



# *Climate Change and Ports: Green House Gas Reduction & Sea Level Rise Vulnerability*

*Prepared for:*

Association of Pacific Ports  
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*Presented by:*

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Port Program Manager



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# Richard Price

- q Professional Engineer—4 states and Guam
- q LEED AP—U.S. Green Building Council
- q ENV SP—Institute for Sustainable Infrastructure
- q CSM—American Public Works Association
- q CISEC—Certified Inspector of Sediment and Erosion Control
- q QISP—California Stormwater Quality Association

*Also a dedicated fisherman, and a disillusioned football fan....*

# EA Engineering Science, and Technology, Inc., PBC

100% employee owned, benefit corporation

550+ employees and 25 commercial offices

- ❖ Pacific Business Unit headquartered in Seattle
- ❖ Seattle office in business since 1988
- ❖ 70+ personnel in Pacific Business Unit

30 years experience at 50+ Ports

Over 560 clients and ~1,740 projects executed in 2020



EA's Extensive Ports and Harbors Experience





# Pacific Operations

- q Established Pacific Offices
  - Ø Alaska—1993
  - Ø Guam—1994
  - Ø Hawaii—1994
  - Ø Fully staffed offices in Hawaii, Alaska, and Guam
  
- q Mobilized to other Pacific Locations—Wake Island, Saipan, American Samoa, Kwajalein, Korea, and Japan.



# Port Infrastructure Planning, Design, Construction





# Sediment Characterization



# Dredged Material Management



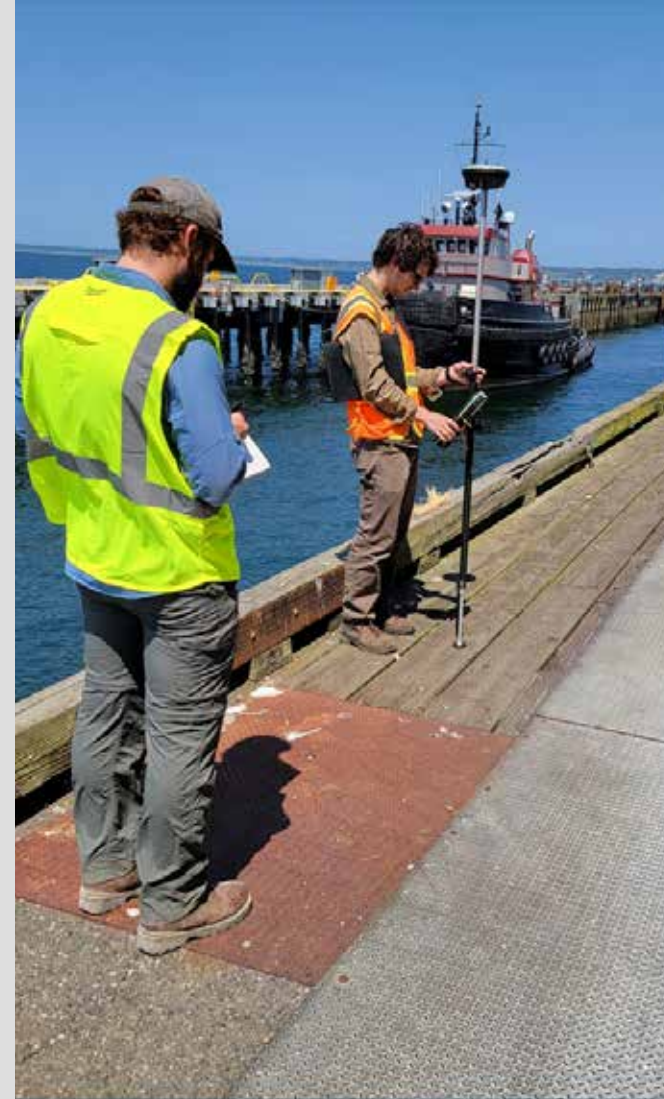
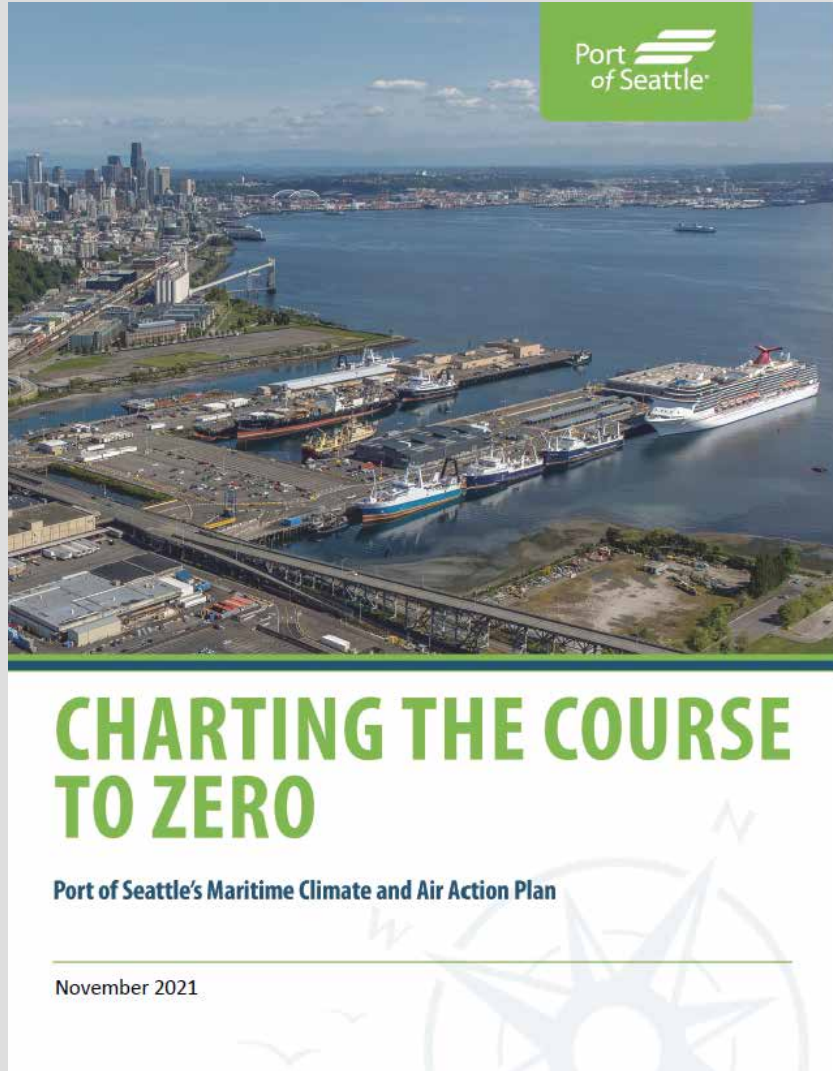


# Contaminated Sediment Studies and Remedial Design





# Climate Services



# Coastal Resilience

## Improving Coastal Environments and Infrastructure

IMPROVING THE QUALITY OF THE ENVIRONMENT IN WHICH WE LIVE, ONE PROJECT AT A TIME®

That is EA's core purpose. In supporting our partners, who are challenged by sea level rise and degraded coastal habitats, we address each project with the goal of improving ecosystems and communities—for the present as well as the future.

