

Ocean-Going Vessel Shore Power

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Photograph courtesy of Everett Herald, Port of Everett, WA

The Team



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CARB Analysis, Washington State Adoption Requirements, Federal Compliance, Port Infrastructure, Emission Reductions, Port Competitiveness



Vessel Traffic & Shipping Costs



Labor & Shipping Cost



Washington State Adoption and Emission Reductions



Utilities and Landside Infrastructure

Agenda

- › Introduction
- › Shore power basics
- › California At Berth Regulation
- › Vessel traffic analysis
- › Emissions analysis
- › Infrastructure and operations cost analysis
- › Competitiveness analysis
- › Questions and discussion



Source: Port of Tacoma

Study Background and Overview



› Phase I

- › Review of CARB At Berth Regulation
- › Analysis of Ocean-going Vessel Traffic to Washington
- › Terminals Potentially Affected
- › Emission Reduction Calculation

› Phase II

- › Shore Power Cost Analysis
- › Port and other Logistical Labor Requirements and Costs
- › Impact on Shipping Industries
- › Impact on Port Competitiveness



Shore Power Basics



What is an Ocean-Going Vessel?



Cruise



Source: Port of Seattle

Roll On/Roll Off (Ro-ro)



Source: DHL

Bulk Carrier



Source: Wikimedia Commons

Container



Source: Creative Commons

Refrigerated Cargo (Reefer)



Source: Creative Commons

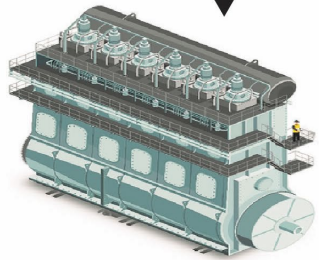
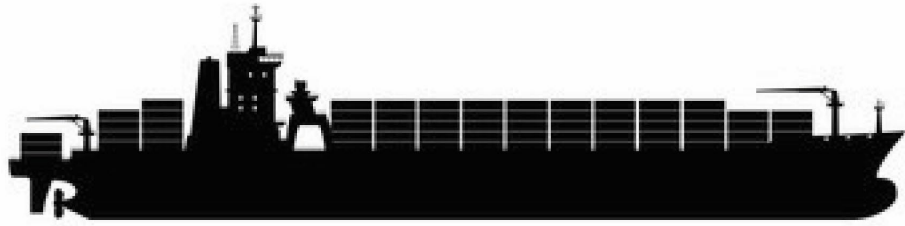
Tanker



Source: Creative Commons

*Not all OGVs are regulated under the At Berth Regulation

How do OGVs Contribute to Emissions at Berth?



Main Engine

Propulsion



Auxiliary Engine

Generate electricity for HVAC, lighting, navigation systems, etc.

At-Berth Emissions

NOx (nitrogen oxides)

PM (particulate matter)

ROGs (reactive organic compounds)

GHGs (greenhouse gases)

