and tenant facilities.

Supply chain: The network involved in producing and transporting a product to a consumer.

Tailpipe emissions: Chemicals released as a result of burning a fuel to operate an engine (e.g., gasoline, diesel, biofuels). Electric and hydrogen fueled engines have zero tailpipe emissions.

Zero emission: For this strategy, use of technologies and fuels that result in no tailpipe emissions, recognizing that emissions may still occur when looking at the full lifecycle.

Acronyms

CHE	Cargo-Handling Equipment
DPM	Diesel Particulate Matter
EGCS	Exhaust Gas Cleaning Systems
GHG	Greenhouse Gas
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
LNG	Liquefied Natural Gas
NO_x	Nitrogen Oxides
NWPCAS	Northwest Ports Clean Air Strategy
NWSA	Northwest Seaport Alliance
OEM	Original Equipment Manufacturer
OGV	Ocean-Going Vessel
PM	Particulate Matter
$PM_{2.5}$	Fine Particulate Matter
POS	Port of Seattle
POT	Port of Tacoma
SO_x	Sulfur Oxides
VFPA	Vancouver Fraser Port Authority
VOC	Volatile Organic Compound

1. Context

1.1 Purpose of this Strategy

The 2020 Northwest Ports Clean Air Strategy (NWPCAS) is a voluntary collaboration among four port authorities with a vision to reduce—and ultimately eliminate—seaport-related air pollutant and greenhouse gas (GHG) emissions throughout the Georgia Basin-Puget Sound airshed. This unique collaboration between the Port of Seattle, Port of Tacoma, Northwest Seaport Alliance, and Vancouver Fraser Port Authority ("participating ports") started with the creation of the NWPCAS in 2008, followed by a substantive update in 2013. Since its inception, the NWPCAS has guided participating ports in their efforts to work collaboratively with industry and government partners in the United States and Canada on reducing emissions. This new strategy continues this spirit of collaboration, building on a decade of successful implementation.

The 2020 NWPCAS recognizes the urgent need to act to reduce emissions that contribute to air quality and climate change. It demonstrates that ports must do their part to help limit global warming to 1.5 degrees Celsius (°C) this century, and recognizes that continually reducing air pollution is important for the health of local communities. At the same time, the 2020 NWPCAS must carefully balance this urgency to reduce emissions with the participating ports' mandates to ensure the continuity and competitiveness of the ports.

Through a commitment to a shared vision, objectives, actions, and progress reporting, participating ports are taking an important step to catalyze collaboration across ports, industry, government, and community to put the ports on the path to phase out seaport-related emissions in the Georgia Basin-Puget Sound airshed.

1.2 Role of International Shipping and Ports

Ports in the Pacific Northwest move goods and people. They are strategically located for trade with the Asia-Pacific region and are important components of regional and national economies, generating significant gross domestic product, creating a wide range of good jobs, and enabling households and businesses to prosper along the entire value chain.

International shipping accounts for about 90% of global trade[1] and is over 90% more carbon-efficient than air transport,[2] the other major method of international goods movement. Moving cargo around the world by ship and through ports is integral to the global economy, without which today's global trade would not be viable. Port terminals move cargo to and from ships, rail, and trucks to enable the import of domestic and international goods, and the export of domestically produced goods. The cargo and products that move through ports are critical to communities and quality of life, for example, food, electronics, clothing, and appliances. Ports in the Pacific Northwest offer the shortest travel distance for goods movement between Asia and markets in the U.S. and Canada.

Pacific Northwest ports also serve as the gateway to the Alaska cruise market that provides significant economic benefits to the communities located along cruise itineraries.

1 Shipping and world trade: driving prosperity, International Chamber of Shipping, accessed November 2020
2 Carbon emissions, World Shipping Council, accessed November 2020

1.3 Ports, Air Quality and Climate Change

Although maritime transport is an efficient means of transporting goods and people compared to other modes, the port network (including the shipping industry, ports, terminals, and port supply chains) currently rely heavily on fossil fuels. As a result, seaport-related activities emit air pollutants, GHGs, and black carbon emissions that affect local air quality and contribute to global climate change.

Local Air Quality

Recent research suggests that the health impacts of air pollution—and the associated economic costs in terms of illness, hospitalization, lost worker productivity, and premature deaths—are much higher than previously thought.[3] According to the World Health Organization, "there is a close, quantitative relationship between exposure to high concentrations of small particulates (PM_{10} and $PM_{2.5}$) and increased mortality or morbidity, both daily and over time." Further, "small particulate pollution has health impacts even at very low concentrations – indeed no threshold has been identified below which no damage to health is observed."[4] Diesel particulate matter (DPM) is specifically known to cause cancer. Other air pollutants can also lead to adverse health outcomes and environmental impacts.[5]

Air quality in the Georgia Basin-Puget Sound region is generally good, and several organizations (private companies, government agencies, and ports) in the region have worked hard to maintain and improve local air quality. However, higher concentrations of air pollutants can occur near sources of emissions. In some circumstances, lower-income communities and communities of color are located closer to pollution sources, amplifying the importance of improving air quality to advance social equity and environmental justice. Seaport-related activities contribute to regional and local air pollutant concentrations.

Global Climate Change

Our world is already seeing the consequences of global climate change, and impacts such as extreme weather events, increased risk of wildfires, loss of species, ocean acidification, sea-level rise and inundation, and risks to health, livelihoods, food security, and economic growth are all on the rise. Reducing these risks will require "far-reaching, multilevel, and cross-sectoral climate mitigation" as urged by the Intergovernmental Panel on Climate Change (IPCC).[6] However, the International Maritime Organization (IMO) inventory and estimates show that GHG emissions from shipping are rising and will continue to rise under current policies.[7] Transitioning port and shipping activities towards low and ideally zero-emissions options is a critical part of the urgent action needed to prevent the projected devasting effects of warming beyond 1.5°C, and will require efforts at a global scale.

Port Competitiveness

Having a shared strategy for the participating ports creates a common platform for leadership in clean air and climate action, ensuring each port addresses these issues, and that lower costs or competitive advantage are not realized in one port due to a lack of environmental action. This approach enables the ports to cooperate on environmental leadership while being economically competitive.

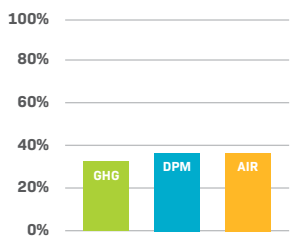
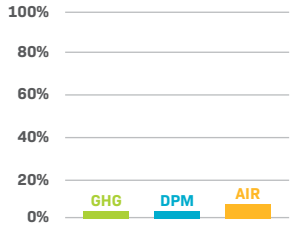
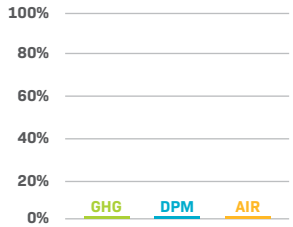
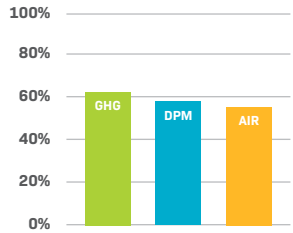
Addressing seaport-related contributions to air quality and climate change will involve adopting new technology that will increase costs and could introduce new risks that can be detrimental to competitiveness, particularly in the near term. Therefore, port authorities, governments, industry, and other partners will need strategies to support early adopters of this new technology to maintain a competitive trade industry in this region. This strategy assumes that in the long term, a proactive and strategic transition to a low-carbon future will minimize risk and provide competitive advantage for the ports and customers. Global awareness and responsiveness to the impacts of climate change will increase along with pressure from consumers and governments to reduce emissions. For example, Walmart aims to reduce 1 billion metric tons of emissions from global supply chains by 2030.[8] Ports and the supply chains that are early adopters of low-emissions technology will be strategically positioned to minimize costs associated with the transition to zero emissions and can develop a competitive advantage relative to other ports and supply chains that are slow to respond to this trend.

3 The Cost of Air Pollution, Organization for Economic Co-operation and Development (OECD), accessed November 2020
4 Ambient (Outdoor) Air Pollution, World Health Organization, accessed November 2020
5 Diesel Exhaust and Cancer, American Cancer Society, accessed November 2020
6 IPCC Special report: Global warming of 1.5°C, IPCC, 2018
7 Reducing Greenhouse Gas Emissions From Ships, IMO, accessed November 2020
8 Walmart to reduce global supply chain emissions by 2030, CleanTechnica, accessed November 2020

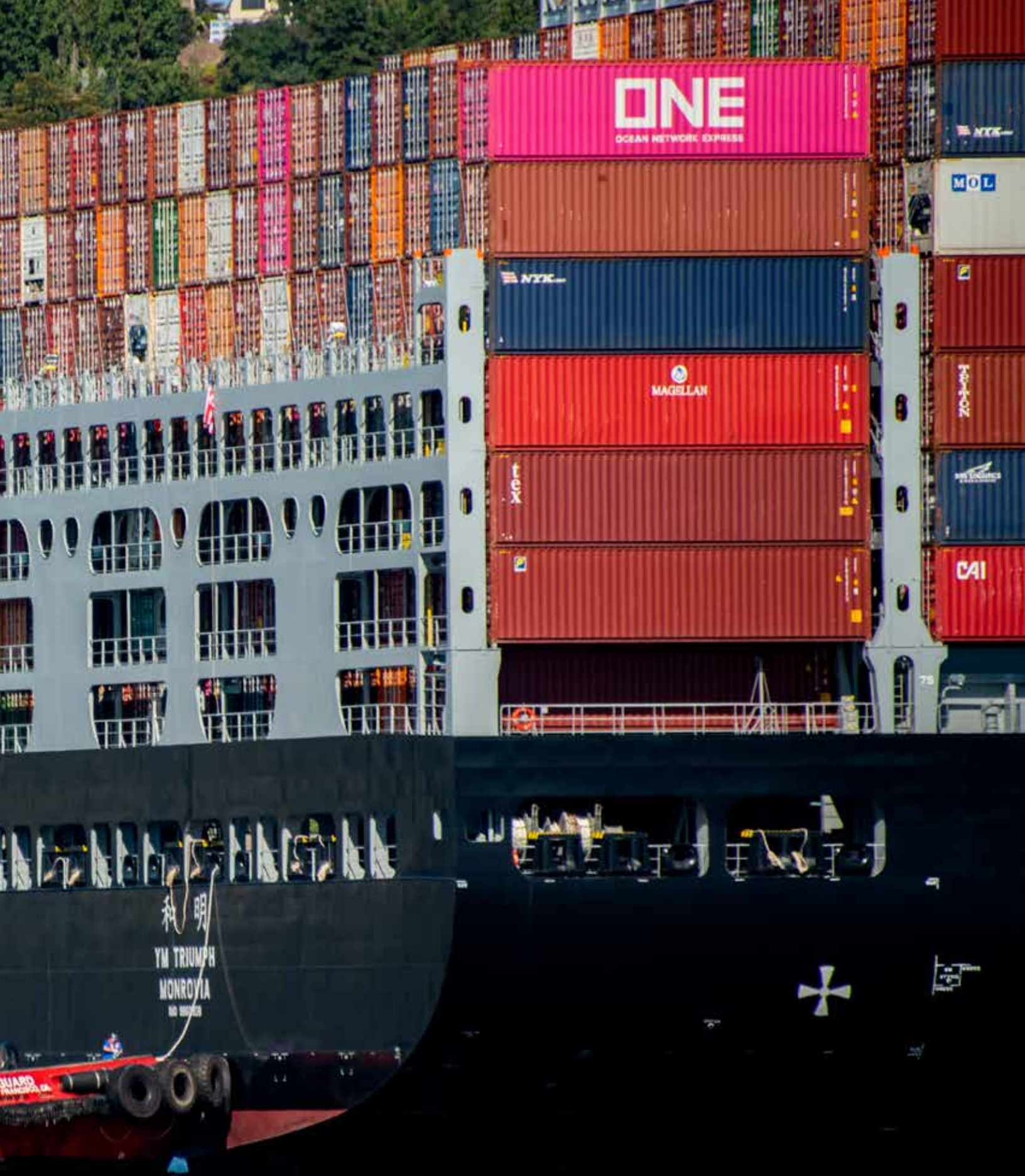
1.4 Participating Ports in this Strategy

The supply-chain activities, technologies, and types of air pollutants are similar at each of the participating ports, but the commercial activities, cargo types, and resulting emissions vary substantially. Table 1 provides an overview of the participating ports along with a snapshot of relative emissions.

Table 1. Summary of participating port authority portfolios and portion of emissions.