## Coastal Resilience Services



Planning



Modeling



Engineering &  
Design



Research



Permit &  
Compliance  
Support



Construction  
Oversight



Grant  
Application  
Support

## Project Types



### Ecosystem Restoration/ Creation/Protection

- Coastal marshes
- Coral reefs and colonies
- Natural and nature-based features
- Anadromous fish passages
- Living shorelines
- Vulnerable shorelines



### Water Resource & Infrastructure Support

- Coastal resilience planning
- Contaminated site assessment and protection
- Engineering support for water resource infrastructure protection
- Algal bloom and red tide evaluations and solutions
- Permitting and NEPA compliance support



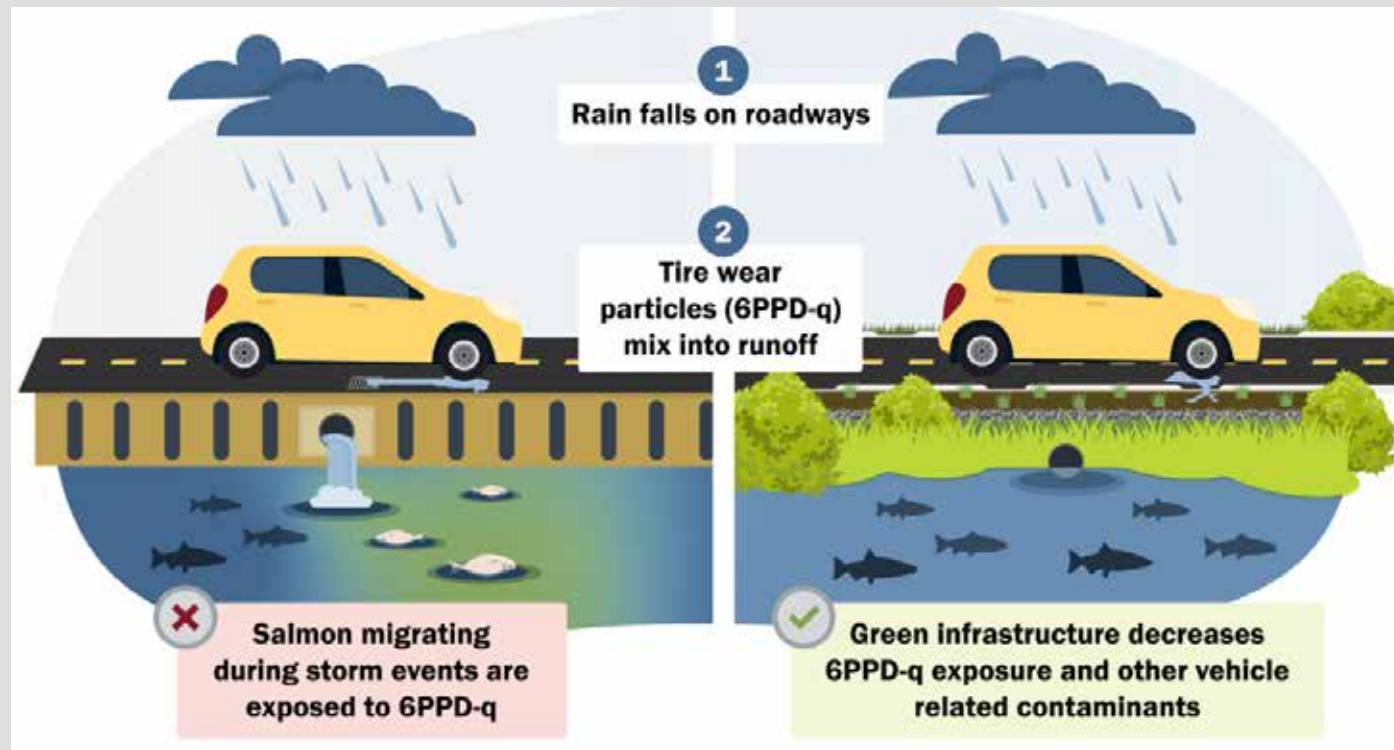
### Metrics & Monitoring

- Biological assessments
- Aquatic species population and foraging assessments
- Physical assessments (waves, currents, and sediment transport)
- Bathymetric surveys
- Sediment sampling



# Emerging Contaminants

- q PFAS
- q 6PPD-Quinone
- q Others



**EA**® EA Engineering, Science, and Technology, Inc., PBC

Chemicals and Contaminants of Emerging Concern

Per- and Polyfluoroalkyl Substances (PFAS)

- Risk Assessment/Communication
- Specialized Analytical Methods/Environmental Forensics
- Conceptual Site Model Development
- High Resolution Site Characterization
- Regulatory Support
- Drinking Water Treatment System Design/Installation/O&M
- Waste Management Solutions
- Fate and Transport Modeling
- Environmental Media Sampling

# Climate Change and Ports

- q Green House Gas Reduction
- q Sea Level Rise Adaptation
- q Coastal Resiliency
- q Take Aways



# Background

*Emissions of GHGs are divided into three types, known as Scopes:*

- q **Scope 1 emissions** are direct emissions from sources owned or controlled by an entity, such as vehicle emissions.
- q **Scope 2 emissions** are from the generation of electricity purchased by an entity, such as emissions from power plants.
- q **Scope 3 emissions** are a consequence of an entity's activities but from sources not owned or controlled by the entity, such as emissions associated with employee travel, emissions from supplier operations, and energy use associated with purchased products and services.

# Background

## Typical Goals

Scope 1 (and 2) emissions, which are direct greenhouse gas emissions from Port owned or controlled sources, shall be:

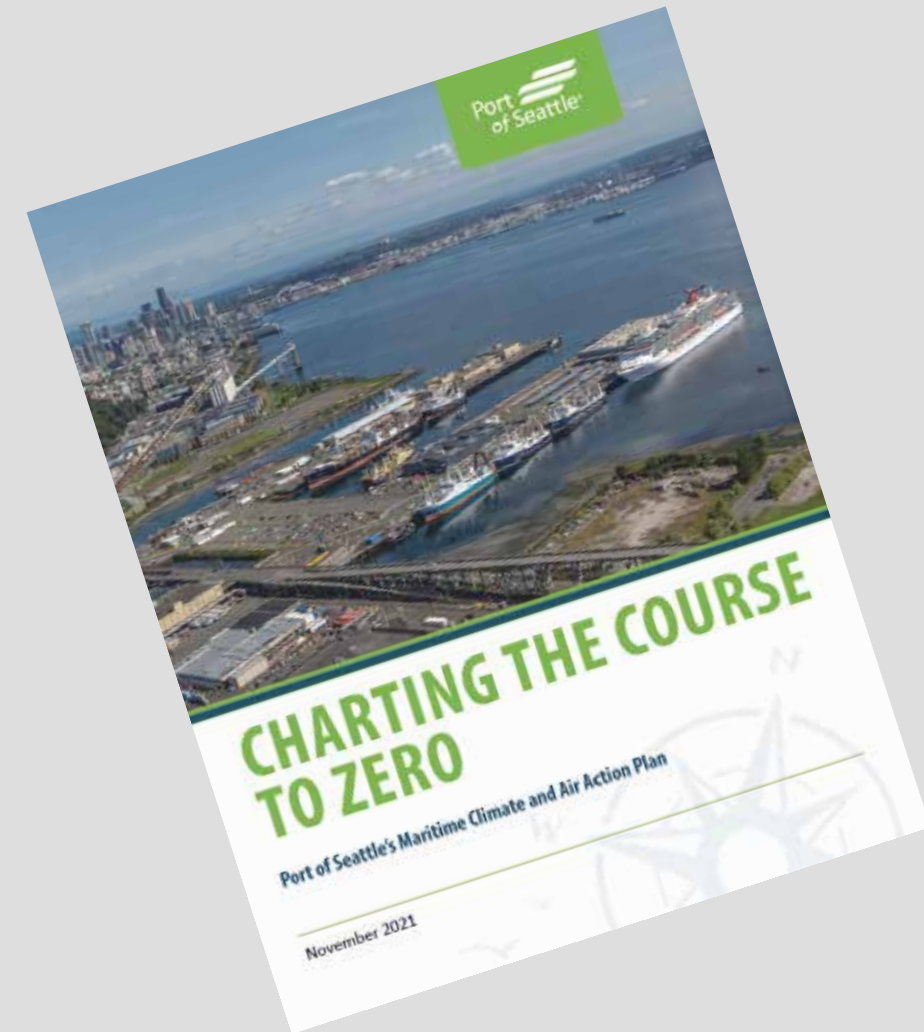
- q *15 percent below 2005 levels by 2020,*
- q *50 percent below 2005 levels by 2030, and*
- q *Carbon neutral or carbon negative by 2050.*