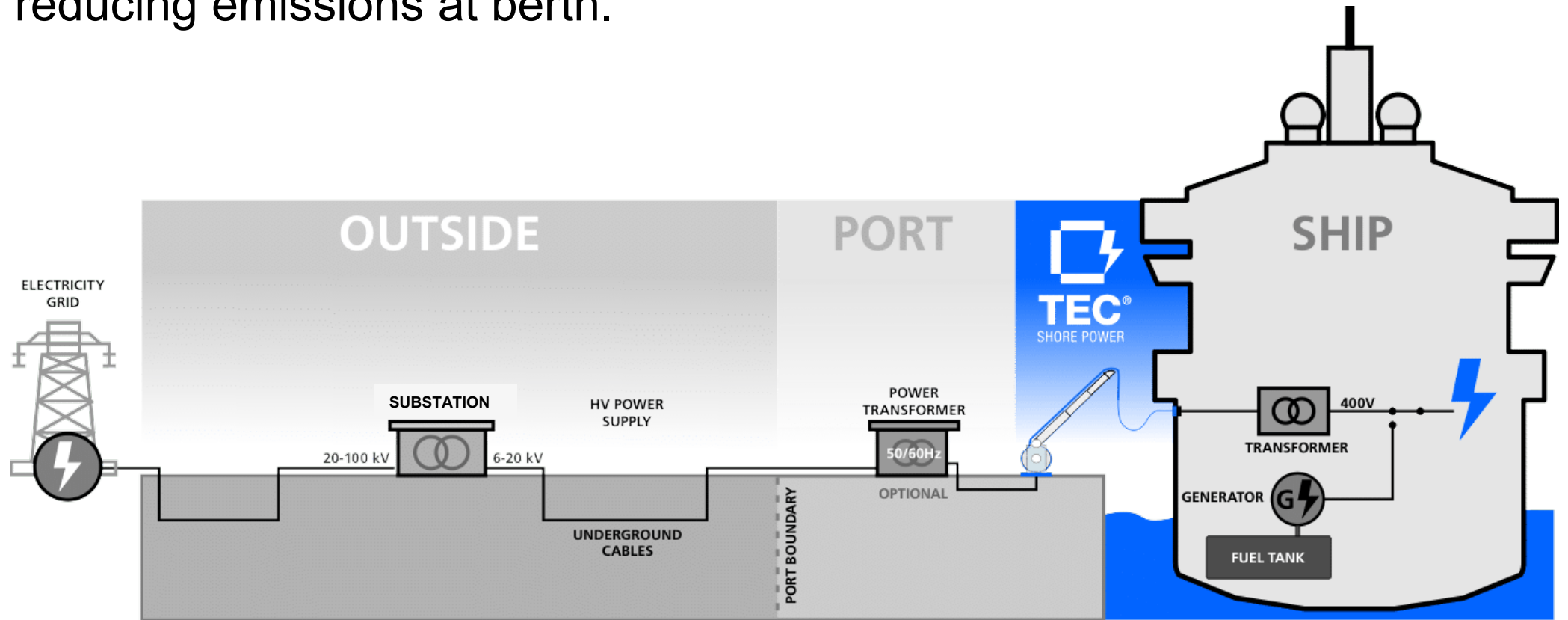
Who is affected?

Port, terminal,
vessel workers

Near-port
communities

What is shore power?

Shore power allows vessels to “plug in” to the landside electrical grid and turn off auxiliary engines, reducing emissions at berth.



California At Berth Regulation



Overview of California At Berth Regulation



The At Berth Regulation requires covered vessels to reduce emissions when berthed at covered terminals.

COVERED VESSELS

OGVs that are 400'+ long, 10K+ gross tons, OR meet engine specs

+

Container
Cruise
Ro-ro
Tanker

WAYS TO COMPLY

CARB-approved Emission Control Strategy (CAECS)

- Shore Power

Remediation Fund

Innovative Concept

COVERED TERMINALS

Terminals receiving 20+ visits per year from covered vessel types.

Visits are counted per vessel type.

Terminals must reduce emissions only for vessel types that meet the 20 visit threshold.

REGULATED ENTITIES

Vessel Operators

Terminal Operators

Ports

CAECS Operators

Phased Implementation in California



Year	2014	2020	2025	2027
Regulation Threshold	Vessels that visited the 6 main CA ports* 25+ or 5+ times/year**		All terminals receiving 20+ regulated vessel calls	
Vessel Types Covered	Containers, cruise, reefers		Containers, cruise, reefers + ro-ro + tankers at LA and LB only	Containers, cruise, reefers, ro-ro + tankers
Required Compliance Level	50%	80%	100%	100%

* 6 main ports were Los Angeles, Long Beach, Oakland, San Diego, San Francisco, Hueneme