Port Authority	**Portfolio** (2019)	**Emissions** (% of total NWPCAS)^
The Northwest Seaport Alliance (NWSA) is a marine cargo operating partnership of the Ports of Seattle and Tacoma, which formed in 2015 to increase the competitiveness of the cargo operations at these ports. The NWSA is an independent port development authority that constructs, maintains, and operates marine terminals, and addresses related transportation and air quality issues. The NWSA supports 58,400 jobs, produces more than $4 billion in labor income, and generates $135.9 million in state taxes (2017). Trade at the NWSA enables $5.9 billion in direct business revenue, $2.9 billion in indirect business revenue, and $3.7 billion in additional household spending.	▪ **Annual cargo: 30,175,000 tonnes** ▪ **4th largest container gateway in North America** ▪ **A major center for bulk, breakbulk, project, heavy lift, and automobiles**	
The Port of Seattle (POS) is an independent special purpose government representing the people of King County, Washington. POS is comprised of three operating divisions, namely Aviation, Maritime and Economic Development. The Port Commission, which includes five individuals elected by King County voters, is the legally constituted governing body. The governing body is charged with the responsibility of fulfilling legislatively mandated purposes and objectives. The Port's cruise ship industry, commercial fishing industry, recreational marinas and other maritime operations generate $3.9 billion in total business output and support over 25,000 jobs.	▪ **Annual cargo: 4,379,000 tonnes, mostly grain** ▪ **Largest cruise port on West Coast: 1,115,000 annual passengers** ▪ **Commercial, recreational marinas** ▪ **Industrial properties** ▪ **60 acres parks, trails, piers, launches**	
The Port of Tacoma (POT) is a special purpose government established in 1918 representing the people of Pierce County, Washington and makes up half of the Northwest Seaport Alliance. The port of Tacoma manages an extensive industrial/commercial real estate portfolio including a grain cargo terminal. Activities at POT supported more than 42,100 jobs, generated nearly $3 billion in economic activity, and produced more than $100 million annually in state and local taxes (2017).	▪ **Annual cargo: 4,843,000 tonnes, all grain** ▪ **Extensive real estate portfolio, primarily in the "Tide Flats" area**	
The Vancouver Fraser Port Authority (VFPA) is the federal agency responsible for the stewardship of the Port of Vancouver, Canada. The VFPA is accountable to the federal minister of transport and operates pursuant to the Canada Marine Act with a mandate to enable Canada's trade through the Port of Vancouver, while protecting the environment and considering local communities. The Port of Vancouver, Canada borders 16 municipalities and intersects the traditional territories and treaty lands of several Coast Salish First Nations. Enabling the trade of approximately $240 billion in goods with more than 170 world economies, port activities sustain 115,300 jobs, $7 billion in wages, and $11.9 billion in GDP across Canada.	▪ **Annual cargo: 147,093,000 tonnes, mix of container, dry and liquid bulk, break bulk** ▪ **3rd largest port in North America by tonnes of cargo** ▪ **Canada's largest port** ▪ **Cruise passengers: 889,000**	 *Air = Air Pollutant

^ Emissions shown as percent of NWPCAS emissions (i.e., relative to other participating ports). Emissions in "Air" include: sulfur dioxides (SO_x), nitrogen oxides (NO_x), particulate matter (DPM/$PM_{2.5}$), volatile organic compounds (VOC), and carbon monoxide (CO), as reported in the most recent port emission inventories (U.S. Ports in 2016 and Vancouver in 2015).



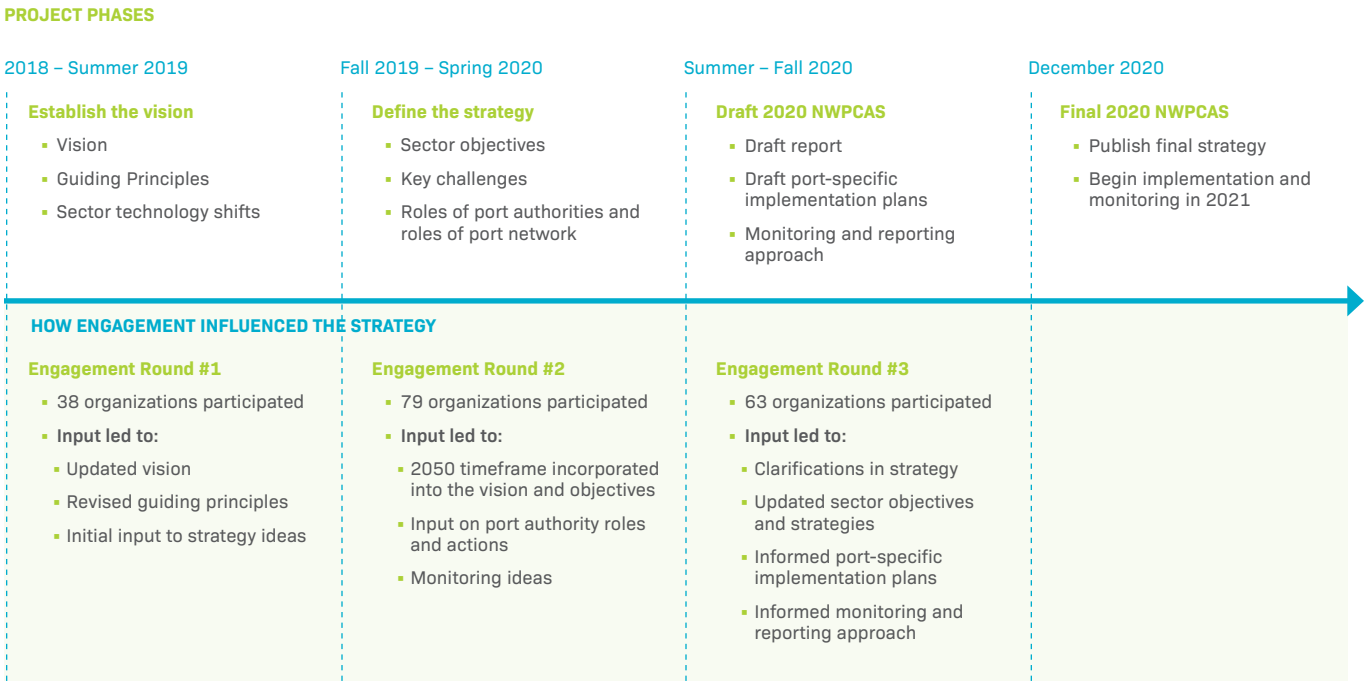
2. Strategy development, scope and history

2.1 Developing the 2020 NWPCAS

Continuing in the spirit of strong collaboration established by earlier NWPCAS, the participating ports led the development of the 2020 NWPCAS through extensive engagement with staff and decision makers at participating ports, as well as substantive input from government partners, industry representatives, non-profit organizations, and community members. The process included joint sessions with participating government agencies that have been actively involved in all versions of the NWPCAS, including: in the U.S., the Environmental Protection Agency, the Washington State Department of Ecology (Ecology), and the Puget Sound Clean Air Agency; and in Canada, Environment Canada, BC Ministry of Environment and Climate Change Strategy, and Metro Vancouver. In addition, ports conducted region-specific engagement with industry, non-profit organizations, additional government agencies, and community representatives (refer to Appendix A for a list of participating organizations).

Figure 1 provides an overview of the key engagement stages undertaken during the process. At each stage, the participating ports reviewed and analyzed the input received to inform the continued development of the strategy. Engagement led to fundamental changes to the vision and objectives, and helped the ports define both the strategy and port-specific implementation plans. The participating ports are deeply appreciative of the time and effort contributed by all participants in the process, and will seek opportunities for ongoing engagement during implementation.

Figure 1. 2020 NWPCAS development process and timeframe.



2.2 2020 NWPCAS Scope

The 2020 NWPCAS covers all of the activities that are included in each participating port's emissions inventory, which includes direct emissions from port operations, as well as emissions from seaport-related activities occurring within the boundary shown in the map in Figure 2.

Like previous strategies, the 2020 NWPCAS addresses emissions from six sectors and the vast majority of these emissions are considered "Scope 3"—that is, they are not in the operational control of port authorities (see box on next page). Since the last strategy, there have been two scope expansions: (1) Port of Seattle is now including commercial fishing vessels and recreational marinas in its emissions inventory scope; and (2) all ports are now including tenant facilities in the Port Administration and Tenant Facilities sector (previously referred to as "Administration") .

Pollutants

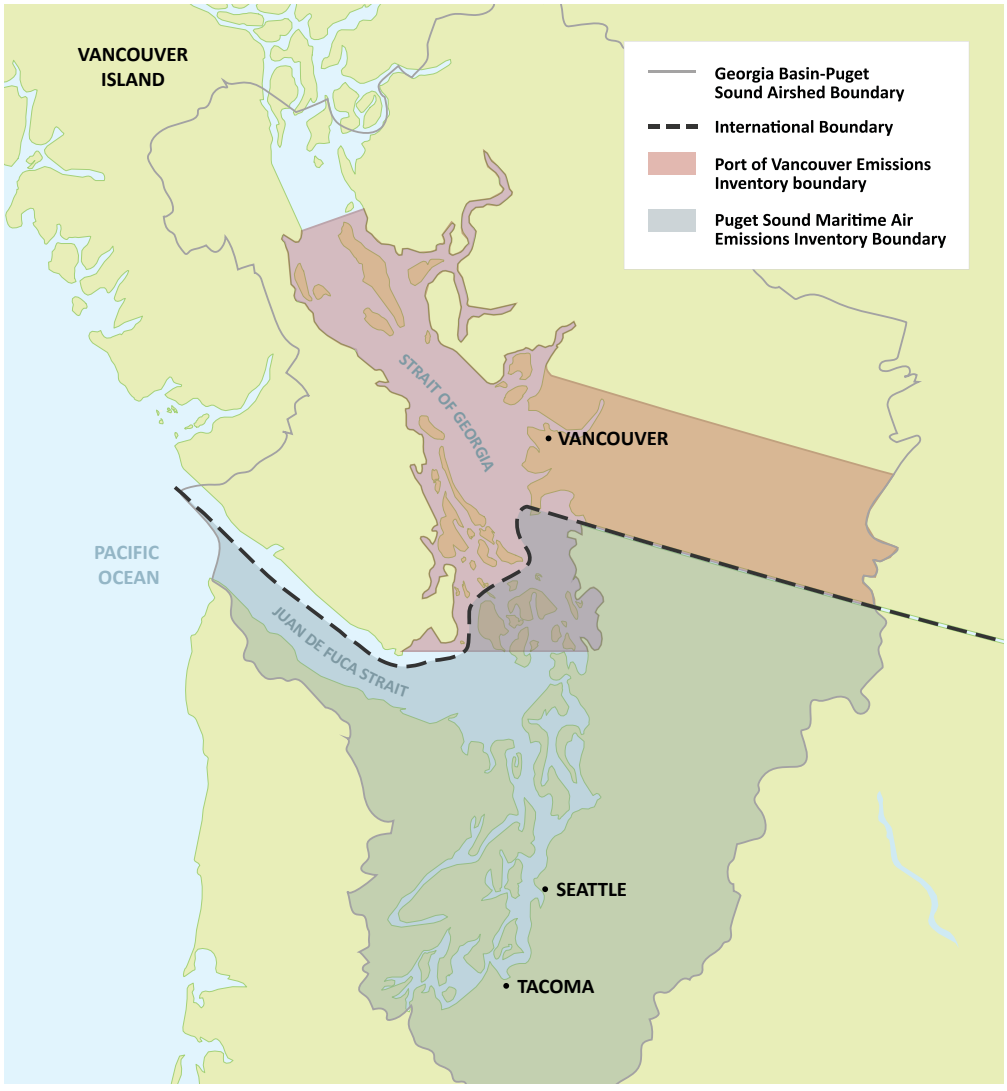
The port emissions inventories provide an estimate of the "tailpipe" emissions from each sector based on models. Tailpipe emissions are released at the time of combustion or when fuel is burned, and do not account for lifecycle emissions (see below). The pollutants considered in the 2020 NWPCAS include:

- Greenhouse gases
- Particulate matter (fine, coarse, and diesel particulate matter)
- Black carbon
- Other air pollutants (sulphur oxides, nitrogen oxides, volatile organic compounds, and carbon monoxide)

Tailpipe vs. Lifecycle Emissions

The inventories have not historically accounted for emissions that result from the extraction, processing, and transport of the fuel or technology prior to its final use, nor for fugitive emissions associated with how products are handled. Although these "lifecycle" emissions have not been estimated in the port emissions inventories and were not considered under previous strategies, the participating ports recognize the importance of improving the understanding of lifecycle emissions as the 2020 NWPCAS is implemented, to ensure that the full emissions impact of alternative fuel and energy options are considered and reduced.

Figure 2. Map of the NWPCAS geographic boundaries.



Port Sectors

Port emission inventories track emissions from port-related activities in six sectors:

OCEAN-GOING VESSELS (OGV)

HARBOR VESSELS

CARGO HANDLING EQUIPMENT (CHE)

TRUCKS

RAIL

PORT ADMINISTRATION AND TENANT FACILITIES

Port Emissions Inventories

- 2016 Puget Sound Maritime Air Emissions Inventory (U.S. Ports)
- 2015 Port Emissions Inventory Report (Port of Vancouver)

Supply-chain efficiency
Existing initiatives at participating ports that aim to increase supply-chain efficiency include:

- **NWSA:** Increased gate efficiency using RFID technology and appointment systems
- **VFPA:** West Coast Supply Chain Visibility Program

Scope of Activities

The 2020 NWPCAS is focused on reducing emissions from the operation of seaport-related equipment, vehicles, and vessels within the geographic scope of each port's emissions inventory. The strategy does not include supply-chain efficiency initiatives. Although these initiatives are important to ports and their customers, and impact emissions, they are very specific to each port and do not fit well within a shared port strategy (see text box for port-specific examples of supply-chain efficiency programs). Therefore, when this strategy refers to "efficiency," the intended focus is on the fuel or energy efficiency of equipment engines, including the general manner in which they are operated (e.g., excessive idling). However, participating ports will seek opportunities to incorporate air pollutant and GHG emissions considerations into established and new supply-chain efficiency programs when implementing this strategy.

