Waves of Change: Studying a Northwest Seaport Alliance-Korea Green Corridor

October 2023

Commissioner Sam Cho

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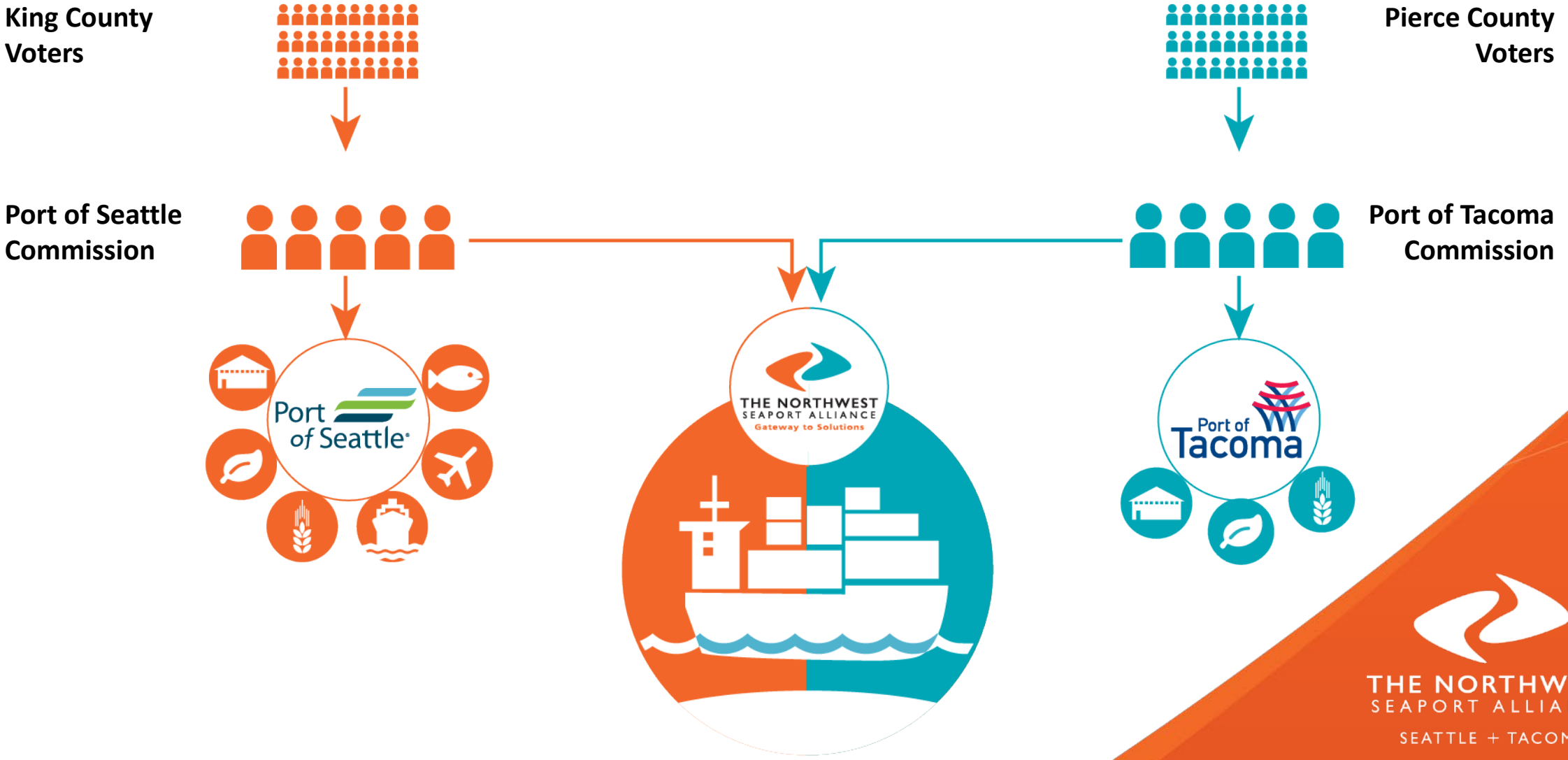
SEATTLE + TACOMA

Port of Seattle

The Northwest Seaport Alliance



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What is a Green Corridor?