** 25+ visit threshold for containers and reefers, 5+ threshold for cruise ships.

Exceptions

VESSEL
TYPES

Military
Government
General cargo
Bulk
Ferries

VISIT
TYPES

Safety and emergency events
“Non-stop” visits
Commissioning visits
Research

VIEs/TIEs

Vehicle Incident Events/Terminal Incident Events

		2023	2024	2025	2026	2027	2028+
TIEs	All Terminals	15%	15%	5%	5%	5%	5%
VIEs	Container/Reefer	5%	5%	5%	5%	5%	5%
	Passenger	5%	5%	5%	5%	5%	5%
	Ro-ro			5%	5%	5%	5%
	LA/LB Tankers			5%	5%	5%	5%
	Other Tankers					5%	5%



Source: DNV

Remediation Fund



Operator or port must show that it cannot comply with emission reduction requirements (e.g., due to needed repairs, construction projects, physical or operational constraints).

Payments calculated per hour of uncontrolled emissions. Rate determined by vessel type.

Fund used to mitigate community impacts of excess emissions.

Typically, fund administrators are local air quality management districts.



Source: Port of Long Beach

Innovative Concept Compliance Option



Operators and ports can propose innovative methods for reducing emissions from sources in and around the regulated port or marine terminal.

Must reduce emission at level equivalent to or greater than what would be achieved through shore power or other CAECS.

Deadline for all applicants was December 1, 2021.

45 day public comment period.

Approval is good for five years.



Source: Powerhouse Rail

Impact on At-Berth Emissions in CA



Emissions Reductions	GHG (Metric Tons CO ₂ E)	NO _x (Tons Per Year)	PM (Tons Per Year)	ROG (Tons Per Year)
2007 Regulation*	180,000	10,000	180	Not Estimated**
2020 Regulation***	34,000	2,000	44	95
Total Reduction	214,000	12,000	224	>95
Statewide Annual OGV At-Berth Emissions by 2027	650,000	2,400	80	120

Source: CARB

* Based on estimated reductions in 2020 at full implementation of the 2007 regulation

** ROG reductions were not required under the 2007 Regulation and are not estimated.

*** Based on calculation of emissions by 2027 from the 2020 Regulation compared to the baseline of emissions from the 2007 Regulation.



Washington Shipping

Washington Shipping Characteristics



CALIFORNIA

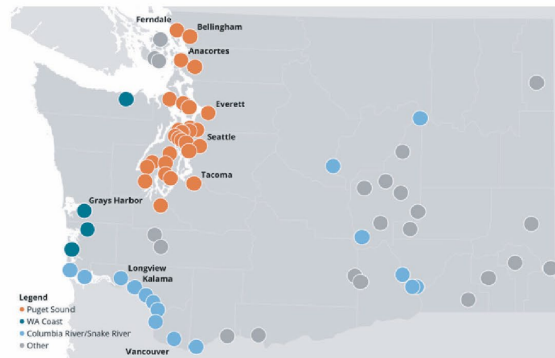


12 public ports + private terminals

Primarily located along the CA coast

Large volumes of container traffic

WASHINGTON



75 public ports + private terminals

Geographically diverse (Puget Sound, WA Coast, Columbia River/Snake River)