2.3 NWPCAS History and Progress 2008–2020

The NWPCAS first began implementation in 2008 and was later updated in 2013. It has been highly successful at advancing seaport-related emissions reduction initiatives across the participating ports. In the 2013 strategy, two emissions intensity reduction targets were established to be achieved by 2020:

- Reduce DPM emissions per metric ton of cargo moved by 80% relative to 2005.
- Reduce GHG emissions per metric ton of cargo moved by 15% relative to 2005.

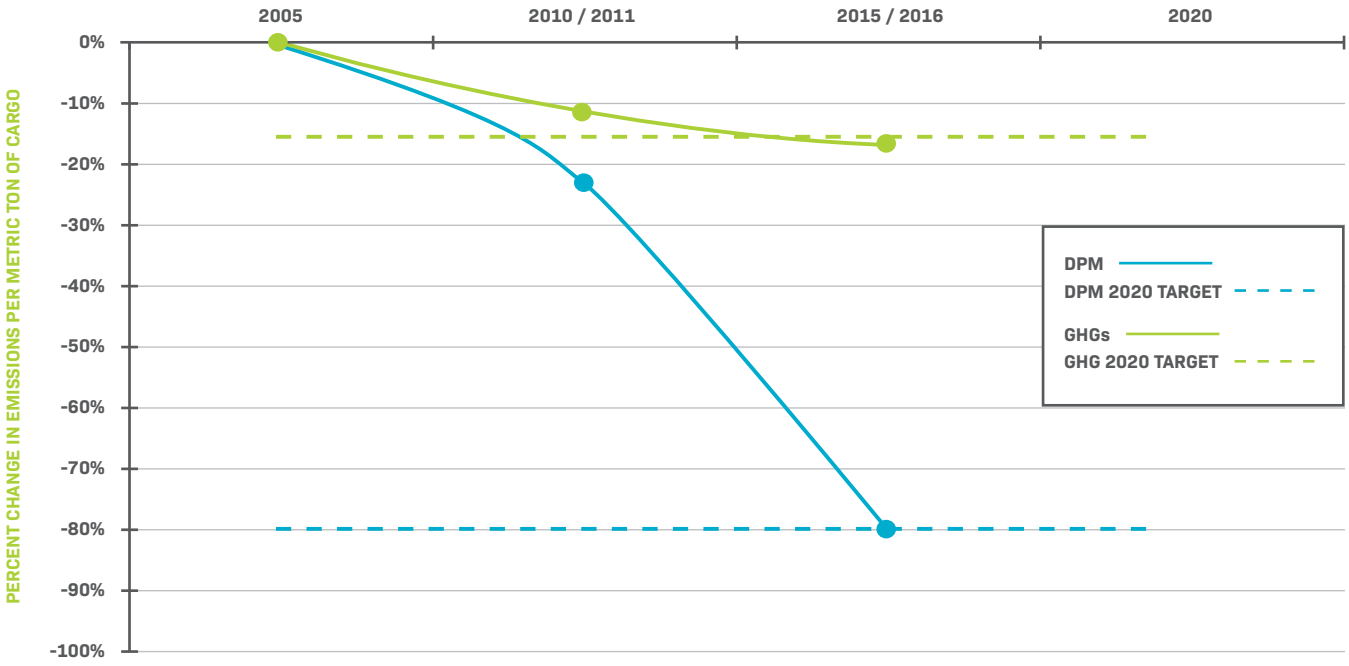
Both of these targets were achieved several years early (Figure 3). The reductions can be attributed to changes in international, national, and provincial regulations; port programs to accelerate the turnover of old equipment; and voluntary efforts by industry to modernize equipment and reduce emissions. Although both emissions intensity targets were met, growth in cargo movement outpaced the reduction of GHG emissions during this period, and as a result, total GHG emissions went up by almost 5%. Total DPM emissions went down by 75% during this period.

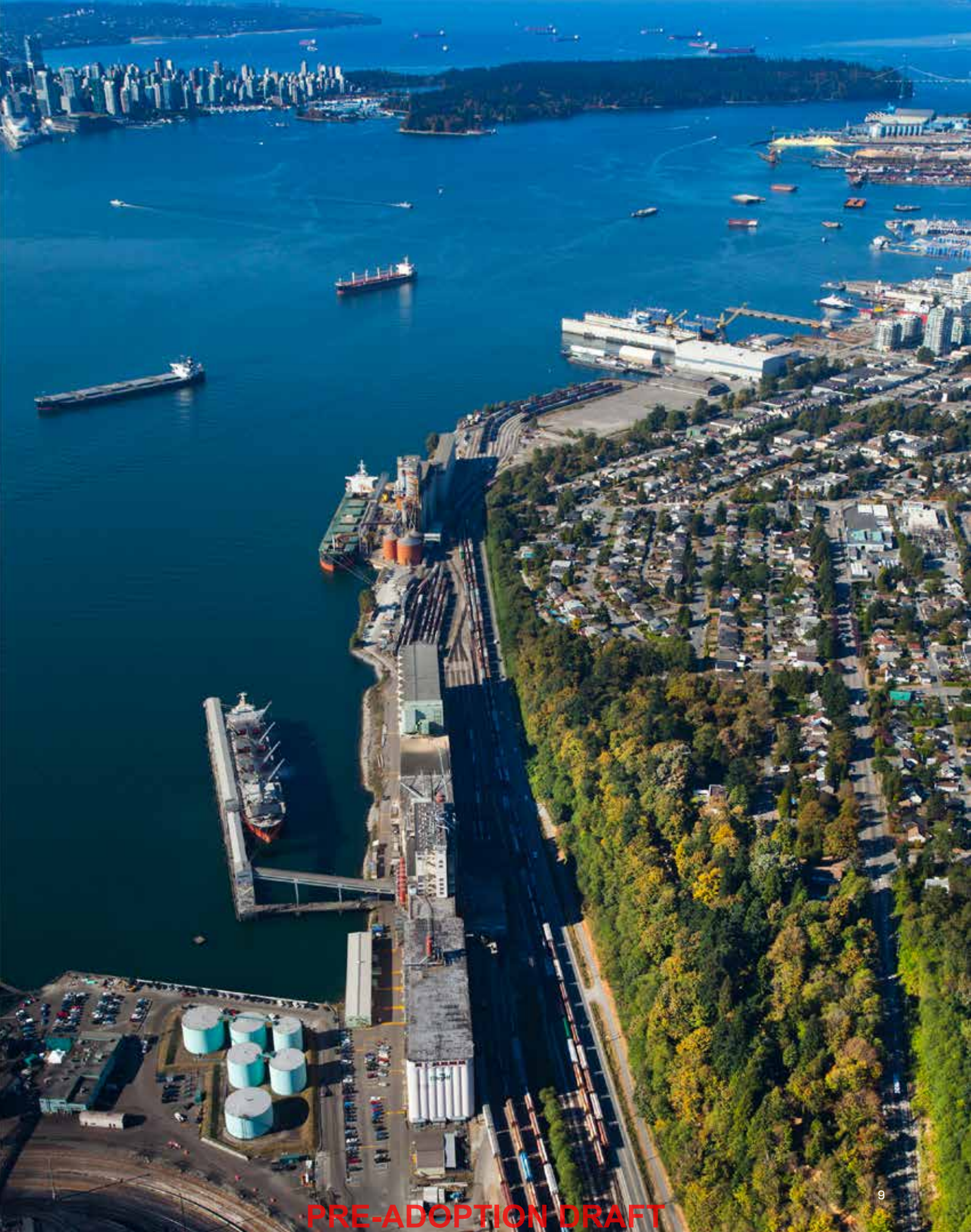
NWPCAS annual implementation reports

From 2008 onwards, ports have annually reported progress toward these targets and several sector-based objectives.

In addition to these targets, the 2013 strategy set several objectives within each of the sectors. Progress toward these objectives continues to be published in the annual NWPCAS Implementation Reports. Although several of the objectives have not been met, the participating ports will continue working toward those that remain relevant to the updated strategy. These are highlighted in section 5.

Figure 3. Progress toward 2013 NWPCAS emissions intensity reduction targets (to be achieved by 2020).





3. Vision, Guiding Principles, Targets

3.1 2020 NWPCAS Vision

Ports participating in this strategy recognize that our planet is at a critical juncture where transformative changes are needed to limit global warming and avoid catastrophic impacts from climate change. Ports have an important role to play in this transformation. In 2018, the IPCC released a Special Report concluding that a number of severe climate change impacts could be significantly reduced by limiting global warming to 1.5°C.[9] The report also states that rapid and far-reaching transitions in energy, land, urban infrastructure, and industrial systems are required, with scenarios demonstrating that global reductions of 45% of total emissions by 2030 and carbon neutrality by 2050 are needed to limit global warming to 1.5°C. At the same time, ports recognize they play an important role in protecting local air quality.

Responding to this call to achieve carbon neutrality and address local air pollution impacts, the 2020 Northwest Ports Clean Air Strategy's vision is to:

> **» Phase out emissions from seaport-related activities by 2050, supporting cleaner air for our local communities and fulfilling our shared responsibility to help limit global temperature rise to 1.5°C.**

This is an ambitious vision. Ports and associated industries rely heavily on fossil fuels to deliver critical services and economic benefits to the port regions and nationwide. A port and industry transformation to zero emissions will require unprecedented investment from a combination of public and private sources.[10] The participating ports—guided by the principles outlined below in section 3.2—will work closely with partners to overcome the substantial technological, policy, investment, and funding barriers to phase out emissions.

The trajectory to phase out emissions will be different for each port sector including vessels, cargo-handling equipment, trucks, rail, and port administration and tenant facilities. Section 5 of this strategy highlights the challenges, key participants, and the participating ports' roles in transforming each sector. As technology may change quickly, ports will need to remain nimble by using an adaptive management approach to implement this strategy. Although each individual port may be just one stop of several in a network of international goods movement and cruise visits, it is critical that ports do their part to facilitate change in every port sector.

What Does "Phasing Out Emissions" Mean?

The primary focus of this strategy is to transition to technologies that have zero tailpipe emissions. Fortunately, in this region ports have access to very low-emission electricity (see text box), providing a clear opportunity to phase out emissions.

It is important to acknowledge, however, that increasing use of zero-emission technologies could still result in emissions or other impacts elsewhere in the lifecycle. For example, increased reliance on battery technology will increase demand for precious mined materials, resulting in emissions and other environmental and social impacts from extraction, processing, and end-of-life disposal.[11]

For simplicity, this strategy uses the term "zero emissions" for technologies and fuels with zero tailpipe emissions, and recognizes that other emissions and impacts within the technology or fuel lifecycle should be considered. The participating ports will work to consider lifecycle emissions and impacts where feasible, and prioritize technologies and fuels that minimize carbon emissions and sustainability impacts over the entire lifecycle of alternatives being considered.

Zero-emissions electricity is fundamental to 2020 NWPCAS success

The 2020 NWPCAS recognizes that low-emissions sources of electricity and alternative fuels are critical to the success of the vision, so that carbon pollution is not transferred from the tailpipe to the point of production or generation. In this region, 92–94% of utility electricity comes from hydroelectricity, wind or biogas, with the remaining 6–8% of electricity generated from nuclear, natural gas, coal, and oil.[12] The State of Washington and the Government of B.C. are committed to reaching 100% carbon-free electricity in the coming decades.

9 IPCC Special report: Global warming of 1.5°C, IPCC, 2018

10 Although these costs have not been estimated for this region, the San Pedro Bay Ports provided preliminary cost estimates for select zero-emissions strategies, and these are in the billions of dollars. An action to estimate these costs for this region is included in this strategy.

11 Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition, Climate Smart Mining for World Bank Group, 2020

12 Seattle City Lights; Tacoma Power; BC Hydro

The Challenge of International Shipping

The IMO, the United Nations agency responsible for regulating international shipping, is developing a GHG regulation for shipping that targets a 50% reduction in total GHG emissions by 2050 (relative to 2008). The IMO regulatory pathway is not aligned with global efforts to achieve net-zero emissions by 2050 and the latest climate science of reductions needed to limit global warming to 1.5°C. It may therefore be questioned whether the 2020 NWPCAS vision is practical or achievable, as shipping activities constitute approximately 50% of seaport-related GHG emissions in this region. The participating ports have considered this issue carefully and feel it is important to set a vision that aligns with global efforts to limit warming to 1.5°C. The participating ports will track and report on shipping sector progress toward the vision, and will make every effort to encourage vessels calling the ports to exceed the global IMO GHG reduction target and achieve net-zero emissions by 2050.

3.2 Guiding Principles

When implementing the strategy vision, all participating ports will be guided by the following principles. These guiding principles will influence how ports prioritize action, funding, and investment.

Community health: Recognize the importance of reducing the impacts of seaport-related emissions on public health.

Climate urgency: Seek early achievement of the vision, recognizing the urgency to act to limit global climate change.

Social equity: Prioritize action in communities that have been most impacted by port operations.

Innovation: Promote investment in innovative technologies, policies, and practices that drive continuous improvement.