A shipping route where zero greenhouse gas solutions are considered, demonstrated and supported.

Green corridors will serve as an essential part of the transition toward zero carbon shipping and reaching our goal of zero maritime emissions by 2050 or earlier

What is a Ports' role in establishing a Green Corridor?

Use port governance structure to:

- Foster collaboration across maritime and fuel sectors
- Partner to establish technological, economic, and regulatory feasibility
- Accelerate implementation of low and ultimately zero GHG emission vessels.

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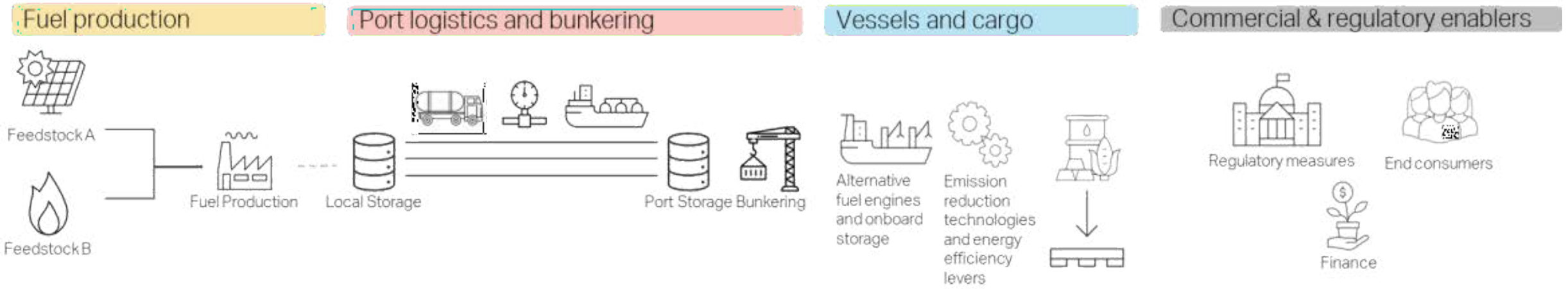
Green Corridors Require Partnership

Green corridors can involve stakeholders from the entire maritime value chain



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Green Corridor Study

Busan Korea + Seattle-Tacoma, US

PARTNERS IN THE STUDY

- Maersk McKinney Moller Center for Decarbonizing Shipping
- United States Government
- Korean Government
- The Northwest Seaport Alliance
- Busan Port Authority
- Others