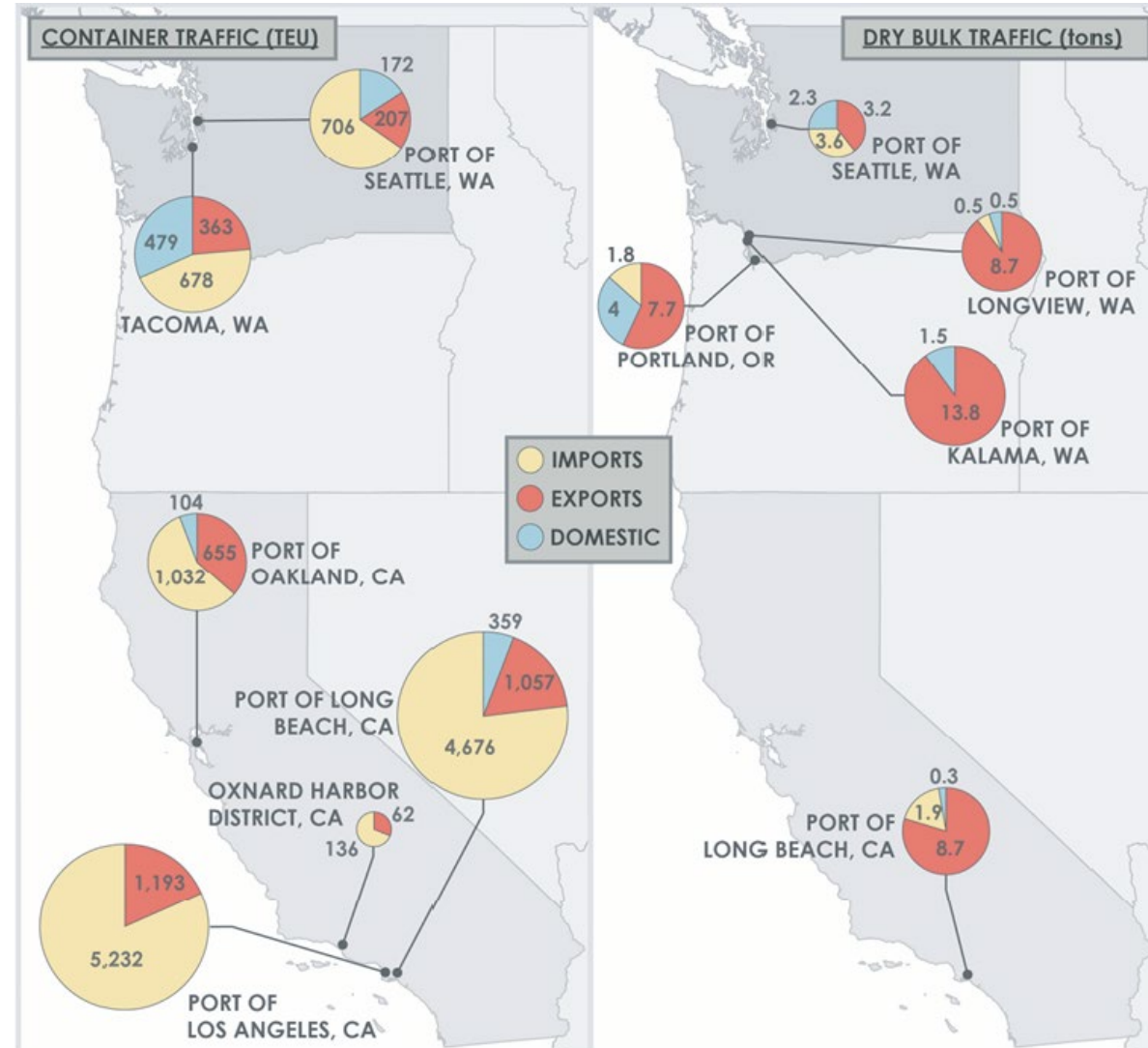
Diverse cargo types

Washington Shipping Characteristics



Excerpt of maps showing top 25 U.S. ports for container and dry bulk traffic, by volume.

- Bulk cargo vessels are not required to reduce emissions under the At Berth Regulation.