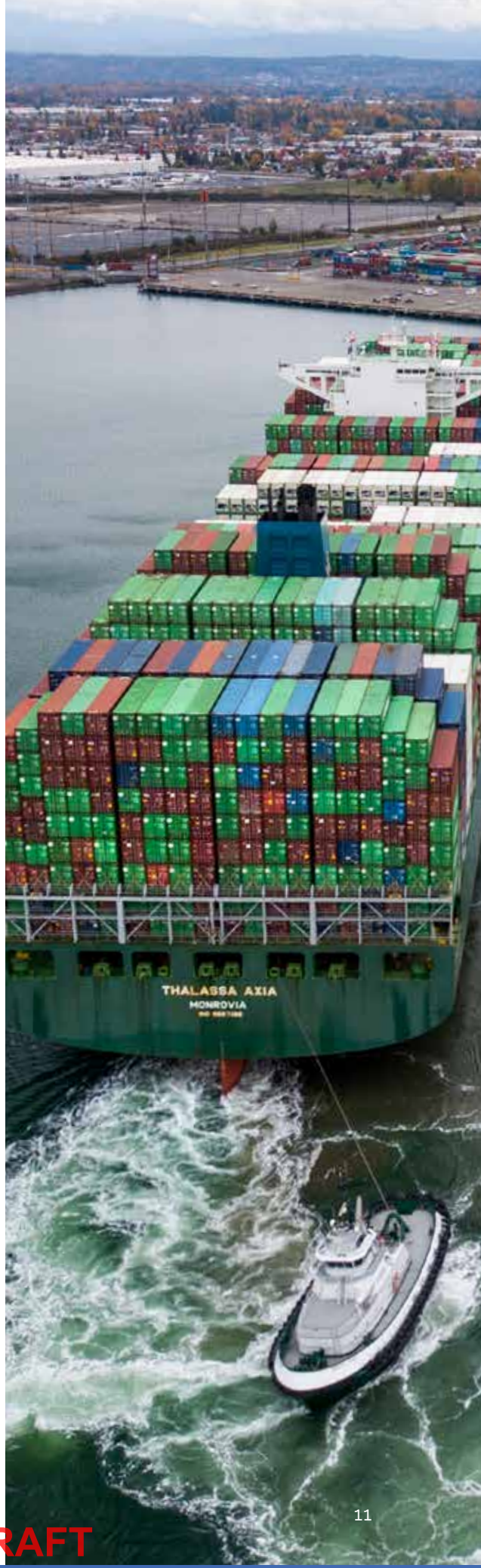
Evidence-based decisions: Use best available climate change and air quality science to inform decisions.

Focused resources: Focus action in areas likely to have the highest environmental, social, and economic impact, recognizing the limits of port authority resources, operational control, and influence.

Leadership: Take a leadership role to facilitate government and industry support for the policies and actions needed to achieve the vision.

Accountability: Provide clear, transparent, and timely updates on progress toward achieving the vision.

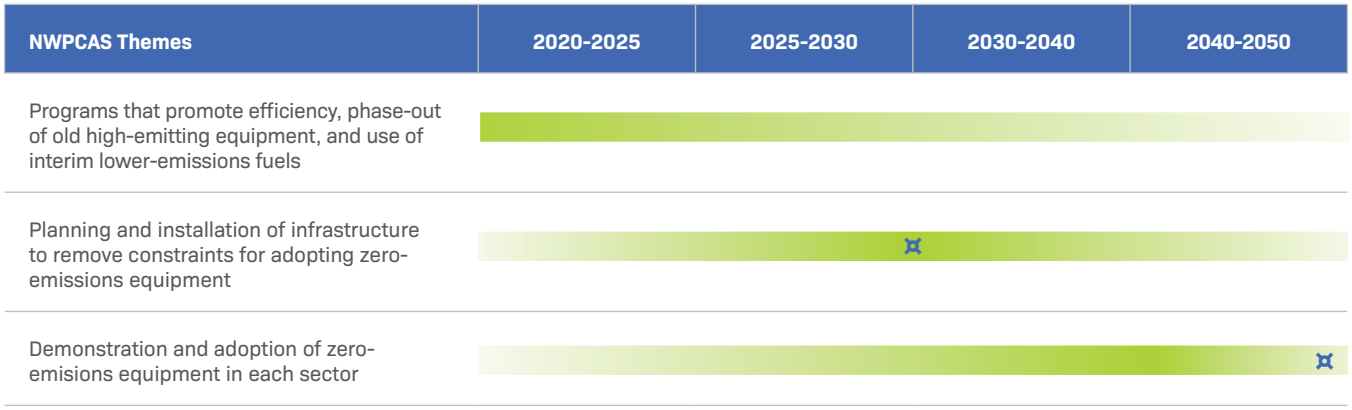
Port competitiveness: Deliver the strategy in a way that supports the competitiveness of ports and the prosperity of communities.



3.3 Themes for Phasing Out Emissions

Phasing out emissions from port activities may look different in each sector and at each participating port; however, three core themes are transferable across every sector and port. As shown in Figure 4, the level of effort required to implement strategies in each of the themes will shift over time, starting with a heavy focus on programs to promote efficiency and fleet modernization while planning for the infrastructure installments needed to support zero-emissions technology. As zero-emissions technology becomes available and feasible, infrastructure will be installed, and the technology will be implemented. In addition to an early emphasis, efficiency will involve ongoing effort. Within each timeframe, participating ports will move as quickly as possible to achieve emissions reductions.

Figure 4. Phasing of effort across the strategy's three themes.



⌑ Key dates: Remove infrastructure constraints by 2030; all seaport-related activities are zero emissions by 2050.

Note: Darker shading indicates higher effort. The shading is less intense during phase-in and phase-out periods. These timeframes show the general timing of effort required to support the vision; however, they are not intended to limit the ambition of advancing more quickly in specific sectors, for specfic types of equipment, or at specific ports.

Theme 1: Efficiency, Fleet Modernization, and Lower-Emissions Fuels

Participating ports will implement programs that improve efficiency, phase out old high-emitting equipment, and increase use of lower-emissions fuels.

It is important that this strategy continue to emphasize minimizing emissions associated with existing equipment fleets, while concurrently enabling a transition to zero-emissions alternatives. The collective monetary value of all equipment currently serving ports is tremendous (for example, thousands of trucks, locomotives, vessels, and cargo-handling equipment serve a single port). Replacing all of this equipment will require both time and unprecedented levels of investment to transition to zero-emissions technologies.

While zero-emissions technology is rapidly becoming available for some applications, such as trucking, in other sectors, such as rail and ocean-going vessels, the development of zero-emissions alternatives may take decades. Where technology is starting to become available, there remain substantial costs and other barriers to immediate adoption. The 2020 NWPCAS must therefore remain focused on reducing interim emissions from existing equipment through approaches available now. For example, phasing out old high-emitting diesel equipment in favor of new diesel technologies can reduce air pollutants by about 90%.[13] Also, drop-in fuels like renewable diesel that can be used in existing engines can substantially reduce tailpipe emissions.[14] The participating ports must also continue to emphasize efficiency in order to minimize resource consumption and sustainability impacts related to alternative fuels and technologies.

Theme 2: Infrastructure to Support Zero-Emissions Technology

Participating ports will facilitate collaboration among government, utilities, fuel providers, and industry to ensure the infrastructure needed to enable zero-emissions technologies is in place at the right time, addressing key constraints as soon as possible before 2030.

As industry identifies the most promising and suitable technologies to phase out emissions, substantive investment in infrastructure will be required to ensure those technologies and fuels are viable and available at the ports. Infrastructure planning and installation requires coordination among several parties, and significant upgrades may take years to implement. It will be essential for the port network to identify and address key constraints in order to enable broad adoption of zero-emissions technology.

13 Dieselnet.com provides a synopsis of federal standards for nonroad diesel equipment, and compares older (Tier 3 and earlier equipment) to the newest standard (Tier 4). Accessed December 2020.
14 Na et al., Impact of biodiesel and renewable diesel on emissions of regulated pollutants and greenhouse gases on a 2000 heavy duty diesel truck, Atmospheric Environment, Volume 107, 2015

For battery-electric technologies, this could mean addressing constraints in the electrical distribution network, such as upgrading or building new utility substations and considering technologies like large-scale battery storage, microgrids, or distributed energy strategies. For alternative fuels, this could mean supporting the establishment or scale-up of hydrogen or renewable fuel processing and fueling facilities. This effort will involve substantial coordination, planning, and investment by participating ports and across the port network.

Theme 3: Adoption of Zero-Emissions Technology

Participating ports will facilitate collaboration toward commercialization and drive adoption of zero-emissions technology before 2050.

The 2020 NWPCAS vision requires all vehicles, equipment, and vessels serving the ports to operate without producing tailpipe emissions. The specific fuels used may vary—ranging from battery electric, to renewable hydrogen, to non-combustion use of liquid fuels that act as energy carriers. The most feasible approaches will be determined by industry's commercialization process (see text box). In most cases, suitable zero-emissions technologies and fuels needed for port applications are not yet commercialized, are not sufficiently available, or are prohibitively expensive. In some cases, adoption may not be feasible for many years.

In both Theme 2 and 3, the participating port facilitation roles may include: leading and/or funding research and studies, advocating for policy changes, chairing or participating in working groups, coordinating the port network to identify and address specific barriers, tracking and providing data, seeking and aligning funding sources, and more.

What does commercialization mean?

Before new types of technology can be adopted at ports, there is a multi-stage process that must be completed, including (based on a concept called Technology Readiness Level):

1. Define basic technology principles
2. Develop the concept
3. Experiment to create a proof of concept
4. Validate parts in a laboratory
5. Validate parts in a simulated environment
6. Prototype system in simulated environment
7. Prototype in an operational environment
8. Test and demonstrate
9. Final technology is proven through successful demonstration in real-life conditions

Ports and port industries are most likely to get involved at stage 8+, where it is essential to demonstrate the technologies in operational settings. This is where pilot projects play a critical role. Most other stages are led by industry with support from government funding.

After all of the steps are complete, the technology is considered commercially viable and can be adopted based on the tested conditions (which may vary between ports). Even at this stage, the technology may need to be tested in various operational environments through pilot projects and will be very costly, requiring funding, such as grants, to enable adoption. At this stage, ports can focus on programs and funding to support broad adoption.[15]

3.4 Emissions Reduction Targets

The participating ports acknowledge that the pathway to phase out fossil fuels remains unknown for some sectors. However, the participating ports also recognize and uphold the guiding principle of climate urgency and the ports will collaborate with industry, government, and community partners to drive this challenging transition. By working toward the 2020 NWPCAS vision, the participating ports are also supporting all established climate commitments relevant to their policy and regulatory contexts (shown in Table 2). Figure 5 shows the historical emissions for DPM and GHGs at participating ports, and the trajectory needed to achieve the vision.

15 Adapted from Technology Readiness Levels, Government of Canada, accessed November 2020

Figure 5. NWPCAS target to phase out seaport-related emissions emissions by 2050, metric tons of GHG and DPM emissions.

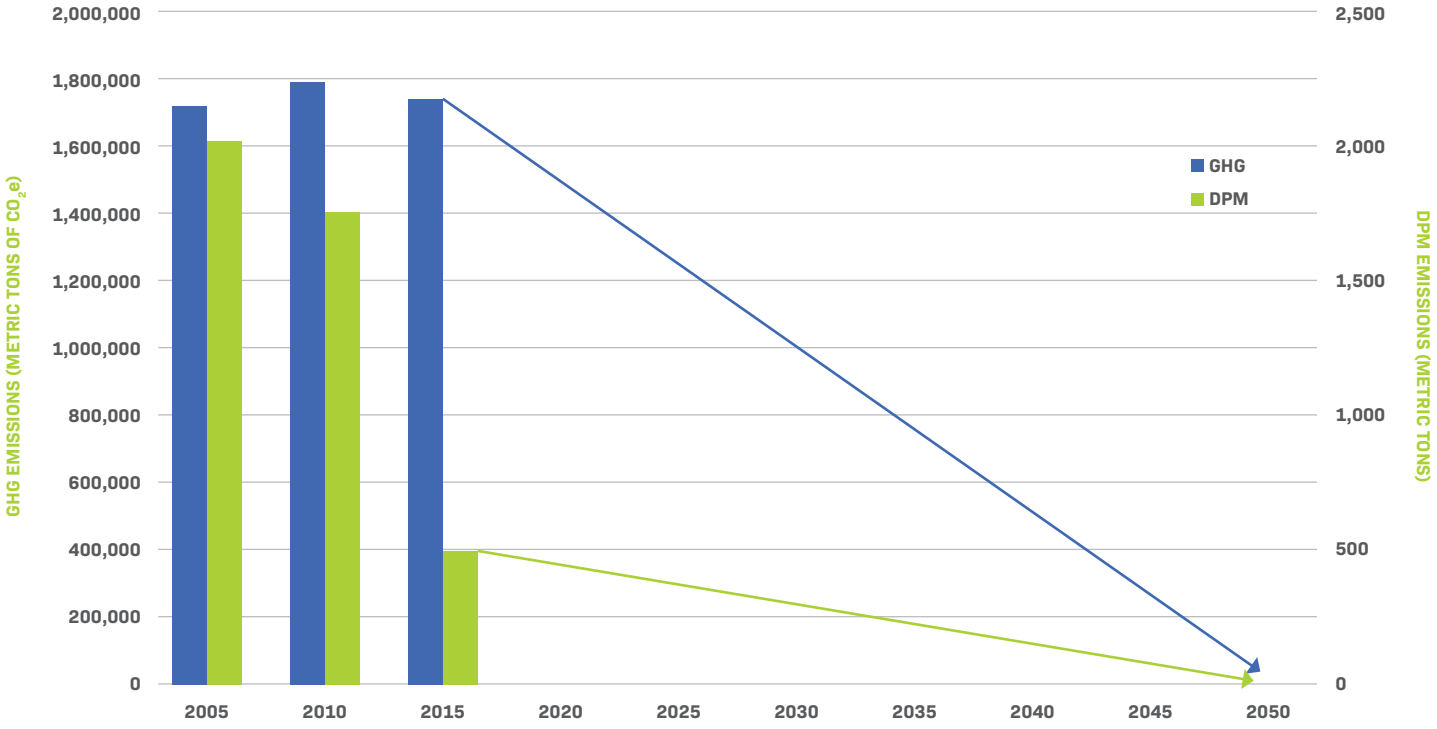


Figure note: Graph represents the emissions at the four participating ports combined, based on port emissions inventories. 2010 represents 2010/2011 inventories and 2015 represents 2015/2016 inventories.