Scope 3 emissions, which are emissions the Port has influence over, not direct control, shall be:

- q *50 percent below 2007 levels by 2030, and*
- q *80 percent below 2007 levels by 2050.*



# Background

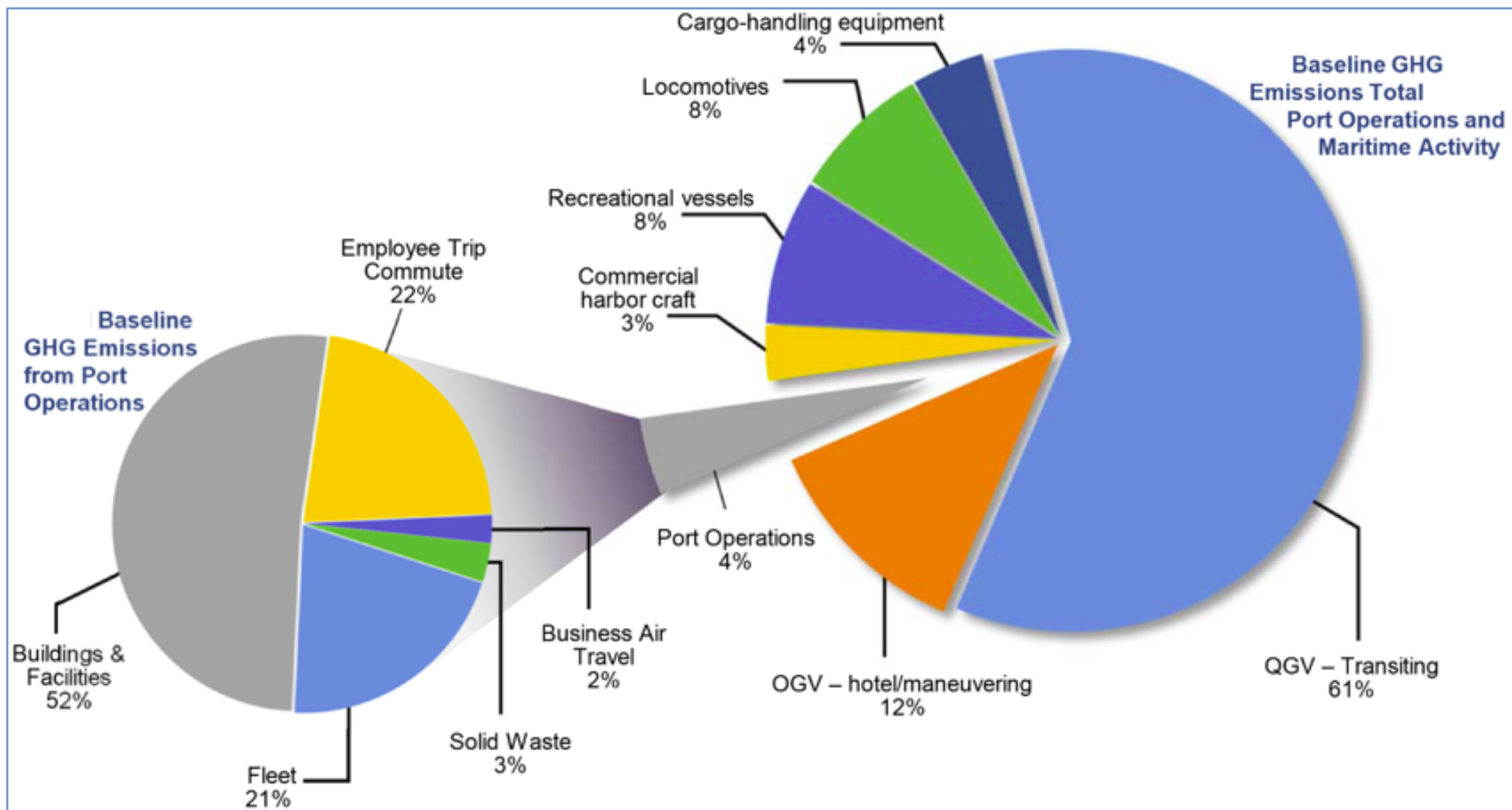


# Control, Guide, Influence

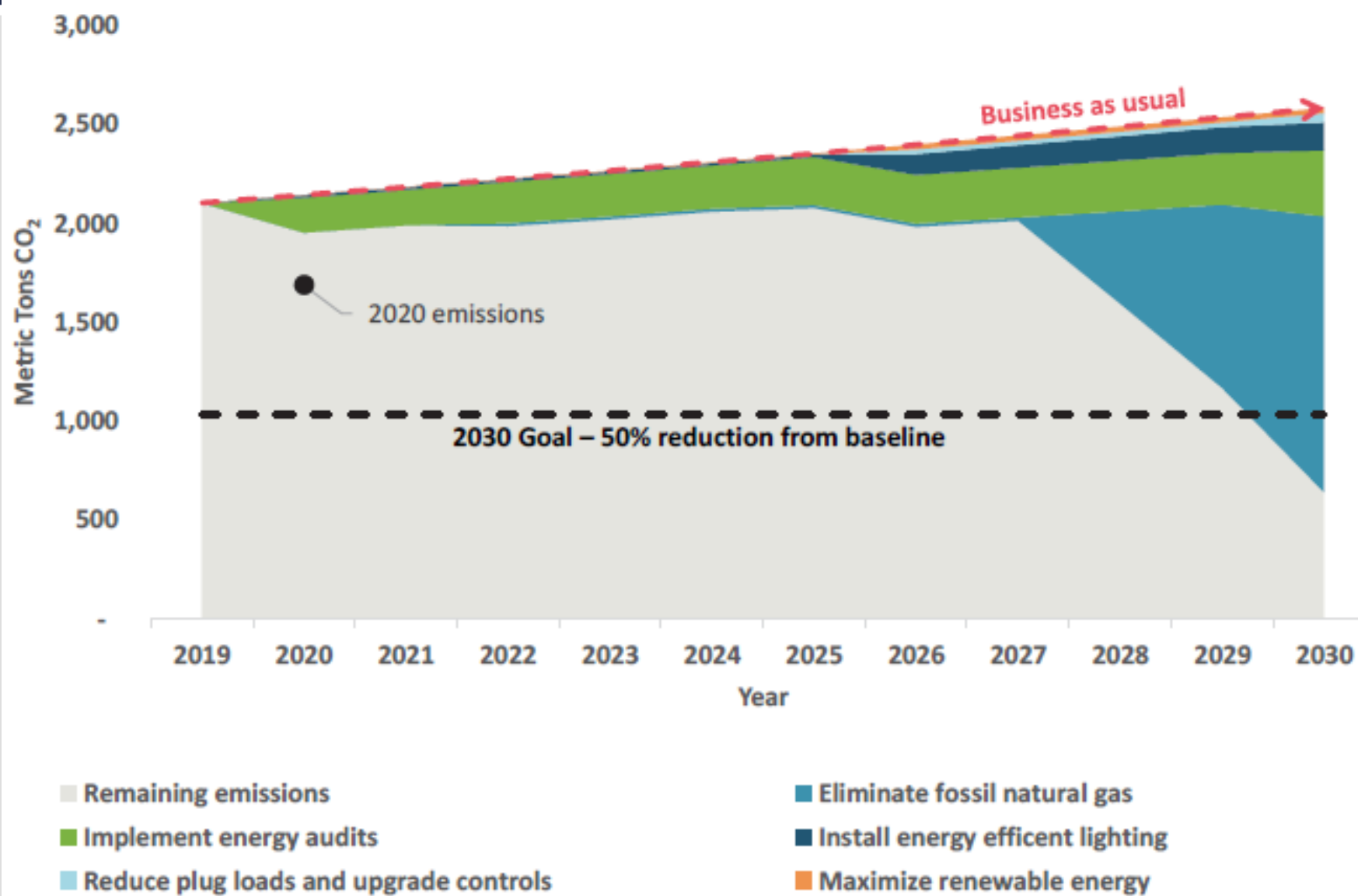
	Scope	Category: PORT OPERATIONS	Category: MARITIME ACTIVITY	Goal Area
		Sector	Sector	
CONTROL	1	Port fleet		Transportation
	1	Staff personal vehicle use		Transportation
	1	Port facility/building natural gas		Facilities
	2	Port facility/building electricity		Facilities
	2	Port facility/building steam		Facilities
	3	Staff business air travel		Transportation
GUIDE	3	Solid waste – Port occupied sites		Solid Waste
	3	Tenant facility/building electricity		Facilities
INFLUENCE	3	Employee trip commute		Transportation
	3	Solid waste – parks, marinas		Solid Waste
	3		Ocean-going vessels	Transportation
	3		Harbor craft - assist tug and fishing vessels	Transportation
	3		Recreational vessels	Transportation
	3		Locomotives	Transportation
	3		Cargo-handling equipment	Transportation