Source: U.S. Dept. of Transportation

Analysis and Findings



Vessel Traffic In Washington – Part 1



High Traffic Areas

- › Number of OGV visits inside each region for 2024 was calculated

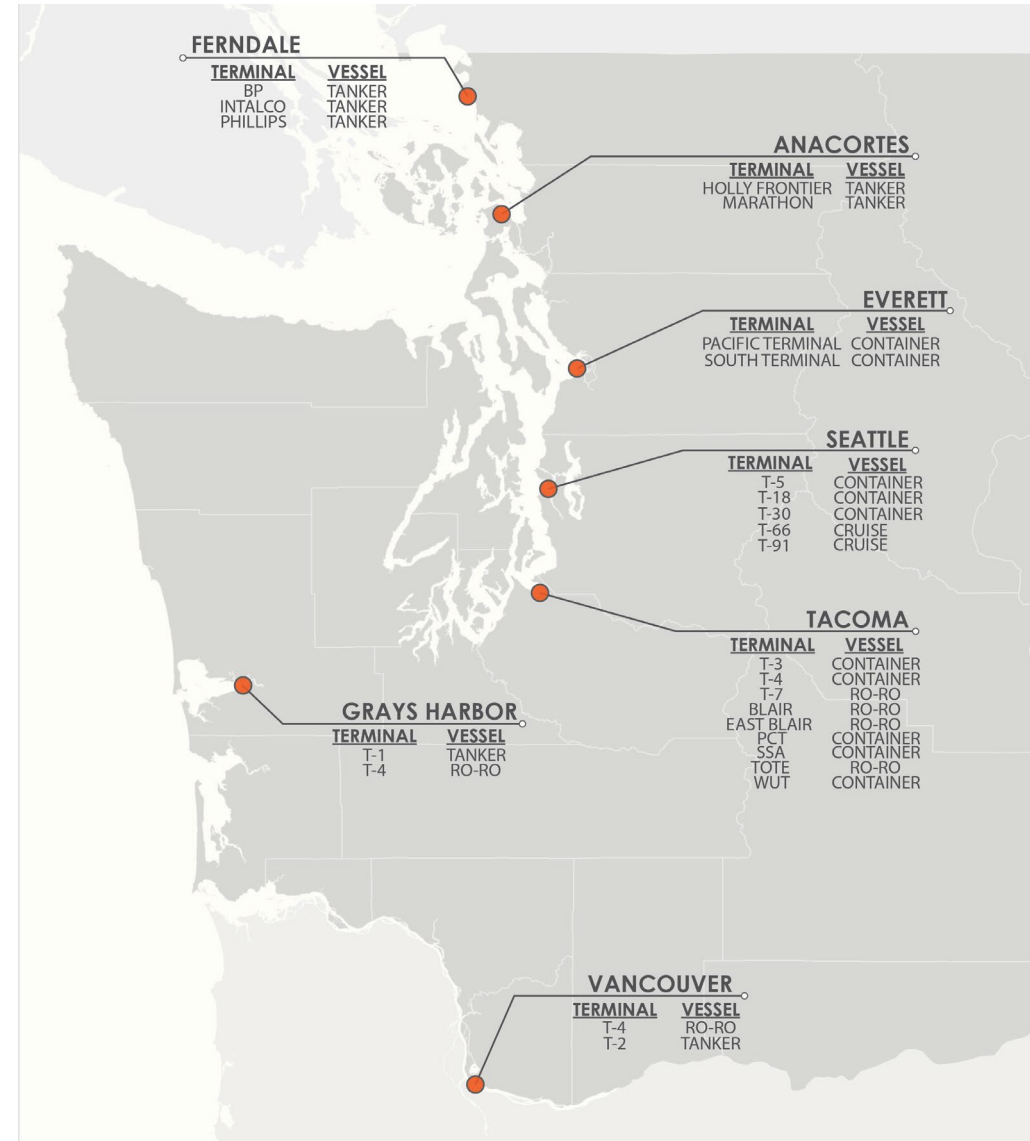
GEOFENCED AREAS WITH 20 OR MORE OGV VISITS IN 2024						
OGV TYPE	<u>Covered Vessels</u>				<u>Not Covered Vessels</u>	
	Container	Cruise	Ro-ro	Tankers	General Cargo	Bulk
GEOFENCED AREA	Everett	Seattle	Grays Harbor	Anacortes	Everett	Grays Harbor
	Seattle Tacoma			Ferndale Grays Harbor Tacoma Vancouver	Kalama Longview Seattle Vancouver	Kalama Longview Seattle Tacoma Vancouver

Vessel Traffic in Washington – Part 2



Potentially Regulated Terminals

- Ports of Seattle, Tacoma, the NWSA, have implemented shore power at some terminals; others are in process (Ports of Everett and Vancouver).