Table 2. Applicable GHG emissions reduction targets in relevant jurisdictions.

Jurisdiction	2030 Target	2050 Target	NWSA	Seattle	Tacoma	Vancouver
IMO	Reduce CO2 emissions per transport work, as an average across international shipping, by at least 40%	Pursue efforts toward reducing CO2 emissions per transport work by at least 70% Reduce total GHG emissions by at least 50% compared to 2008	X	X	X	X
Government of Canada	GHG emissions 30% below 2005	Net-zero carbon emissions[16]				X
Government of B.C.	GHG emissions 40% below 2007	Total GHG emissions 80% below 2007				X
Metro Vancouver	GHG emissions 45% below 2010	Carbon neutral				X
State of Washington	GHG emissions 45% below 1990	Achieve net-zero carbon emissions	X	X	X	
U.S. ports ("scope 3")	GHG emissions 50% below 2005/2007[17]	Total GHG emissions 80% below 2005/2007	X	X	X	
U.S. ports ("scope 1 and 2")	GHG emissions 50% below 2005	Carbon neutral or carbon negative	X	X	X	

16 In November 2020, the federal government (Canada) held first reading of the Net-Zero Emissions Accountability Act, though this has not yet passed at the time of this writing.
17 Northwest Seaport Alliance and Port of Tacoma use 2005 as the baseline year, while Port of Seattle uses 2007.

4. Collaboration

Collaboration across the port network is fundamental to this strategy. Collaboration in this context means that participating ports establish a shared vision, guiding principles, and objectives, and constructively engage industry, governments, utilities, unions, communities, and more, to work together to pursue, fund, and implement the ambitious vision of phasing out seaport-related emissions by 2050.

4.1 Role of the Port Authorities

Port authorities play an important role in facilitating commerce, which in turn provides significant economic benefits through direct and indirect jobs and access to domestic and international markets.

The participating port authorities are primarily "landlord ports" that lease port lands to private companies. The port authorities own and/or operate only a fraction of the vehicles, equipment, and vessels that move through port properties. The port authorities have various types of relationships and degrees of interaction and influence with owners and operators of the equipment, vehicles, and vessels.

For example, the port authorities have direct business relationships with marine terminal operators through commercial lease agreements. Lease agreements are an important tool for influencing private tenants, though these agreements are generally long term and often extend decades between renewal or re-negotiation opportunities. Relationships with truck companies are less direct and ports exert influence through port programs that place environmental requirements on trucks accessing port terminals (such as the NWSA Clean Truck Program and the VFPA Truck Licensing System).

The port authorities have limited to no regulatory authority, nor direct control over the majority of emissions from seaport-related activities on or off of port land. Ports must operate within the regulatory environment established by governments, though port authorities can take a leadership role in advocating to strengthen these regulations in relation to air quality and climate change.

4.2 Role of Government Policy and Investment

Phasing out emissions over the coming decades will require unprecedented levels of investment across the port network on the order of billions of dollars in this region alone. However, a proactive and strategic approach to transitioning to zero emissions could reduce costs in the long term and avoid costs of inaction. Governments must play a critical role in the success of this transition through a combination of enabling policies and investments that, for example, support infrastructure development and improve the cost-competitiveness of zero-emissions operations.

There are existing policies in this region that support investment in lower-emissions operations, including the carbon tax and low-carbon fuel standard in British Columbia and requirements for the sale of zero-emissions vehicles in both British Columbia and Washington State. However, in their current form, these policies are not sufficient to support a full transition to zero-emissions ports. Continuing to identify and update the most effective policies and regulations on both sides of the border will be key to the strategy's success, and ports will advocate for these.

Policy change alone will not be sufficient. Supporting this transition will also require significant and continual investment in the research, development, commercialization, and adoption of zero-emissions technology and supporting infrastructure. In particular, funding will be important to reduce the risks of early adoption. Innovative new financing mechanisms, expanded grant funding, public-private partnerships, and many other tools will need to be explored. Ports will facilitate government and industry discussions to identify preferred mechanisms that ensure ongoing port competitiveness while working to achieve the vision.

4.3 Call for Collaboration

The complexity of the port system and diversity of relationships across all aspects of port business present a strong case for approaching the challenges of a zero-emissions transition in a highly collaborative manner. Table 3 highlights six key conditions to successfully achieve the 2020 NWPCAS vision. With each condition, the roles that participating ports and others in the port network will need to play are highlighted to demonstrate the importance of collaboration. The port authorities commit to fulfilling their role through collaborative actions identified in this strategy and through port-specific implementation plans (see Section 6).

Table 3. Key conditions to achieve the 2020 NWPCAS vision.

Conditions for Success	Port Authority Roles	Port Network Roles
Enabling policy is in place domestically and internationally to support investment in zero-emissions technology and infrastructure	▪ Advocate to all levels of government for supportive policies that create incentives for the adoption of zero-emissions technologies and accelerate reaching cost parity with conventional equipment ▪ Identify and implement port programs to incentivize and accelerate adoption of zero-emissions technologies ▪ Actively engage with other government agencies and industry to ensure strategies and efforts are aligned	▪ **Government:** establish and strengthen carbon reduction policies ▪ **IMO:** strengthen rules and implementation strategies for global use of low-carbon fuels, vessel efficiency requirements
Funding and/or access to capital to support adoption of zero-emissions technology and infrastructure development where business case alone is insufficient	▪ Understand the full cost of the transition ▪ Communicate the scale of funding needed, and seek public and/or private funding to offset port and industry costs ▪ Ensure port authority investments are directed toward zero-emissions infrastructure and technology ▪ Convene government and industry partners and others in the port network to identify new financing mechanisms ▪ Facilitate funding or access to capital, supporting replacement of old equipment before end of life	▪ **Government:** create funding mechanisms to support the transition to near-zero or zero emissions ▪ **Lending institutions and insurance providers:** provide suitable loans and insurance rates that support industry adoption of zero-emissions technology ▪ **Private sector:** potential role for private funders or new public-private partnerships
Adequate electricity and/or fueling infrastructure is available when and where needed	▪ Conduct planning studies with utilities and industry ▪ Coordinate and plan with utilities, tenants, governments, and others in the port network ▪ Invest in infrastructure on port property ▪ Participate in regional collaboration to deliver required infrastructure for investments needed beyond port property	▪ **Utilities and fuel providers:** plan for and install needed capacity ▪ **Regional partners:** lead the planning and installation of infrastructure required outside of port property ▪ **Terminal operators:** participate in planning, enable and/or lead installation of infrastructure
Technology is commercially available and demonstrated for port applications, and total cost of ownership is competitive (which may require enabling regulation and funding)	▪ Facilitate demonstration projects ▪ Conduct technology assessments on the state of technology, market availability, and costs in the region ▪ Establish or update port programs, lease tariffs and agreements to advance zero-emissions technology adoption ▪ Coordinate grant and funding programs ▪ Advocate for charging and fueling standardization	▪ **Governments, utilities, and others:** fund zero-emissions technology development and demonstration ▪ **Manufacturers and Original Equipment Manufacturers (OEMs):** design and commercialize cost-competitive zero-emissions options for seaport-related equipment, vehicles, and vessels ▪ **Operators:** participate in pilot projects
Industry commitment to transition to zero-emissions operations through investments and business planning	▪ Convene industry partners to identify and address barriers ▪ Provide technical resources to support transition planning ▪ Collaborate with operators on infrastructure needs, including lease terms ▪ Help align funding for zero-emissions technology ▪ Monitor and share information about technology developments and recognize early adopters	▪ **Owners/operators of equipment:** incorporate the transition to zero-emissions technology into capital planning and operations ▪ **Governments and others:** provide long-term funding mechanisms to give industry confidence to plan and budget for the transition
Workforce is trained to operate and maintain zero-emissions technology	▪ Support maritime workforce education and training programs ▪ Support and advocate for zero-emissions technology training	▪ **Governments, trade associations and education institutions:** provide training and accreditations ▪ **Industry:** support ongoing training

4.4 Community Engagement

Ports support and contribute to communities through job creation, transportation of goods, and creation of community amenities. Port activities and associated transportation networks can also have negative community impacts, which include air quality, noise and light pollution, and traffic/rail safety, and as a result, environmental health disparities exist in some near-port communities. Participating ports are committed to better understanding and addressing those disparities and, through implementation of this strategy, advancing environmental justice and social equity.

Ongoing engagement is important to help port authorities understand the impact of port operations on communities, better plan and manage operations and development projects, and identify and prioritize areas for improvement. Participating ports also recognize the importance of building stronger relationships with communities as this strategy is implemented.

The participating port authorities undertake regular or have ongoing community engagement mechanisms. For the purposes of advancing this strategy, the port authorities will engage communities to:

- Continue to build support for the NWPCAS vision and objectives.
- Identify opportunities to partner and build relationships with communities.
- Understand where to prioritize implementation to mitigate any adverse impacts from port operations, and find ways to invest and build capacity in near-port communities.
- Report on implementation progress and performance metrics.
- Inform an adaptive management approach to ensure the NWPCAS continues to drive improvements.

Maintaining the support of communities for emissions reductions will be beneficial to demonstrate to governments, and other providers of capital, the importance of investing in emissions reductions.

5. Sector Strategies

Successfully transitioning ports from heavy reliance on fossil fuels toward zero emissions by 2050, while continuing to maintain port competitiveness, will involve concerted effort and collaboration by all participants in the port network. As noted in section 4, there are multiple conditions needed for success, and strategies to address these conditions will vary in each sector.

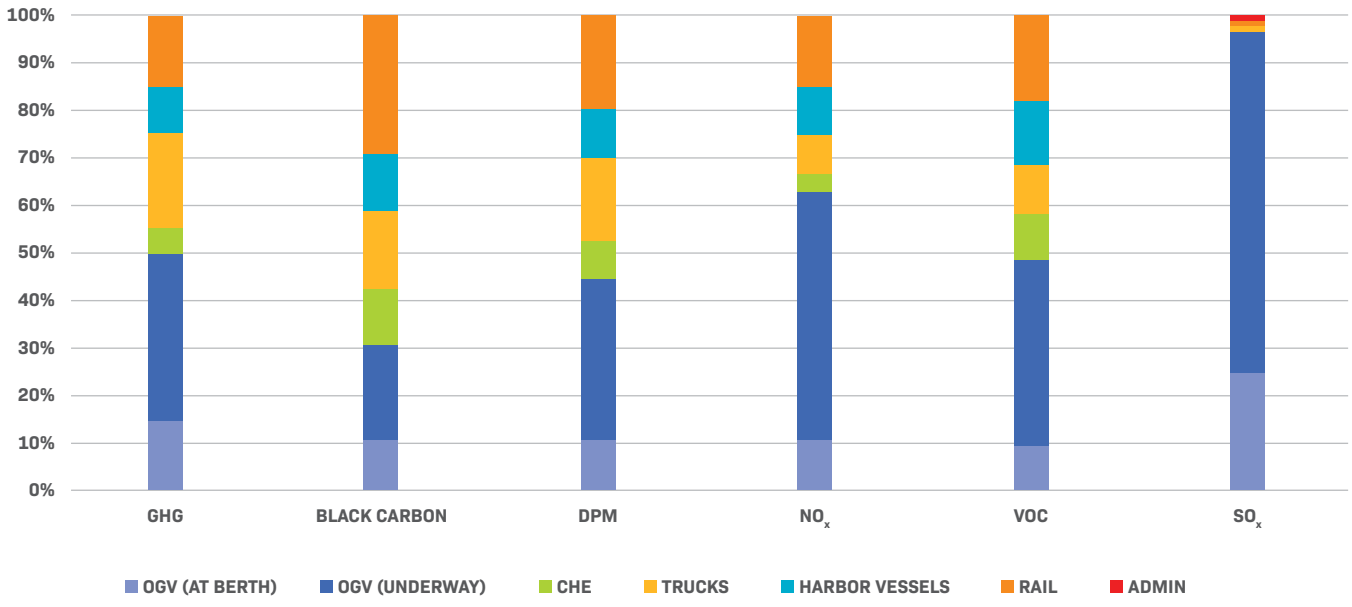
This section of the report dives into each sector by:

- Establishing the current context.
- Providing a summary of the current state of technology.
- Summarizing the sector objectives and general strategies that port authorities will employ to achieve those objectives. Some objectives from the 2013 NWPCAS are included that have not been met and that port authorities will continue to work toward.
- Identifying key metrics that the participating ports will track and report on annually.