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Existing Cargo Flows

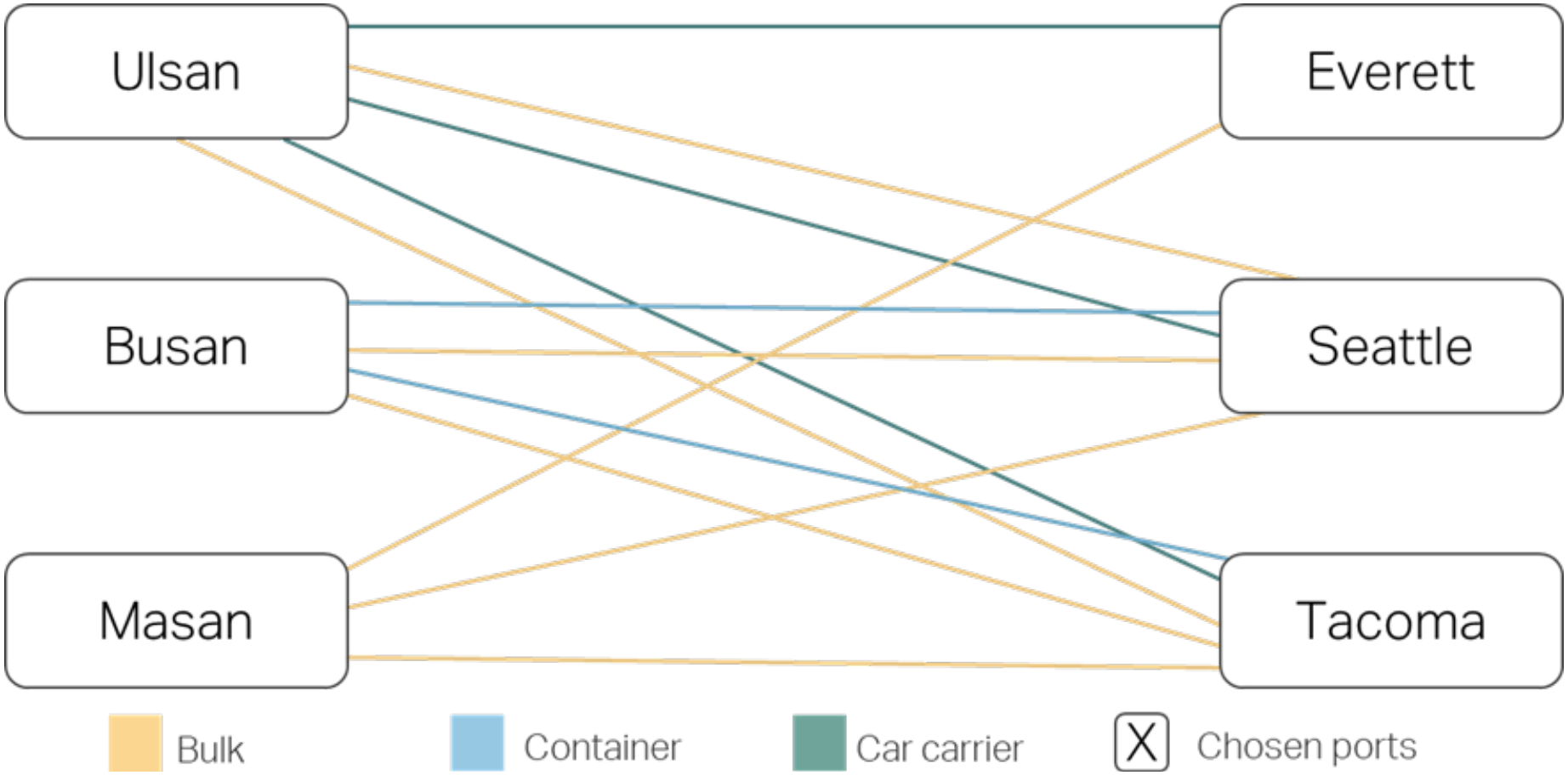
Cargo Volumes between the US & Korea

- US is Korea's #1 export market and #3 importer; Korea is the US's #4 export market and #5 importer.
- 70% of all cargo from Korea is from the three ports included in this study (Busan, Ulsan, NWSA)
- Vessel shipments between the USA and the ROK are expected to grow by 67%–90% (2021 to 2050)
- Over 90% of vessel shipments within the scope are container ships
- Container ships between Seattle and Busan account for 60% of total estimated fuel consumption

Types of Cargo

- Top corridors for each vessel type: Seattle-Busan for the container ships, Tacoma-Busan for bulk carriers, and Tacoma-Ulsan for the RO-RO carriers
- RO-RO carriers tend to use cleaner fuels, indicating that the RO-RO carriers might be more favorable to cleaner alternative fuels.