Projected Emissions Reduction

Emulating CA's Phased Approach: Example of Possible Phased Approach for WA

Phase I – Partial Coverage

- › Container & cruise in Seattle & Tacoma
- › Terminals with 20+ calls a year
- › 50% compliance requirements

Phase II – Increased Coverage

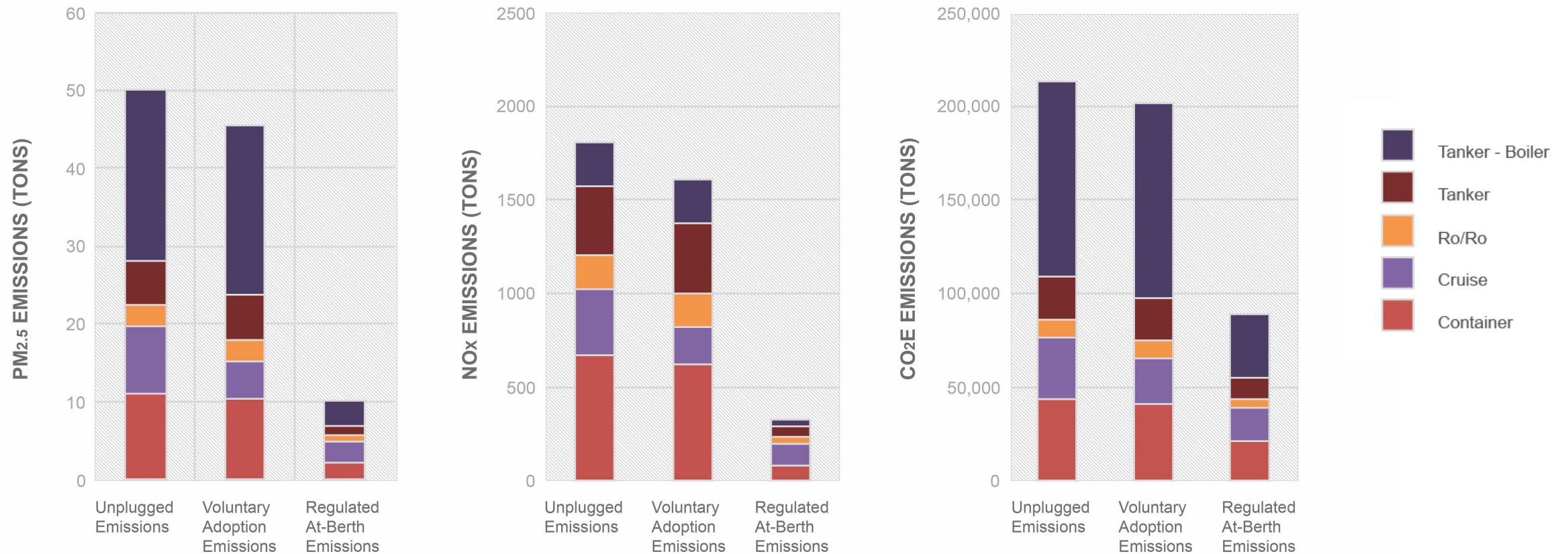
- › Container, cruise, & ro-ro
- › Port of Vancouver is added
- › Terminals with 20+ calls per year
- › 80% compliance requirements

Phase III – Full Coverage

- › Container, cruise, ro-ro, tankers
- › Terminals with 20+ calls per year
- › 100% compliance requirements