Figure 6 summarizes the portion of emissions in one year that come from each sector. Six pollutant groups are shown. Climate change pollutants are on the left and air quality-related pollutants are on the right. The objectives and strategies outlined for each sector address the themes of:

- Reducing emissions in the existing fleet (e.g., equipment efficiency, fleet modernization, and use of lower-emissions fuels)—prioritizing community health through efforts to reduce exposure to air pollutants in areas most impacted.
- Supporting zero-emissions infrastructure as soon as feasible.
- Ramping up efforts to support the shift to zero-emissions technology.

Figure 6. Portion of emissions by sector for each pollutant, combined for all participating ports, 2015 (Vancouver) and 2016 (U.S. Ports).



5.1 OCEAN-GOING VESSELS (OGV)

Ocean-going vessels (OGVs) include container ships, cruise ships, tanker ships, bulk cargo ships, breakbulk cargo ships, and roll-on/roll-off ships that carry vehicles. Port emission inventories capture ship emissions within the airshed while in transit, at anchor, maneuvering, and at berth loading cargo or passengers (see map in section 2.2).

In 2019, over 2,200 vessels made almost 5,200 combined calls to participating ports.

Current Context

- The IMO and the flag states in which vessels are registered regulate OGVs based on rules for fuel quality, engine standards, design requirements, and more.
- International and domestic shipping lines own and operate container and cargo vessels, which are hired by cargo owners to transport cargo between ports.
- Cruise lines own and operate cruise vessels. Port of Seattle and Vancouver Fraser Port Authority operate cruise terminals.
- Individual ports of call have limited influence on ship environmental practices and performance.
- Vessels can visit many different ports of call on each voyage and may or may not call at an individual port more than once.

Current State of Technology

- **Reducing emissions:** OGVs require energy-dense fuels for trans-Pacific journeys. In the future, it is likely these fuels will continue to be gaseous or liquid. Lower-emissions fossil fuels with established global infrastructure, such as liquefied natural gas (LNG), may be used while the shipping industry transitions to zero-emissions fuels (e.g., carbon-based synthetic fuels, methanol, ammonia, and hydrogen) that are in development for the longer term. Due to long vessel lifespans, a dual strategy is needed that promotes use of lower-emissions fuels in existing vessels, while also promoting zero-emissions propulsion technologies for new vessels. Fortunately, some renewable or biofuels can be used in existing engines. Drop-in fuels, such as renewable diesel, are operationally feasible today and have been tested by marine carriers; however, supplies are limited and prices can be significantly higher. Some vessels use exhaust gas cleaning systems (EGCS), also referred to as scrubbers, to enable combustion of fuels that would otherwise be non-compliant under IMO rules in order to remove excess sulfur emissions to air.
- **Zero-emissions at berth:** Shore power provides a significant emissions reduction opportunity while vessels are at berth by replacing diesel engine power with electric grid power. An increasing number of cruise and container ships are equipped to connect to shore power. However, other OGV types, such as tanker or bulk cargo ships, are generally not equipped with shore power at this time. Other alternatives are being explored, such as hydrogen-based shore power systems and zero-emissions on-board generation systems, but these have not been demonstrated at scale, nor are they commercially available at this time.

Objectives for OGVs

Continually increase vessel efficiency and decrease emissions from existing vessels.

> Continuous improvement in vessel efficiency is important to minimize impacts associated with traditional marine fuels. For example, incorporating modern wind power into vessel propulsion (e.g., wind foils or rotors) can reduce fuel consumption by up to 10%. Industry-leading vessels are about twice as efficient as industry laggards across major vessel types due to technical efficiency improvements, operational speed practices, and ship size differences.[18] Therefore, it is critical that ports continually promote maximum vessel efficiency while simultaneously promoting a shift to zero-emissions technologies.
>
> Participating ports also need to carefully consider any unintended environmental impacts associated with emissions control equipment or alternative fuels and technology. For example, in some EGCS, wash water is discharged overboard, potentially affecting water quality and harming aquatic organisms.[19] The participating ports will work together to share information and expertise on these issues and engage industry to avoid unintended impacts of emissions reduction strategies and phase out or prohibit undesirable practices as needed.

18 Long-term Potential for Increased Shipping Efficiency Through the Adoption of Industry-Leading Practices, ICCT, 2013

19 Exhaust Gas Scrubber Washwater Effluent, U.S. E.P.A., 2011. As of January 1, 2020, POS has prohibited all EGCS wash water discharges from cruise ships at berth in its Terminal Tariff #5.

By 2030, install shore power at all major cruise and container berths.

Based on the current state of technology, shore power is the only zero-emissions option at berth, though others are in development and may become practical in the future.

To minimize emissions at berth, port authorities have set a goal to install shore power at each major cruise and container berth. This involves substantial investment from the port authorities and typically from other levels of government, as well as coordination with utilities and terminal operators. Ports will also establish programs, tariffs, or special agreements to encourage increased use of shore power once the infrastructure is available. Ports will continue to monitor alternative opportunities to lower emissions at berth for other vessel types (i.e., not cruise or container ships).

Support international efforts toward phasing out emissions from vessels.

Although individual port authorities have no direct influence over the selection of fuels or types of engines developed, port authorities will advocate for international policies that align with the NWPCAS vision, and lead or participate in efforts to coordinate incentives to reduce shipping emissions across multiple port authorities internationally. Ports will facilitate the land-side infrastructure and safety procedures necessary to support alternative marine fuels. As these fuels become available, ports will play an important role in promoting increased use of zero-emissions fuels. Ports will also support and/or participate in pilot studies with shipping lines interested in sending vessels with zero-emissions capabilities to the Pacific Northwest.

Monitoring

Metric	Objective
Percent vessel calls with Tier 3 marine engines, cleaner fuel or other emissions-reduction technologies while underway (e.g., wind or battery assistance)	Continuous Improvement
Percent major cruise and container berths with shore power installed	100% by 2030
Percent of shore-power-capable ships that plug in and percent of total ships that plug in	Continuous Improvement

5.2 CARGO-HANDLING EQUIPMENT (CHE)

Cargo-handling equipment (CHE) moves goods at marine terminals between ships, railcars, and trucks. The types of CHE in use vary by terminal operating model and lines of business. 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 other types of non-road equipment.

Almost 2,400 pieces of CHE operate at participating ports. Three-quarters use diesel, and the remaining use propane, natural gas, or electricity.

Current Context

- Terminal operators, who have lease agreements with port authorities, own or lease almost all CHE.
- U.S. and Canadian federal emissions standards regulate new CHE.
- Port authorities have influence in this sector due to the commercial landlord relationships between terminal operators and port authorities.
- Port of Tacoma operates one terminal and has direct control of this terminal's CHE.

Current State of Technology

- **Reducing emissions:** The current standard for new diesel equipment is Tier 4, which emits substantially less DPM than older diesel equipment (close to a 90% reduction). Hybrid diesel-electric models are commercially available for some types of equipment, and engine start-stop technologies can be retrofitted on existing equipment to reduce idling, save fuel, and reduce emissions. Drop-in biofuels and renewable diesel are increasingly available options for existing equipment to reduce emissions, though currently these fuels may cost more.
- **Zero-emissions technology:** Large cranes are already electric (including some rail-mounted gantry cranes and ship-to-shore cranes), and electric rubber-tire gantry cranes are available in a grid-connected or catenary format using electric cable reels or bus bars, though they are not feasible in all terminal layouts. Battery-electric equipment is commercially available for specific equipment types, such as smaller capacity forklifts, straddle/shuttle carriers, and yard trucks. Both battery-electric and hydrogen fuel cells are being pilot tested for other types of equipment in various locations. Key constraints include sufficient battery capacity to handle very large loads and operate for extended periods, access to and time required for charging or refueling, and total cost of ownership, which is generally much higher than new diesel equivalents at this time; however, this area is quickly developing and demonstrations in challenging port conditions are ongoing.

Objectives for CHE

Continually increase equipment efficiency, replace old equipment, and decrease emissions from existing CHE.

> Where zero emissions CHE is not feasible to adopt in the short term, it is important for participating ports, along with terminal operators, to accelerate efforts to remove old diesel equipment from operation in favor of Tier 4 or hybrid equipment, which use advanced emissions controls, such as diesel particulate filters, exhaust gas recirculation, and selective catalytic reduction to significantly reduce air pollutant emissions. Ports will support replacement of old equipment through updated port programs, negotiating lease requirements, and by helping tenants identify and secure grants and funding for upgrades. Ports will support operational efficiency through promoting best practices in fuel efficiency plans, facilitating peer-to-peer learning on emissions reduction opportunities, and supporting pilot projects, such as installing anti-idling technology.

By 2030, sufficient infrastructure is in place to enable transition to zero-emissions technology.

> To support zero-emissions CHE, port authorities will collaborate with utilities and terminal operators in the near term to identify where electrical distribution network upgrades are needed based on load profiles, existing utility grid capacity, and future energy needs. Ports will also plan for on-terminal upgrades required to support zero-emissions technology and facilitate these upgrades based on tenant needs.
>
> Ports will continue to work with terminal operators to understand feasibility of hydrogen technologies and collaborate on demonstration projects and fueling infrastructure needs. This objective focuses on creating utility or alternative fuel capacity to adopt zero-emissions technology. These investments need to be planned so that

the timing matches the need. The final point of delivery (e.g., the actual charging or fueling stations) will generally be installed at the time new equipment is purchased.

By 2050, zero-emissions cargo-handling equipment is adopted.

To facilitate the commercialization and adoption of zero-emissions technology, port authorities will support demonstration projects, identify funding strategies to help transition all CHE, and engage with industry and labor to identify and support workforce training needs. Ports may also establish lease requirements or fee-based programs that promote a transition to zero-emissions technology, recognizing that some equipment types may not have a feasible zero-emissions option in the near term.

2013 NWPCAS Objective (In Progress)

By 2020, 80% of CHE meets Tier 4 interim emissions standards or equivalent.

In 2019, across all ports, 52% of CHE met this standard, representing a significant shift from 2011 (34%). This existing objective has been met at the Port of Seattle (92%), where equipment at the cruise and grain terminals is mostly propane or electric. However, the objective has not been met at the Northwest Seaport Alliance and Port of Vancouver terminals (50% and 51% respectively), which have heavier and more diverse equipment fleets. Note that all CHE used at Port of Tacoma is captured under NWSA.

Monitoring

Metric	Objective
Percent of CHE that meets Tier 4i emissions standards (in progress)	80% of CHE meets Tier 4i equivalent by 2020
Percent zero-emissions CHE adopted	100% by 2050
Total cost of ownership of zero-emissions CHE relative to diesel CHE	Information only

5.3 TRUCKS

The truck sector includes container and other heavy-duty trucks that move cargo to and from marine terminals and other port facilities. Buses serving cruise ship terminals also make up a small portion of emissions in this sector.

Close to 5,600 container trucks and over 900 other heavy-duty trucks move cargo to and from port facilities. The participating port authorities have more direct relationships with container trucks that serve the ports than other heavy-duty trucks, which may serve much broader markets, and thus more focus is placed on container trucks in this strategy.

Current Context

- U.S. and Canadian federal governments set emissions standards for new heavy-duty diesel engines. Provincial and state governments have purview over regulations pertaining to vehicle sales and roadway management. Washington State is one of 15 states that signed a Memorandum of Understanding led by California to boost electric heavy-duty truck sales with the targets of 30% and 100% ZEV truck sales by 2030 and 2050, respectively.
- Both individual owner-operators and trucking companies own and operate the trucks serving the ports.
- Most of the container trucks serving ports are older, used trucks with a residual value of approximately $50,000. Owner-operator businesses may have limited or no access to capital, making investment in new trucks difficult or impossible; as a result, many trucks used for cargo transport are purchased second or third hand.
- Trucks spend the majority of their time operating off of port terminals on the local road network and most do not serve the ports exclusively.

Current State of Technology

- **Reducing emissions:** The phase-out of old, high-emitting diesel trucks in favor of newer trucks (i.e., engine model year 2007 and newer) will significantly reduce air pollutants. Natural gas-fueled trucks are commercially available alternatives that reduce air pollutants relative to diesel, but they do not substantially reduce GHG emissions unless fueled by renewable natural gas. Renewable diesel could significantly reduce net GHG (e.g., up to 80%) and DPM emissions (e.g., up to 34%) and can be "dropped in" to existing engines, but is not widely available in the region.[20] Efficiency improvements can be achieved through technologies, such as driver training, on-board monitoring, anti-idling technology, hybrid fuel-electric trucks, and scheduling or appointment systems.
- **Zero-emissions trucks:** Battery-electric and hydrogen fuel cell trucks are increasingly available and expected to rapidly improve in the next five to ten years. The Ports of Los Angeles and Long Beach have set a goal to have 100% zero-emissions trucks by 2035, and this is already driving an advancement in these technologies. However, these trucks are extremely expensive compared to new diesel trucks.[21] Battery-electric trucks are progressing quickly and are at an "early commercial launch" stage.[22] Hydrogen fuel cell trucks are in demonstration in port applications in other regions, however, there are substantial barriers that need to be resolved to enable commercialization.

Objectives for Trucks

Continually increase vehicle efficiency and decrease emissions from existing trucks.