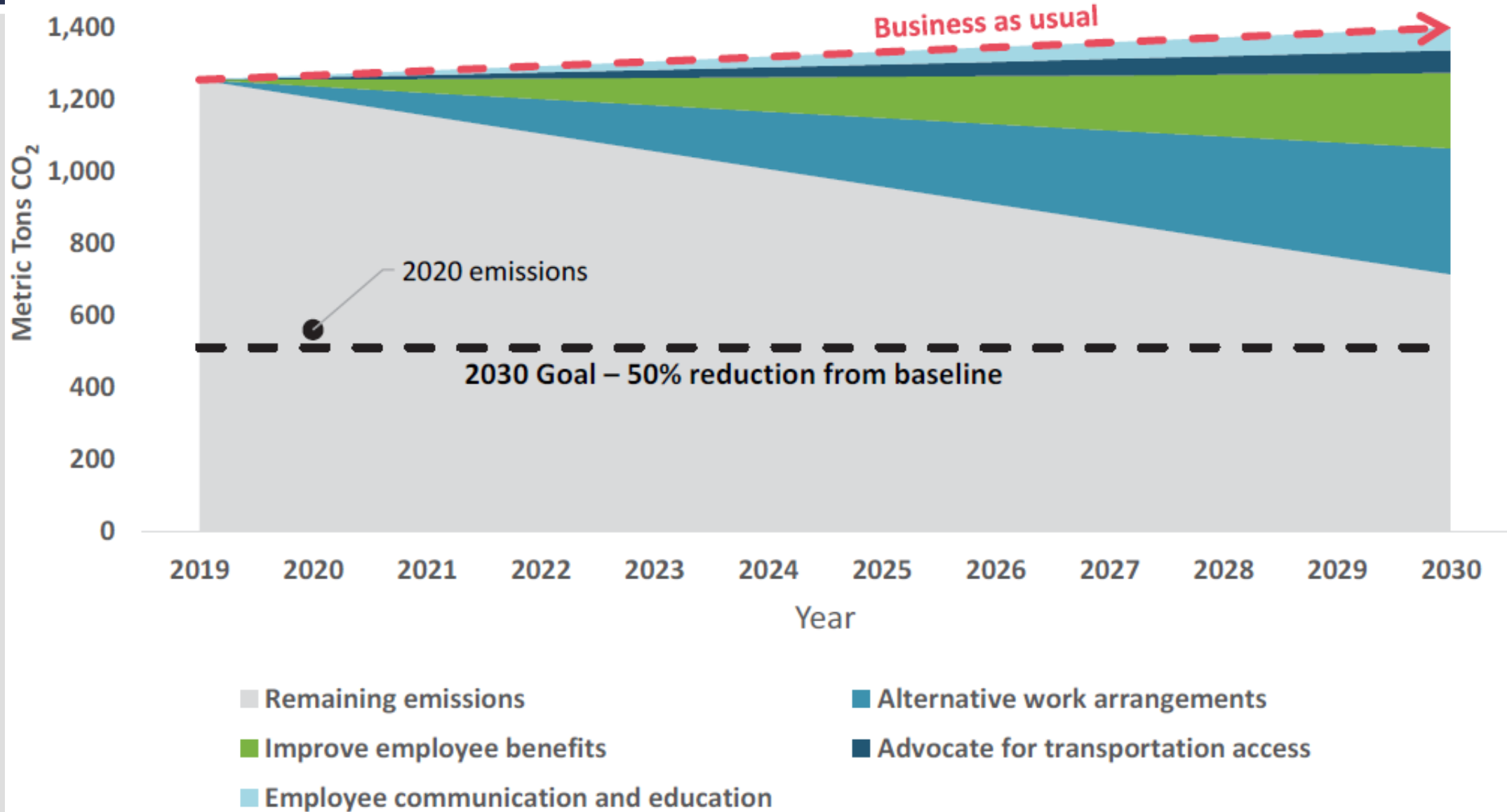
# Case Study



# Case Study—Building and Campus Energy

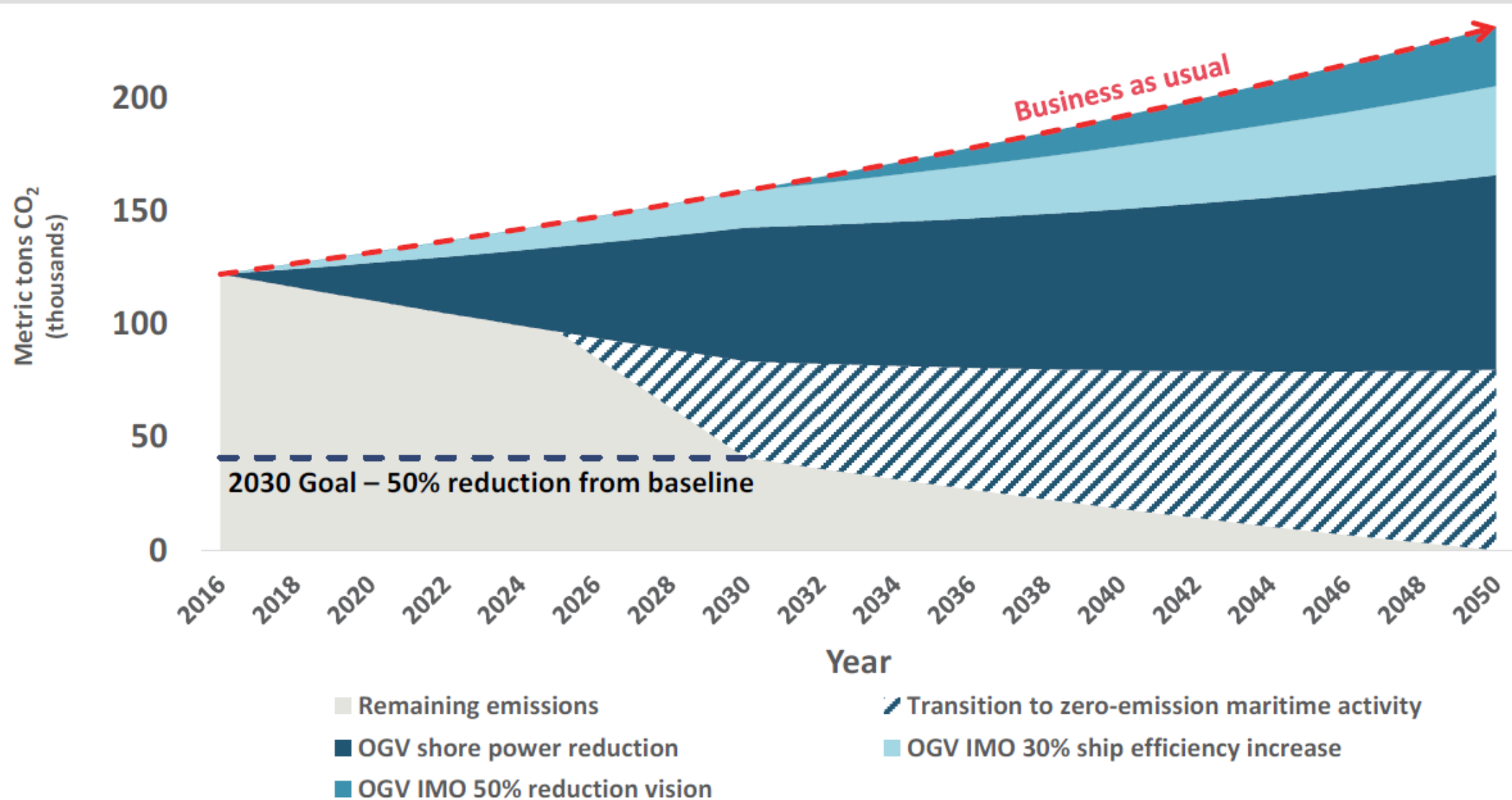


# Case Study—Employee Commute



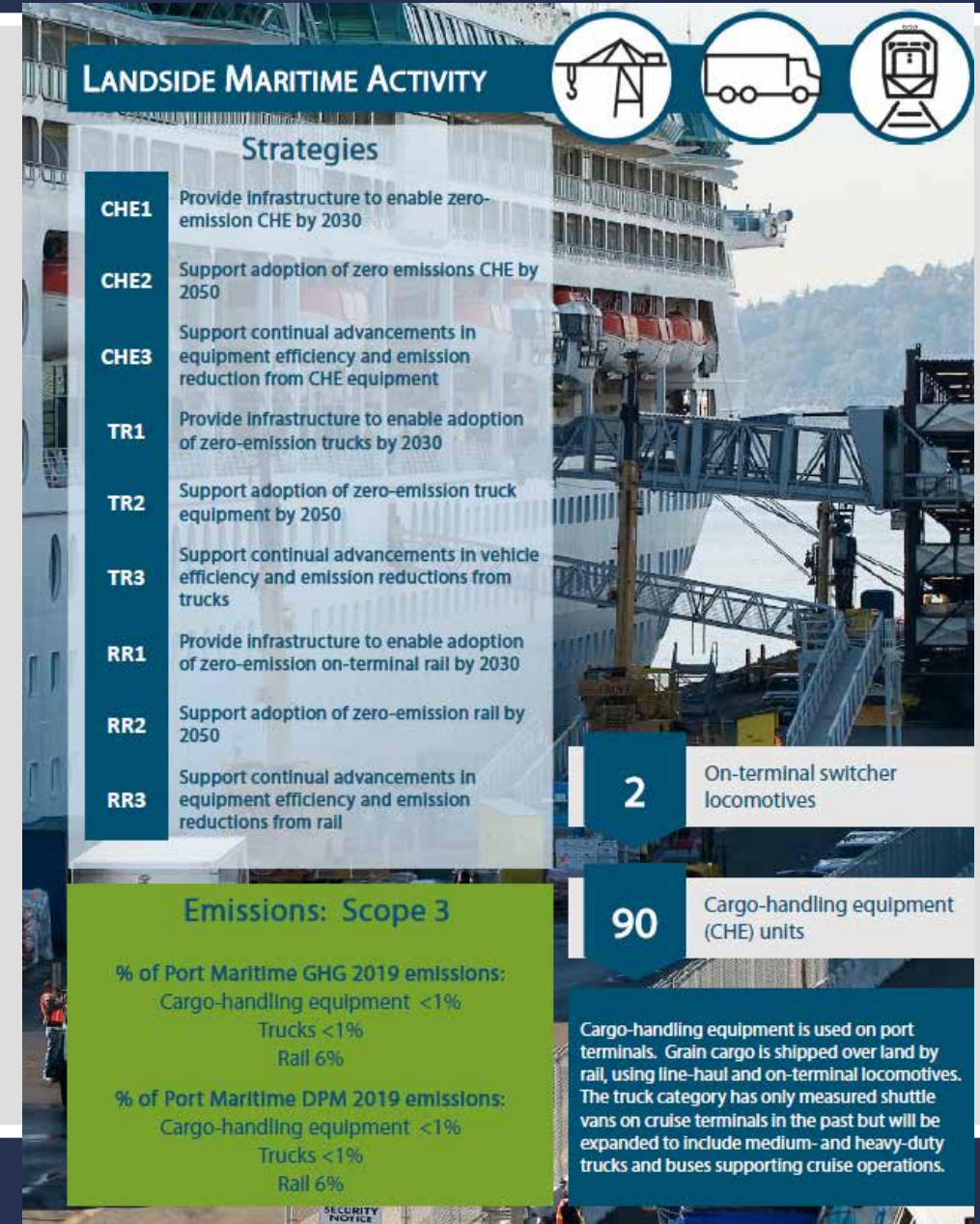