	Phase I (Year 5)	Phase II (Year 10)	Phase III (Year 15)
Vessel Type	Container & cruise	Add ro-ro	Add tankers
Threshold	20 visits	20 visits	
Required Plug in Rate	50% of visits	80% of visits	100% of visits
Regions	Seattle & Tacoma	Add Vancouver	All regions

Potential Emission Reduction



Vehicle Equivalent 500,000 vehicles removed from the road

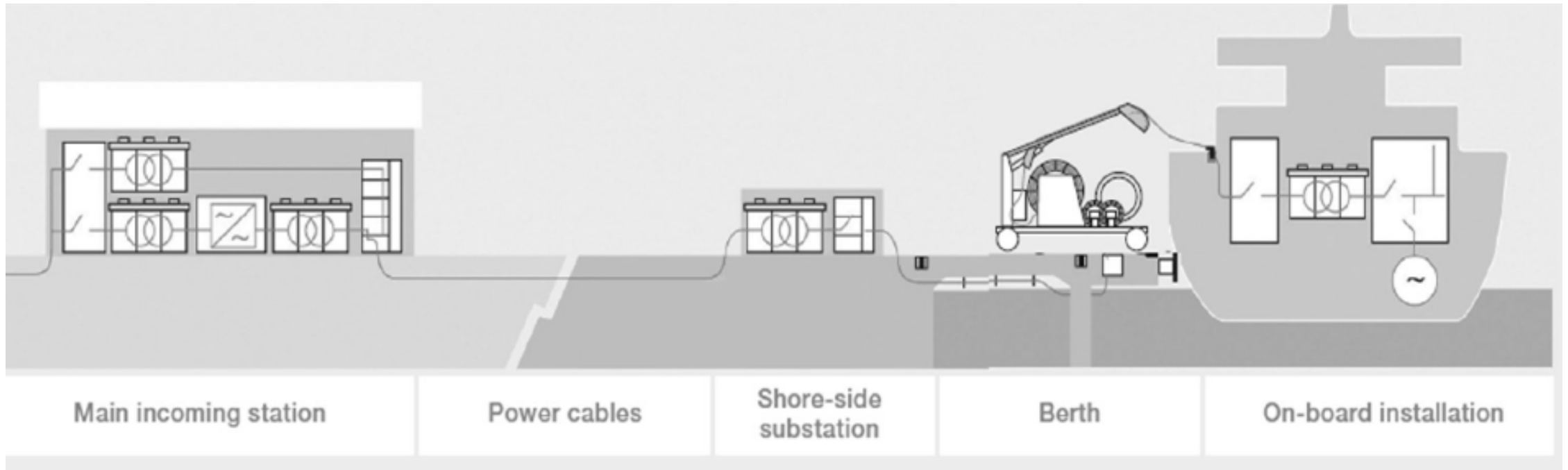
870,000 vehicles removed from the road

27,000 vehicles removed from the road

Cost of Installing Shore Power



Shore Power Components



Shore Power Components



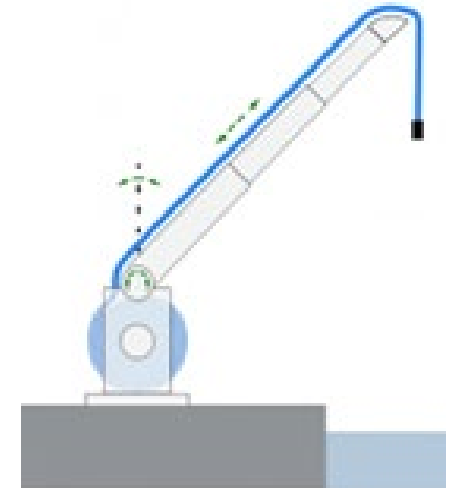
Berth-level Equipment

Underground Vault

Above Ground SPO Houses

Cable Extension System

Cable Management System



Capital Cost Variability



Cherry Point, WA



Shore Power Costs and Financing



Types of Costs

- Capital
 - Landside
 - Shipside
- Operating Costs
 - Staffing
 - Contracting for services
 - Electricity Costs
 - Additional fees incurred under regulation
- Financing