> Where zero-emissions trucks are not feasible to adopt in the short term, it is important to increase operational efficiency and accelerate removal of high-emitting diesel trucks. This includes port programs that promote use of newer diesel trucks with advanced emissions controls, discourage idling, penalize unlawful tampering with emissions controls, and reduce emissions and truck congestion, especially in sensitive or affected neighborhoods. To ensure an equitable transition, particularly for owner-operators, port programs will also consider access to capital needed to meet future program requirements.

By 2030, sufficient infrastructure is in place to enable the transition to zero-emission trucks.

> The vast majority of zero-emissions infrastructure will need to be provided off of port land, whether it is charging for electric trucks or fueling for hydrogen trucks. Ports lack sufficient space to support charging/fueling for the entire trucking fleet, and operators will also need this infrastructure when not doing port jobs. Therefore, regional collaboration (i.e., all levels of government, ports, trucking industry) is essential to provide infrastructure

20 Renewable Diesel, Western Washington Clean Cities, accessed November 2020
21 2018 Feasibility Assessment for Drayage Trucks, Tetra Tech/Gladstein, Neandross & Associates for San Pedro Bay Ports, 2019
22 Ibid

to support zero-emissions heavy-duty trucks and meet operational needs. Ports will also work with the trucking industry and near-port communities, where trucks often park or idle between shifts, to plan for zero-emissions infrastructure and fuelling facilities in these areas.

By 2050, zero-emissions trucks are adopted.

To facilitate the adoption of zero-emissions trucks, ports will support demonstration projects, identify funding strategies to help transition the fleet, and engage with industry and labor to identify and support training needs. Ports will also monitor the total cost of ownership of zero-emissions trucks to inform policy and program development.

2013 NWPCAS Objective (In Progress)

By 2017, 100% of trucks meet or surpass U.S. EPA emissions standards for particulate matter for engine model year 2007.

Model year 2007 truck engines are 10 times cleaner than 1994 to 2006 engines for PM emissions. This existing objective aims to replace old container trucks with those that have newer, low-emissions engines or to achieve reductions through retrofits and engine replacements. As of the end of 2019, 98% of trucks at NWSA, and 66% of trucks at Port of Vancouver have met this standard.

Monitoring

Metric	Objective
Percent of container trucks that meet or surpass U.S. EPA standards for model year 2007 for particulate matter (in progress)	100% of container trucks meet or surpass U.S. EPA standards for model year 2007 by 2017
Percent zero-emissions container trucks adopted	100% by 2050
Total cost of ownership of zero-emissions container truck relative to diesel truck	Information only
Percent renewable fuels adopted	Information only

5.4 HARBOR VESSELS

The types of harbor vessels operating at each port vary depending on the port's line of business. While the strategy considers several types of harbor vessels, the primary emissions source in this sector is tug boats that assist ocean-going vessels.[23] There are several types of tugs in operation at the ports, including harbor tugs and ocean tugs. Tugs have a wide variety of assignments, including maneuvering OGVs into and out of berth, escorting ships with certain types of cargo, towing ships or barges, firefighting or other safety responses, and more.

As of 2019, there were 18 tug companies and 126 tugs operating at the participating ports.

Current Context

- Tug companies own and operate tugs that are hired by shipping lines to escort ships in and out of the harbors, or to move barges and goods throughout the region.
- U.S. and Canadian federal governments set emissions standards for marine engines.
- Some tug companies are tenants of the ports.
- At the Port of Vancouver, the port authority collects harbor dues from tug companies that call the port, whereas the U.S. Ports do not collect any dues from tug companies.
- Port of Seattle and Vancouver provide moorage to commercial fishing fleets and recreational vessels at marinas.

Current State of Technology

- **Reducing emissions:** Technology is available now to reduce emissions from tugs by repowering or replacing older engines with new Tier 3 and Tier 4 or hybrid engines. As a transition fuel, LNG and drop-in renewable fuels could reduce local emissions of DPM and NO_x. LNG tugs are currently operating at Port of Vancouver. Many commercial vessels, including tugs, use shore power while at berth.
- **Zero-emissions vessels:** The most promising zero-emissions technologies include battery electric and hydrogen, though these are still in development, have not been demonstrated at scale, and are not yet commercially available. The first fully electric tug is anticipated for delivery in 2021 at the Ports of Auckland, New Zealand.[24] Tugs operating over longer ranges (ocean tugs) face challenges similar to ocean-going vessels and may need to rely on zero-emissions liquid fuels that are currently in development.

Objectives for Harbor Vessels

Continually increase vessel efficiency and decrease emissions from existing vessels.

> Harbor vessels have long lifespans, must be able to operate under intermittent heavy loads, and when on duty, must be ready for immediate deployment. Since zero-emissions options are still being researched, the transition period for harbor vessels is likely to take longer than other equipment. In the short term, port authorities need to accelerate efforts to support engine replacements, adopt hybrid technologies, implement efficient vessel operating practices, and increase use of drop-in renewable fuels. This may include updating port programs to drive use of efficient technologies and conducting outreach about efficient operations.

By 2030, sufficient infrastructure is in place to enable adoption of zero-emissions harbor vessels.

> To support zero-emissions harbor vessels, port authorities will engage with harbor vessel operators to understand infrastructure needs. For example, ensuring sufficient electrical capacity is available to support plug-in hybrid technologies and shore power, facilitating access to renewable fuels, and/or working with engine manufacturers and vessel operators to advance technologies such as hydrogen. Port authorities will engage regional partners to support the planning and installation of necessary infrastructure so that by 2030, infrastructure is not a major impediment to early adoption of zero-emissions vessels. Results of pilot projects for tugs and other harbor vessels over the next few years will provide valuable information to support planning and implementation.

23 Port of Seattle also includes commercial fishing fleets and recreational vessels moored at marinas operated by the port in its port-specific implementation plan.
24 Ports of Auckland Buys World-First Electric Tug, Maritime Executive, 2019

By 2050, zero-emissions harbor vessels are adopted.

Based on the current state of technology, it is not yet known which type of technology or fuel will enable zero-emissions harbor vessels, though promising candidates include battery electric, hydrogen fuel cell, or possibly alternative liquid fuels (e.g., ammonia) for harbor vessels requiring longer ranges.

To facilitate the adoption of zero-emissions harbor vessels, port authorities will support demonstration projects, advocate for government funding for research and development, and engage with industry to identify and support workforce training needs.

Monitoring

Metric	Objective
Percent tugs by tier level	Information only
Percent commercial vessels with hybrid engines or using renewable fuels	Information only
Percent zero-emissions commercial vessels	100% by 2050
Total cost of ownership of zero-emissions tug relative to diesel tug	Information only

5.5 RAIL

The rail sector includes two types of transport—locomotives that move railcars within a rail yard or terminal (switching or yard locomotives, also known as switchers) and locomotives that haul trains to the ports from across North America (line-haul locomotives).

There are an estimated 72 switchers operating at the ports, in addition to line-haul locomotives that come and go.

Current Context

- U.S. and Canadian federal governments set emissions standards for locomotives.
- National rail lines own line-haul locomotives, which are largely operated off of port property and have little to no relationship with port authorities.
- National rail lines also own and operate switchers, and these may move between different regions.
- Port tenants also own and operate some switcher locomotives.

Current State of Technology

- **Reducing emissions:** Existing technologies to improve efficiency include automatic-start-stop technology (to reduce idling), replacement of conventional switchers with multi genset switchers and use of training simulators to reduce training runs. There are also diesel and electric versions of rail car pushers and electric indexers that replace the need for larger switcher locomotives for some activity. Lower-emissions fuels, including drop-in renewable fuels, may provide emissions reduction opportunities in the interim, before zero-emissions technology is commercially available for rail.
- **Zero-emissions rail:** Electric rail is a reality on limited lines in other regions where catenary systems are installed, but it would require massive investment in infrastructure for use on North American line-haul locomotives and may not be feasible for locomotives transiting high mountain passes and challenging geography. Battery electric options are in development but are not yet commercially available. Demonstrations have also been run on hydrogen-powered locomotives, but these have encountered barriers to commercialization.

Objectives for Rail

Continually increase equipment efficiency and replace old high-emitting engines.

Locomotives tend to have very long lifespans and are capital-intensive investments, which is why they are typically the oldest equipment serving the ports. Some locomotives in this region are over 50 years old. Given the state of technology and the extremely high costs of zero-emissions locomotives, it may take decades to replace this equipment. In the short term, it is important for port authorities to continue efforts to promote phase-out of old unregulated and Tier 1 engines from operation on port property, to support practices and technologies that increase efficiency, and to support increased use of lower-emissions fuels (such as drop-in renewable diesel). This will include updating port programs and facilitating use of efficient technologies and practices, particularly in relation to tenant-owned switchers.

For line-haul locomotives, ports will advocate to government and rail companies to continue increasing the stringency of emissions standards for new and re-built engines, adopt policies that support use of hybrid engines as they become available, and conduct more engine repowers or replacements that achieve Tier 3 or higher emissions standards.

By 2030, sufficient infrastructure is in place to enable adoption of zero-emissions on-terminal rail.

For switchers owned or operated by terminal operators, infrastructure planning will be similar to CHE—involving coordination with utilities, fuel providers, and marine terminal operators to understand the technologies, infrastructure needs, impact on grid capacity, and timing. Port authorities will play a key coordination and facilitation role in this planning. For switchers owned by rail companies, this may be more complex because the switchers often rotate in and out of the region.

For line-haul operations, port authorities have very limited involvement. Ports can engage with rail companies to understand emerging fuel and infrastructure needs and support regional efforts to ensure the needed infrastructure is in place over the coming decade.

By 2050, zero-emissions on-terminal rail is adopted.

To facilitate the adoption of zero-emissions switchers, port authorities will support demonstration projects, advocate for government funding for research and development, identify funding strategies to help with the transition, and engage with operators to identify and support training needs.

Port authorities have limited ability to influence the transition of line-haul rail, and federal policies and programs are required to develop a comprehensive energy provision network (e.g., catenary systems, hydrogen fueling.)

2013 NWPCAS Objective (In Progress)

By 2020, 20% of unregulated locomotives are upgraded, relative to 2013.

This objective reports the percentage of unregulated locomotive engines that were present in fleets as of December 31, 2013 (when the 2013 strategy came into effect) that have been replaced with Tier 2 or better engines. Many locomotives in operation have old engines (pre-1973) that are exempt from emissions standards and from requirements to install engine upgrade kits when overhauling engines.

This objective is not on track to be met in 2020. Of the 72 seaport-related switcher locomotives operating at or near the ports, 26 are known to be unregulated, 21 are Tier 0 or Tier 1, and 13 are known to be Tier 2 or better. The remainder are unknown tiers. Two unregulated locomotive engines have been repowered since 2013, both by Tacoma Rail (one in 2015 and one in 2016).

Monitoring

Metric	Objective
Percent of unregulated engines known to be upgraded (in progress)	20% upgraded by 2020, relative to 2013
Percent switcher engines that use renewable fuels	Information only
Percent zero-emissions switcher engines adopted	100% by 2050

5.6 PORT ADMINISTRATION AND TENANT FACILITIES

Port authority administration includes emissions sources that are within the direct operational control of the port authorities, including 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 the buildings and lighting that are operated on land owned by and leased from the port authorities, but operated by tenants.

Port administration and tenant facilities are responsible for approximately 1% of GHG emissions across the participating ports.

Current Context

- Tenant facilities are not directly controlled by the participating ports, however, lease agreements and business relationships with tenants can include conditions relating to maximizing energy efficiency.
- Building codes define the minimum energy efficiency requirements for new and remodeled facilities. In Seattle, these codes require periodic energy audits and energy reporting.
- Washington State law requires public fleets to use 100% electricity or alternative fuel, to the extent practicable.
- In 2020, Washington State enacted a Zero Emissions Vehicle law, which requires vehicle makers to deliver a certain number of zero-emissions vehicles each year.
- In B.C., a province-wide regulation requires that 100% of light-duty vehicle sales be zero-emissions vehicles by 2040.

Current State of Technology: Fleets

- Reducing emissions: Fleet vehicles and equipment may use renewable or low-emissions fuels (renewable natural gas, biodiesel, renewable diesel, or renewable gasoline) and/or hybrid technology where electric versions are not available. Vehicle and fleet right-sizing can be used to improve vehicle and fleet efficiency by choosing the most efficient vehicle for the job and by thoughtfully adjusting vehicle utilization across port fleets.
- Zero-emissions fleets: There are increasingly available options for zero-emissions light-duty vehicle fleets and port-owned cargo handling equipment.

Current State of Technology: Buildings

- Reducing emissions: Efficiency measures include use of electric high-efficiency mechanical systems, advanced building system controls, and LED lighting, and use of renewable natural gas where electric equipment is not feasible.
- Zero-emissions buildings: There are increasingly available and affordable technologies to achieve new net-zero energy buildings. Existing buildings will require significant retrofits, including improvements to control systems, building envelopes, and lighting; the elimination of fossil natural gas for heating and cooking; and in some cases, onsite renewable energy generation.

Objectives for Port Administration and Tenant Facilities

Continually increase efficiency in port authority fleets, facilities, and lighting.

> Port authorities will develop lighting and building retrofit programs to support the ongoing improvement in efficiency in all facilities, and engage with port tenants to provide support for energy efficiency improvements. Port authorities will also demonstrate leadership by adopting hybrid equipment if feasible where zero-emissions options are not feasible in the shorter term.

By 2030, port authority passenger fleets are zero-emissions vehicles or use renewable fuels.