# Case Study—Waterside Maritime Activity



# Case Study—Landside Maritime Activity

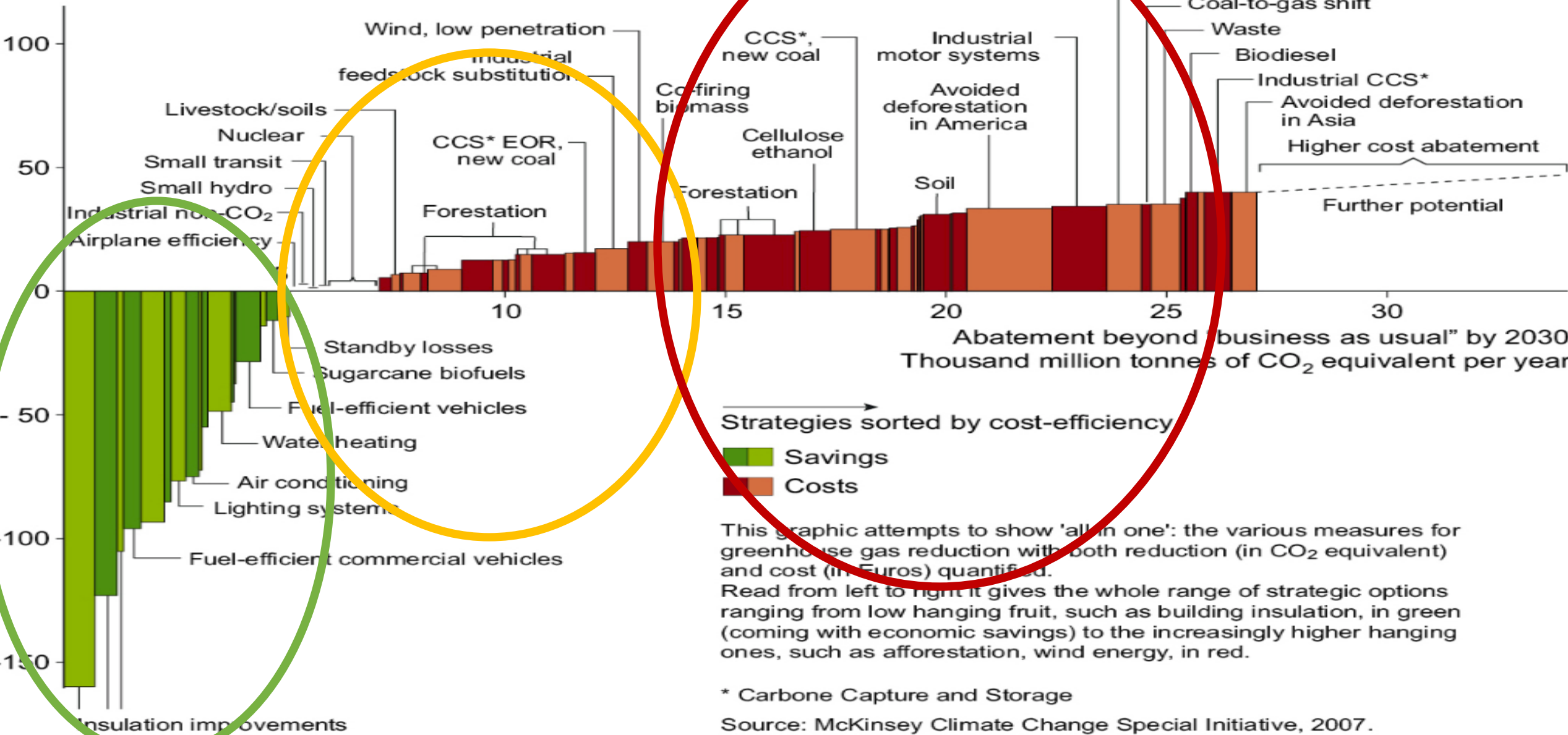
- q Cargo Handling Equipment
- q Trucks
- q Railroads
- q *Infrastructure, technology, workforce acceptance*