Source: Port of Seattle

Case Study of Shore Power Capital Costs



Costs per Berth, 2025 CA Project	
Component	Costs \$ M
Main Incoming Power Station. Design and installation including area acquisition and utility coordination	\$15.0
Power Cables. From main incoming station through shoreside substation and to the berth, including overhead and underground elements.	\$5.5
Shoreside Substation. electrical building with transformers and switchgear including foundation.	\$6.0
Berth Components. Power receptacles and cable extension system or, if insufficient space, Cable Management System (CMS) with structural platform	\$3.5 - \$5.5
Total Capital Costs	\$30.0 - \$32.0

Examples of Washington Shore Power Capital Costs



Costs of Recent WA Projects			
Shore Power Project: Year Completed Vessel Type/Number of Berths	Total Capital Cost	Fed/State Grants	Net Costs/ Berth
Port of Seattle, Terminal 18: In Planning Phase, Container, 2 Berths	\$45.0 Million	\$30.0 Million	\$7.5 Million
Port of Seattle, Pier 66: 2024 Cruise, 1 Berth	\$44.0 Million	\$5.6 Million	\$38.4 Million
Port of Tacoma, Terminals 3 & 4: 2022, Container, 1 Berth	\$15.5 Million	\$3.1 Million	\$12.4 Million

Analysis of Potential Diversion



This study considered the likelihood that the increased cost of unloading cargo due to shore power implementation could drive shippers to berth at other locations. We are currently working with Ports to refine conclusions.

Our study assumes that all costs would ultimately be put on shippers.

Cruise and tanker diversion is unlikely.

Working with stakeholders to finalize container and ro-ro estimates.



Stakeholder Outreach Findings



Stakeholder Category	Summary of Shared Input
Public ports, private terminals (cruise, container, ro-ro, liquid bulk tankers)	• Some have voluntarily installed shore power for equipped OGVs (and other vessel types). • Preference for voluntary adoption to maintain flexibility in budgeting, negotiation, planning, etc. • Concern over potential loss of unique business lines, such as ro-ro. • Emphasize need for backing from state and coordinated approach.
Refinery facilities (tankers)	• Support decarbonization, concerned about safety and alignment with international regs. • Shore power unavailable or unproven for tankers. Safe, scalable technologies not yet available. Chartered vessel operators reduce control over vessel modifications. • Operation of shore power occurs in high-risk environment, risk compounded by absence of engineering standards and international regulatory guidelines.
Electric utilities	• Utilities facing growing power demands. Upgrading takes years and varies in costs. • State regulations set GHG neutrality and emission reduction goals for utilities. Utilities will need to generate more renewable electricity to meet shore power demands.
Trucking	• Many working towards 2040 carbon neutrality goals. • Want to know how the state will support new OGV At Berth Regulation.
Labor	• Focused on safety and health of workers and surrounding communities. See emissions reduction as an improved working condition. • Safety regulations need to be developed for new technologies.
Environmental/Regulatory	• Emphasize need for emission reductions to support community and statewide health.

Regulatory Resources to Implement



Regulatory team

- Drafting 2007 Regulation and 2020 Amendment
 - Multi-disciplinary: air quality modeling, economic impact analysis, legal review, health and community impact analysis
- Reviewing port and terminal compliance plans, issuing TIE/VIE events, evaluating Innovative Concepts and remediation fund requests
- New technology approvals
- Stakeholder coordination
- Community engagement, preparing public documents

Enforcement team

- Conduct visible emissions inspections in the field
- Enforcement audits of vessel visits
- Take enforcement action for noncompliant visits
- Develop and maintain an auditing database
- Perform desk audits and cross-referencing with marine exchange data to ensure accurate reporting



Questions and Discussion



Thank you