> Zero-emissions battery-electric passenger vehicles are currently commercially available and the number of models is increasing annually. Port authorities will establish internal purchasing policies to require use of zero-emissions passenger vehicles in their fleets, and install electric vehicle charging infrastructure for zero-emissions fleet vehicles. Where electric vehicles are not feasible by 2030, port authorities will use renewable fuels.

By 2050, port authorities have adopted zero-emissions vehicles, equipment, and vessel fleets.

> While participating ports will aim to transition to electric or renewable fuel in passenger vehicles by 2030, heavy-duty vehicles and equipment and port-owned vessels will take more time as zero-emissions technology develops. Port authorities will keep abreast of the technology and demonstrate leadership through early demonstration and adoption of heavy-duty zero-emissions technology in port fleets.

By 2050, zero-emissions buildings and high-efficiency lighting are in place.

> It is already feasible to build zero-emissions new buildings, and port authorities will update policies to ensure these standards are incorporated before construction. A much larger source of emissions to address is existing buildings, which will require extensive retrofits or even replacement to meet a zero-emissions level. A challenge will be planning for the significant investment required to upgrade building energy systems, potentially before they reach end of life.
>
> Port authorities will prepare green building policies, establish port programs or lease requirements to support building and lighting efficiency and retrofits, engage with tenants on efficient building technologies, and demonstrate leadership through projects that improve efficiency and employ zero-emissions technology in port-managed buildings.

Monitoring

Metric	Objective
Absolute GHG emissions from buildings and lighting	Zero by 2050
Percent of light-duty passenger fleet vehicles that are zero emissions or use renewable fuels	100% by 2030
Percent of entire port authority fleet (including all vehicles, equipment, vessels) that are zero emissions	100% by 2050

6. Implementation

Implementation of the 2020 NWPCAS will involve two components:

1. **Cross-port collaboration on implementation**
   The participating ports have identified some specific challenges and opportunities they feel are best addressed as a group through collaborative action. Examples include pooling resources and expertise to improve understanding of clean technologies available for port applications, hosting engagement workshops with industry to raise awareness of the strategy and to explore opportunities for emissions reductions, and sharing methodologies and lessons learned from undertaking parallel emissions inventories.
2. **Port-specific implementation**
   Recognizing each port has a unique operating context, the participating ports will develop implementation plans that are tailored to their business and operations. The implementation plans will include policies, programs, and projects undertaken to advance the 2020 NWPCAS in a particular port, for example, specific environmental requirements for container trucks or ship incentive programs.

The following section outlines some of the opportunities for port collaboration, highlights topics that will benefit from action in the near-term, and discusses an approach for port-specific plans.

6.1 Cross-Port Collaborative Action

Successful implementation of the 2020 NWPCAS will benefit from active collaboration between the participating ports, for example, to pool resources and expertise and to amplify engagement and advocacy with industry and government.

The following is an overview of areas identified for cross-port collaboration that will be pursued in the near term and that are expected to be completed by 2025. Medium and longer-term collaborative actions will be developed as strategy implementation progresses.

Technology and Investment Studies

In the near term, the participating ports will work together to improve understanding of the commercial availability and cost of zero-emissions technology applicable to ports, such as battery-electric cargo-handling equipment or container trucks. This information will enable the participating ports to develop an estimate of the cost and investment needed to transition to these technologies.

Participating ports can use this information to engage with government and industry, including, for example, hosting workshops for terminal operators across all ports to learn about zero-emissions technologies and explore barriers to adoption. In addition, the information generated from these studies will be useful in engaging government to advocate for the regulation and policy needed to support adoption of these technologies and to plan the supporting infrastructure needed, all while enhancing competitiveness of the ports.

Infrastructure Studies and Planning

The information generated in the technology studies will be helpful in understanding future power demand for the electricity grid and the improvements likely needed to enable broad adoption of battery-electric technologies and fast-charging facilities. Although each port will undertake separate infrastructure studies, the participating ports will share methods and lessons from these studies with each other. Furthermore, the use of other alternative fuels, such as hydrogen or bio-LNG, will require development of new infrastructure and safety and operational protocols that will benefit from collaboration among port authorities. In these instances, the ports will work together to improve understanding of infrastructure solutions and best practices in safety and operational practices.

Other Areas for Cross-Port Collaborative Action

In addition to the opportunities described above, the participating ports remain committed to exploring ways to work together to advance the 2020 NWPCAS vision, including:

- Advocating for public and private investment in the transition to zero emissions.
- Engaging industry to identify leaders willing to work with ports to advance the strategy.
- Facilitating engagement between government and industry on decarbonizing ports and shipping.
- Facilitating demonstration and pilot projects of low- and zero-emissions technologies.
- Undertaking or supporting air quality studies and preparing comprehensive emissions inventories to improve understanding of port-related emissions and their impact on local air quality.
- Engaging near-port communities and non-profit sector to advance the strategy.

6.2 Port-Specific Implementation Plans

In addition to committing to the above collaborative action, each participating port will develop and maintain a port-specific implementation plan for the 2020 NWPCAS. After collaborating on the NWPCAS for over a decade, the participating ports recognize the value of setting shared objectives while also maintaining flexibility in how objectives will be met at each port where emissions profiles and operations differ. Port-specific implementation plans will enable ports to identify, prioritize and focus resources on actions in a way that is strategic and relevant to their lines of business, policy contexts, and the regions where they operate.

Implementation plans will demonstrate how each participating port plans to advance the 2020 NWPCAS vision and objectives, with a focus on near-term actions. Initial port-specific implementation plans will be published in the first year of implementation (2021), and will be updated on an ongoing basis.

7. Monitoring and Reporting

7.1 Adaptive Management Framework

Participating ports will take an adaptive management approach to monitoring and reviewing the 2020 NWPCAS. Technology, policy, and funding opportunities are expected to change and advance over the next decade. This adaptive approach will allow participating ports to incorporate changes into implementation in the near term, as well as consider the implications of the changing landscape into the 2050 objectives and vision over time.

Ports will employ the following approach for the review and update of NWPCAS elements:

Together as Participating Ports

- Annual review of collaborative actions – Review progress on each action, identify lessons learned, and update actions as needed.
- Annual monitoring of key metrics – Monitor key metrics, and identify areas that are on track or areas that may be falling behind and require further action.
- Strategy review and update – Review NWPCAS vision, objectives, metrics, and all key aspects of the NWPCAS a minimum of every five years.

Each Port

- Annual review of implementation efforts – Review progress on each action, identify lessons learned, and update each action plan as needed. Ports may also identify relevant port-specific metrics to review and report annually.

7.2 Annual Reporting

As a core element of this collaborative strategy, participating ports commit to publicly reporting progress toward the 2020 NWPCAS vision and objectives on an annual basis, beginning in 2022 (following the first year of implementation). Participating ports will provide clear, transparent, and timely updates on progress. Annual reporting will serve to communicate the findings of the reviews outlined in the previous section, and will consist of:

- Annual report on collaborative actions and key metrics.
- Individual port updates on port-specific implementation plans.

Table 4 on the following page provides a summary of the potential metrics identified through the strategy development process that will be refined during the first year of strategy implementation in preparation for the first annual report. To ensure metrics remain relevant, they will continually be reviewed and updated through the adaptive management process.

Table 4. Summary of potential metrics for annual reporting.

Sector	Metrics	Targets / Objectives
Overall emissions ^	Absolute emissions (GHG, black carbon, $PM_{2.5}$, SO_x, NO_x, VOC, CO)	Vision: phase out to zero emissions for all GHG and air pollutants by 2050
	Percent change in GHG emissions relative to 2005/2007/2010	Port, federal and state/provincial GHG targets 2030, 2050
Efficiency ^	GHG emissions per metric ton of cargo moved	Continuous improvement
	Impact of supply-chain efficiency programs on emissions, as available	Information only
Infrastructure	Percent of terminals with sufficient infrastructure in place to support uptake of zero-emission CHE, trucks, rail, harbor vessels	100% by 2030
	Total investments in zero emission infrastructure	Information only
OGV	Percent vessel calls with Tier 3 marine engines, cleaner fuel, or other emission-reduction technologies while underway	Continuous improvement
	Percent major cruise and container berths with shore power installed	100% by 2030
	Percent shore-power-capable ships that plug in and % of total ships that plug in	Continuous improvement
CHE	Percent CHE that meets Tier 4 emission standards	80% of CHE meets Tier 4i equivalent by 2020*
	Percent zero-emissions CHE adopted	100% by 2050
	Total cost of ownership of zero-emissions CHE relative to diesel CHE	Information only
Trucks	Percent container trucks that meet or surpass U.S. EPA standards for model year 2007 for particulate matter	100% of container trucks meet or surpass U.S. EPA standards for model year 2007 by 2017*
	Percent zero-emissions container trucks adopted	100% by 2050
	Total cost of ownership of zero-emissions container truck relative to diesel truck	Information only
Harbor	Percent tugs by tier level	Information only
	Percent commercial vessels with hybrid engines or using renewable fuels	Information only
	Percent zero-emissions commercial vessels	100% by 2050
	Total cost of ownership of zero-emissions tug relative to diesel tug	Information only
Rail	Percent unregulated engines known to be upgraded	20% are upgraded by 2020, relative to 2013*
	Percent switcher engines that use renewable fuels	Information only
	Percent zero-emissions switcher engines adopted	100% by 2050
Administration and tenant facilities	Absolute GHG emissions from building and lighting energy use	Zero by 2050
	Percent light-duty passenger vehicles that are zero emissions or use renewable fuels	100% by 2030
	Percent entire port authority fleet (including all vehicles, equipment, vessels) that are zero emissions	100% by 2050

^ Overall emission and efficiency metrics will be reported to coincide with port emissions inventories. Currently, emissions inventories are completed every five years, with the next inventory years planned for 2020 (Vancouver), and 2021 (U.S. Ports).

* Existing metrics that have not yet been met from the 2013 NWPCAS and remain relevant. Ports will continue to track progress until they are met.

8. Closing

This 2020 Northwest Ports Clean Air Strategy builds upon past successes and strong partnerships forged over the last decade of collaborative action among the participating ports. It seeks to reduce contributions to local air pollution and global climate change while sustaining and improving their economic vitality and competitiveness. It puts forward a bold vision for the future—a future that eliminates harmful emissions of local air pollutants, greenhouse gases, and black carbon by mid-century, maintains clean, healthy air for local and regional communities, and limits global temperature rise to 1.5°C.

Ports cannot succeed in this vision alone. The NWPCAS was developed through engagement with numerous organizations representing many facets of the port network. The participating ports look forward to continuing to collaborate with industry, governments, non-profits, communities, and other ports and partners to implement this strategy and advance toward a zero-emissions future.

Appendix A: Participants in strategy development engagement

Joint NWSA, POS, POT and VFPA engagement included:

- U.S. Environmental Protection Agency
- State of Washington, Ecology
- Puget Sound Clean Air Agency
- Environment and Climate Change Canada
- Government of B.C.
- Metro Vancouver

NWSA, POS and POT engagement included:

- 350 Seattle
- American Lung Association
- American Waterways Operators
- BNSF Railway
- Citizens for a Healthy Bay
- City of Tacoma
- City of Seattle
- Clean Energy Fuels
- Climate Solutions
- ColumbiaH2
- Cruise Lines International Association-Northwest and Canada (CLIA-NWC)
- Duwamish River Cleanup Coalition
- ECOSS
- Environmental Defence Fund / Friends of San Juans
- Front and Centered
- Harbor Trucking Association
- Husky Terminal/International Transportation Services
- International Longshore & Warehouse Union (ILWU)
- International Transportation Service, Inc.
- Pacific Coast Terminals / Everport
- Pacific Merchant Shipping Association
- Port of Seattle Community Action Team
- Portland Container
- Puget Sound Clean Air Agency
- RoadOne
- Seattle City Light
- Shippers Transport Express
- SSA Marine
- State of Washington, Ecology and Transportation
- Tacoma Public Utilities
- U.S. Environmental Protection Agency
- Washington Maritime Blue
- Washington Trucking Association
- Washington United Terminal

VFPA engagement included:

- All Boat Survey
- BC Chamber of Shipping
- BC Hydro
- BC Marine Terminal Operators Association
- BC Maritime Employers Association
- BC Trucking Association
- Chamber of Marine Commerce
- City of Vancouver
- CN
- CP Rail
- Coast Mountain Bus Company
- Council of Marine Carriers
- Cruise Lines International Association-Northwest and Canada
- DNV-GL
- Environment and Climate Change Canada
- FortisBC
- GCT
- Government of B.C., Ministry of Environment and Climate Change Strategy, Ministry of Transportation and Infrastructure, BC Ministry of Energy, Mines and Petroleum Resources
- Interfor
- International Chamber of Shipping
- International Ship Owners Alliance of Canada
- J.S. McMillan Fisheries
- Maersk
- Mainland Sand and Gravel
- Metro Vancouver
- Parkland
- Pembina
- Railway Association of Canada
- Richardson International Ltd.
- Saam Towage
- Seaspan
- Shell
- Shipping Federation of Canada
- Southern Railway of BC
- Transport Canada
- Union Pacific
- Vancouver Economic Commission
- Vancouver Coastal Health
- Viterra
- Western Stevedoring

NORTHWEST PORTS CLEAN AIR STRATEGY

PRE-ADOPTION DRAFT