# Strategic options for climate change mitigation

## Global cost curve for greenhouse gas abatement measures

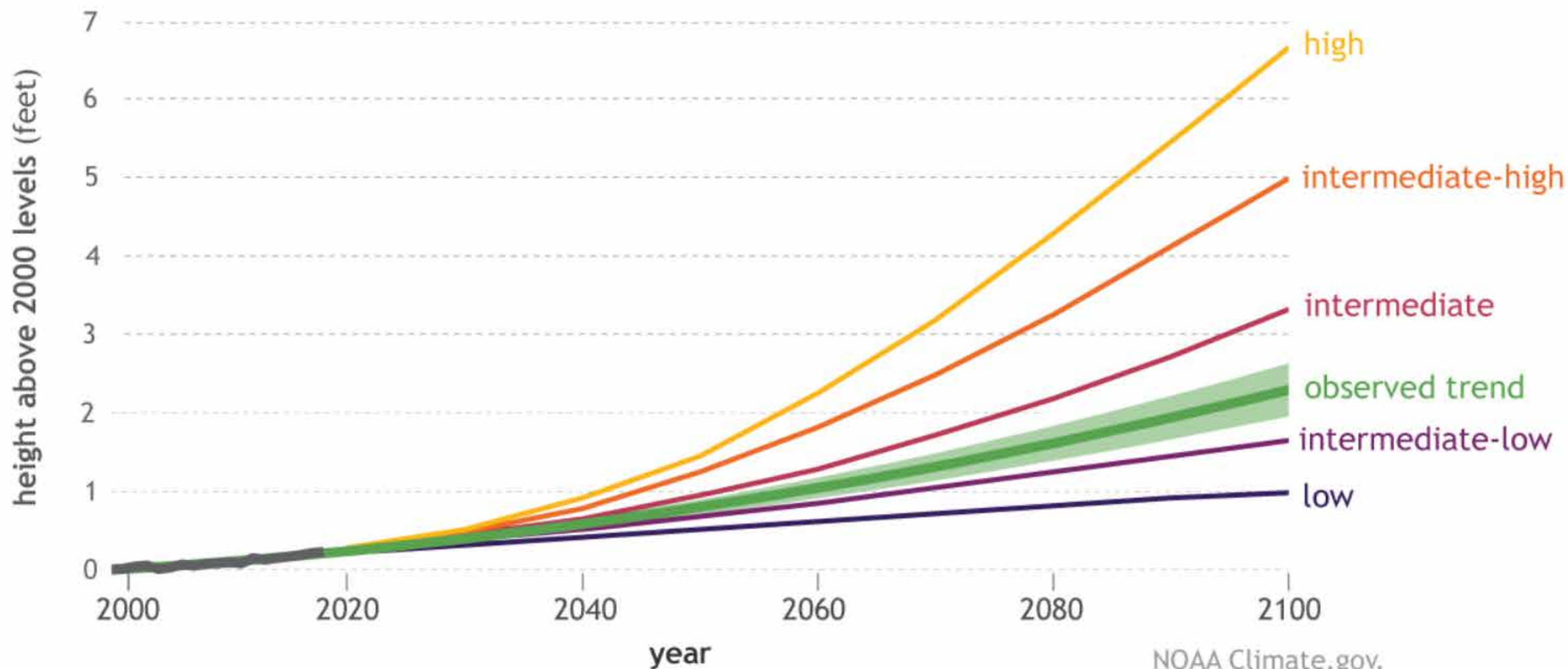
Cost of reducing greenhouse gas emissions by 2030  
Euros per tonne of CO<sub>2</sub> equivalent avoided per year