Exploring Cargo Types and Routes



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Current Estimated Carbon Emissions By Cargo Type

Between Busan Korea + Seattle-Tacoma, US

2021	Ro-Ro	Bulk Carrier	Tanker	General Cargo	Container
Ships (port calls)	52	25	15	12	437
CO_2 Emissions ($tonCO_2$)	90,014	41,501	21,816	17,241	1,888,275

2022	Ro-Ro	Bulk Carrier	Tanker	General Cargo	Container
Ships (port calls)	53	48	5	16	427
CO_2 Emissions ($tonCO_2$)	91,250	80,759	6,747	20,141	1,888,856

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Next Generation Maritime Fuel

Korean Efforts Underway

- Efforts to increase supplies of alternative marine fuels on the rise, especially regarding methanol
- “Green methanol” already being bunkered at Port of Ulsan
- Korea-based ship-builders building green methanol and green ammonia- capable ships for Maersk and others
- Korea based ocean carrier (Hyundai Merchant Marine) recently ordered $1.1B worth of methanol-fueled ships
- Clean Methanol Council recently established to develop national strategy and study feasibility of domestic production.

(Pictured is a Green Methanol Vessel in Odfjell Terminal Korea)

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Next Generation Maritime Fuel

US Efforts Underway

- Alternative fuel production in US/PNW currently limited to biodiesel, renewable diesel, renewable natural gas, and sustainable aviation fuel.
- Several RNG projects planned, but supply committed to local gas grids for commercial and residential heating.
- Little existing production capacity for blue or green ethanol and ammonia; financing/siting/permitting issues in PNW.
- Proposed facility in Alberta (Canada) would significantly increase production of methanol and ammonia nearby.
- PNW Clean Hydrogen Hub will be a game-changer.

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"Port Readiness" Levels Vary

RESEARCH	DEVELOPMENT	DEPLOYMENT
Fuel Relevance Assessed	Vessel Call or Bunkering Approach	Vessel Call or Bunkering System Established on Project Basis
Interest of Port Stakeholders	Vessel Call or Bunkering Framework	Vessel Call or Bunkering System Complete & Qualified
Sufficient Information Gathered	Vessel Call or Bunkering Framework Demonstrated	Vessel Call or Bunkering Service Readily Available

Projected Readiness at Korean ports

Country	Port	Alternative Fuel (Current)									
		LNG		Methanol		Ammonia		Hydrgen		Bio diesel	
		Bunker	Cargo	Bunker	Cargo	Bunker	Cargo	Bunker	Cargo	Bunker	Cargo
ROK	Ulsan	0	9	6	9	3	9	2	4	9	9
	Busan	4	4	3	3	2	2	2	2	9	9
	Masan	7	-	7	-	2	-	2	-	9	9

Country	Port	Alternative Fuel (In 2025)									
		LNG		Methanol		Ammonia		Hydrgen		Bio diesel	
		Bunker	Cargo	Bunker	Cargo	Bunker	Cargo	Bunker	Cargo	Bunker	Cargo
ROK	Ulsan	8	9	9	9	5	9	3	6	9	9
	Busan	7	6	6	5	4	4	4	5	9	9
	Masan	9	-	6	-	6	-	6	-	9	9

Country	Port	Alternative Fuel (In 2030)									
		LNG		Methanol		Ammonia		Hydrgen		Bio diesel	
		Bunker	Cargo	Bunker	Cargo	Bunker	Cargo	Bunker	Cargo	Bunker	Cargo
ROK	Ulsan	9	9	9	9	9	9	5	7	9	9
	Busan	9	7	9	7	9	6	5	6	9	9
	Masan	9	-	9	-	9	-	5	-	9	9

Projected Readiness at US ports

Country	Port	Alternative Fuel (Current)											
		LNG		Methanol		Ammonia		Hydrgen		Renewable FO		Bio Oil	
		Bunker	Cargo	Bunker	Cargo	Bunker	Cargo	Bunker	Cargo	Bunker	Cargo	Bunker	Cargo
USA	Tacoma	8	9	1	1	1	1	1	1	3	3	1	3
	Seattle	2	9	1	1	1	1	1	1	3	3	3	3