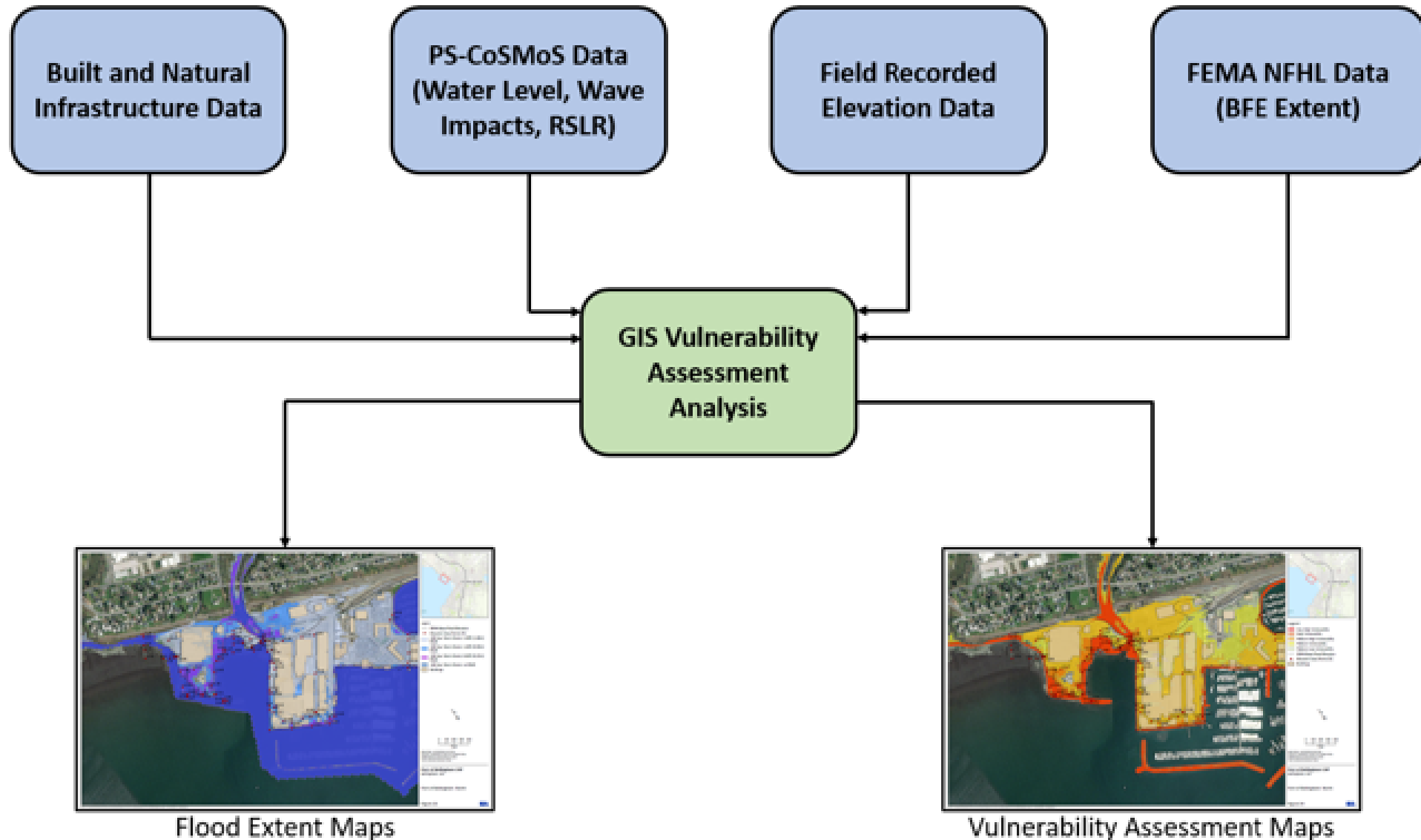
# Sea Level Rise Vulnerability

Possible pathways for future sea level rise



NOAA Climate.gov,  
adapted from Sweet et al., 2022

# Vulnerability Assessment



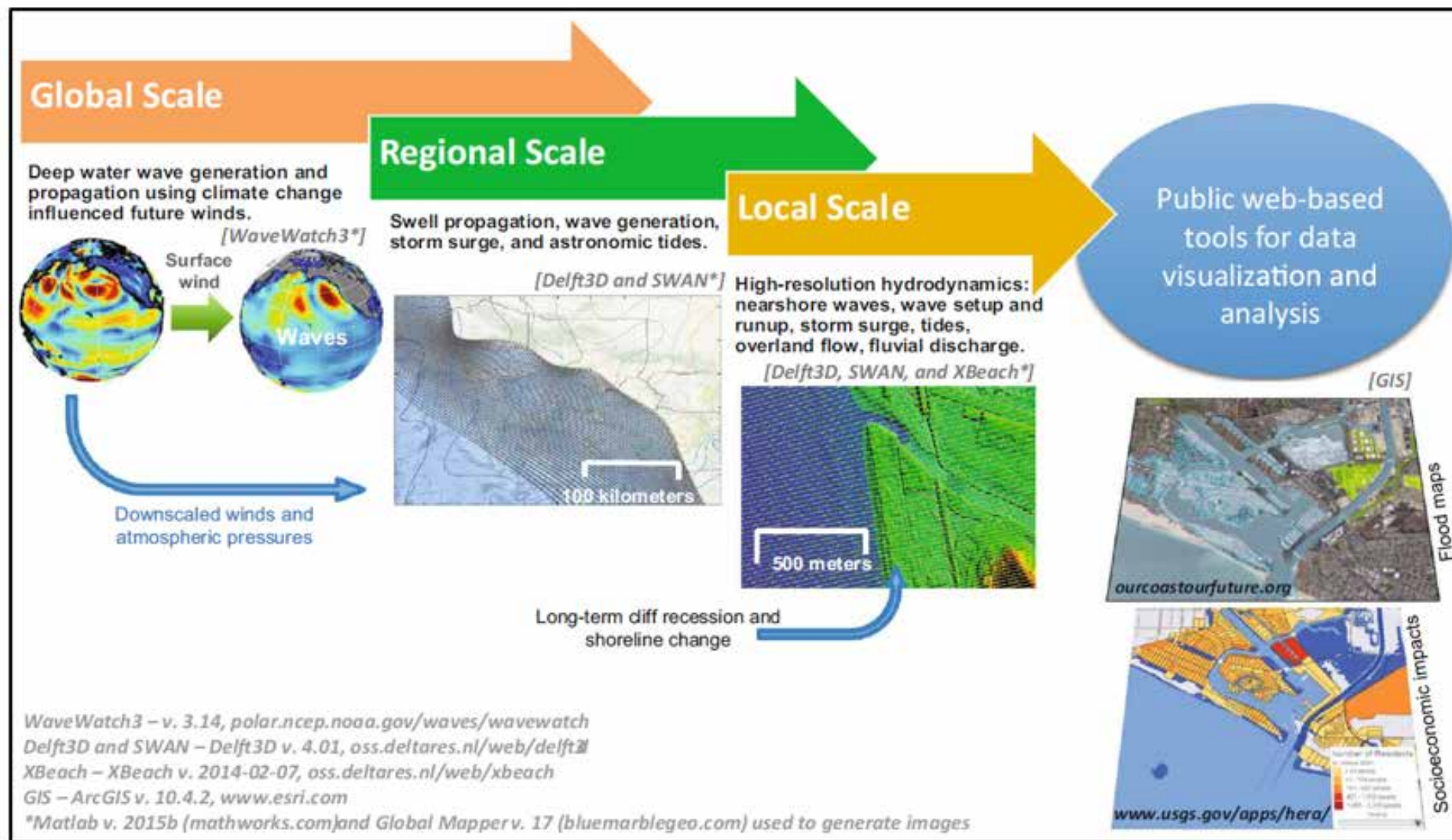
# Vulnerability Assessment

## Data Collection and Tools:

- q Identify Key Assets
- q As-builts
- q Survey
- q LIDAR
- q RTK GPS
- q NOAA
- q USGS
- Ø CoSMoS
- q State/Local/University Resources