Country	Port	Alternative Fuel (in 2025)											
		LNG		Methanol		Ammonia		Hydrgen		Renewable FO		Bio Oil	
		Bunker	Cargo	Bunker	Cargo	Bunker	Cargo	Bunker	Cargo	Bunker	Cargo	Bunker	Cargo
USA	Tacoma	8	9	3	3	3	3	3	3	9	9	5	9
	Seattle	3	9	3	3	3	3	3	3	9	9	5	9

Country	Port	Alternative Fuel (in 2030)											
		LNG		Methanol		Ammonia		Hydrgen		Renewable FO		Bio Oil	
		Bunker	Cargo	Bunker	Cargo	Bunker	Cargo	Bunker	Cargo	Bunker	Cargo	Bunker	Cargo
USA	Tacoma	9	9	6	7	6	7	6	7	9	9	9	9
	Seattle	6	9	6	7	6	7	6	7	9	9	9	9

Country	Port	Alternative Fuel (in 2035)											
		LNG		Methanol		Ammonia		Hydrgen		Renewable FO		Bio Oil	
		Bunker	Cargo	Bunker	Cargo	Bunker	Cargo	Bunker	Cargo	Bunker	Cargo	Bunker	Cargo
USA	Tacoma	9	9	7	9	7	9	7	9	9	9	9	9
	Seattle	7	9	7	9	7	9	7	9	9	9	9	9

Proposed Path Forward

First wave of "Green Corridors

- Container route between the Busan Port Authority and the NWSA operating on green methanol by 2026;
- Container route between the Busan Port Authority and the NWSA operating on green ammonia by 2033; and
- Car carrier route between the Port of Masan and the NWSA, potentially operating on green methanol or ammonia

Organize "Consortium Incubation Workshop"

- Use CIW to engage stakeholders and identify "commercial momentum"
- Finalize list of "first wave" corridors based on CIW

Conduct full feasibility assessment of potential "first wave" corridors

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Green Corridor Timeline

COP28 UAE

Pre-Feasibility Study (12/22-present)

Review, discuss, decide next steps (10/23-12/23)

Feasibility Study on "First Wave" corridors (2024)

Review, discuss, decide next steps (12/24)

Create a "Green Corridor" (2025+)

We are here!

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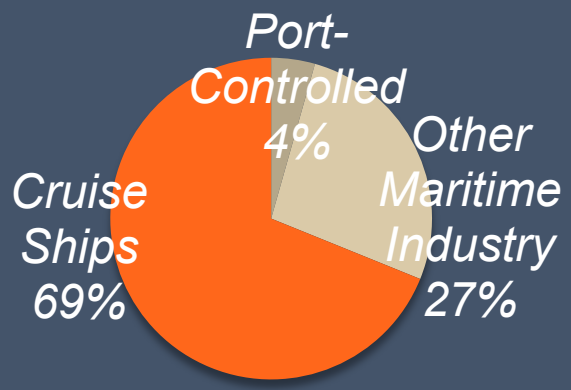
2022 SEASON

289 calls
1.4 million revenue passengers

PORT OF SEATTLE GHG EMISSIONS



↑ BELL STREET CRUISE TERMINAL
Pier 66

← SMITH COVE CRUISE TERMINAL
Terminal 91

The Pacific Northwest to Alaska Green Corridor Project

Port of Seattle
City and Borough of Juneau
Greater Victoria Harbour Authority
Carnival Corporation
NCLH Norwegian Cruise Line Holdings Ltd.
Royal Caribbean Group
Carnival
NCL Norwegian Cruise Line
RoyalCaribbean International
PORT of vancouver | Vancouver Fraser Port Authority
Princess Cruises come back new
Holland America Line Savor the Journey
Oceania Cruises Your World. Your Way.
Celebrity Cruises
Sitka
Haines Borough Alaska
Cunard
Seabourn
Regent Seven Seas Cruises
Silversea
Blue Sky Maritime Coalition
Global Maritime Forum
blue
CLIA Cruise Lines International Association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