# CoSMoS



**CoSMoS Modeling Flowchart (Barnard et al. 2019)**



# Vulnerability Assessment



## Legend

- FEMA Base Flood Elevation
- King Tide, no RSLR
- King Tide, 0.82ft (0.25m) RSLR
- King Tide, 1.64ft (0.50m) RSLR
- King Tide, 3.28ft (1.00m) RSLR
- Buildings
- Catch Basin
- Cleanout
- Manhole
- Storm Sewer Line



## Legend

- FEMA Base Flood Elevation
- 100-Year Storm Event, no RSLR
- 100-Year Storm Event, 0.82ft (0.25m) RSLR
- 100-Year Storm Event, 1.64ft (0.50m) RSLR
- 100-Year Storm Event, 3.28ft (1.00m) RSLR
- Catch Basin
- Cleanout
- Manhole
- Storm Sewer Line

# Vulnerability Assessment

## Vulnerability Assessment Categories

Storm Event	RSLR (ft [m])			
	0	0.82 [0.25]	1.64 [0.50]	3.28 [1.00]
10-Year	High	High	High	Medium High
50-Year	High	High	Medium High	Medium
100-Year	High	Medium High	Medium	Medium

### Notes:

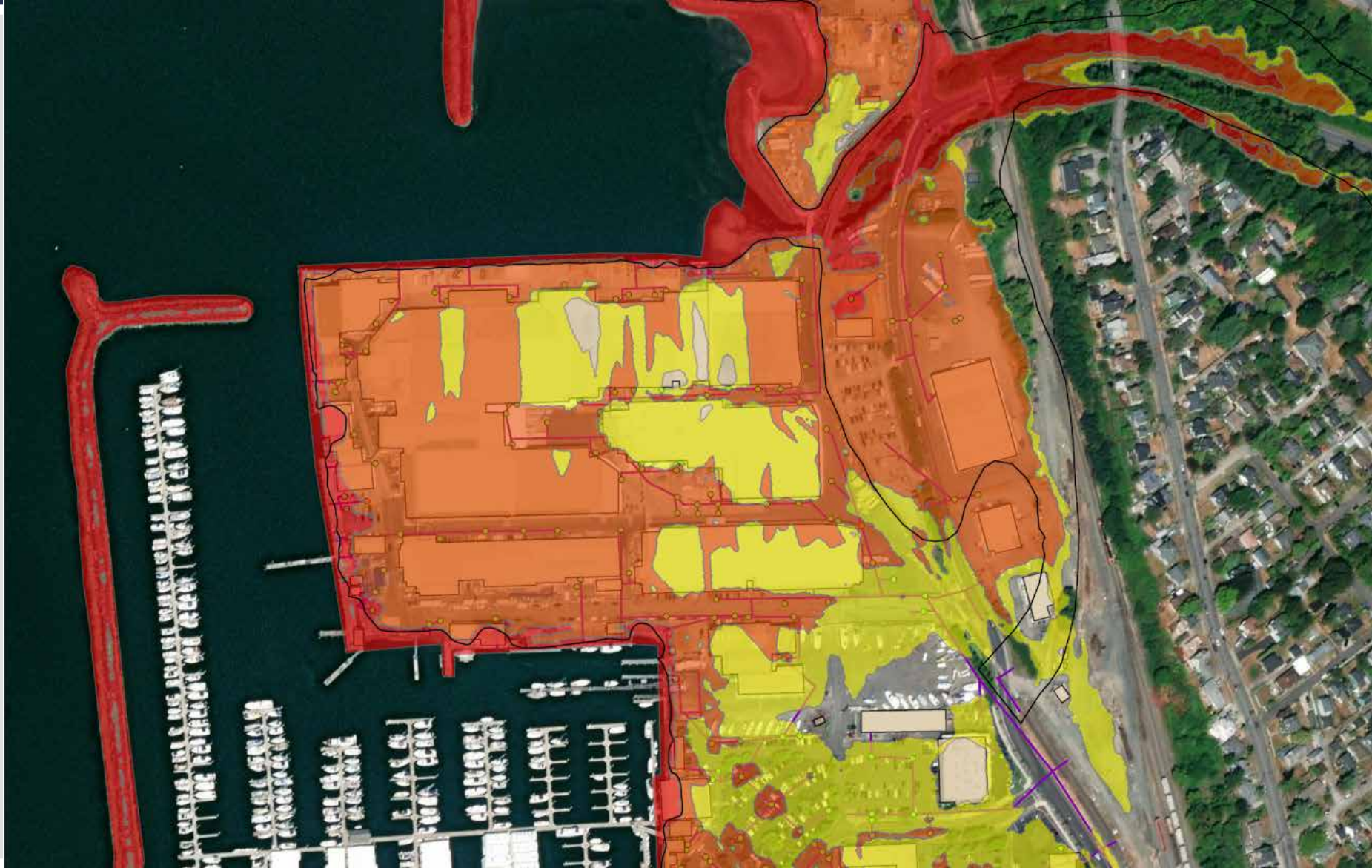
- 1) Vulnerability categories are broken up into three levels from medium (yellow) to high (red).
- 2) Vulnerability is ranked relative to storm levels, it is important to note medium still represents significant potential for damage to some areas.
- 3) Unshaded areas of the Port, while considered “low” vulnerability, may still be impacted by specific extraordinary scenarios.

ft = feet

m = meters



# Vulnerability Assessment



# Exposure, Sensitivity, and Adaptive Capacity

Subarea / Asset Group	Exposure	Sensitivity	Adaptive Capacity	Vulnerability
1. Central Maintenance Building				
1.a Office Area	Medium	High	High	High
1.b Portable/Non-Fixed Equipment – within 7 in of the floor	Medium	High	Low	Medium
1.b Portable/Non-Fixed Equipment – between 7 in and 20 in above the floor	Low	High	Low	Low
1.c Fixed Equipment	Medium	High	High	High
	Low			
1.d Electrical Panels/ Switches/Receptacles	Medium	High	High	High
	Low			
1.e Hazardous Material Storage	Medium	Medium	Low	Medium
2. Fuel Island				
2.a Fuel Tanks	High	High	Low	High
2.b Electrical Assets and Pumps	High	Medium	Low	Medium
2.c Stormwater Catch Basins and Trench Drains	High	High	High	High
	Medium			
3. Outdoor Parking: Front Parking Lot				
3.a Vehicle Parking	High	High	Low	High
4. Outdoor Parking: Back Parking Lot				
4.a Vehicle Parking	High	High	Low	High
4.b Oil-Water Separator	High	Medium	Low	Medium
4.c Outdoor Storage Containers/Sheds	High	High	Low	High
4.d Outdoor Storage Materials/Equipment	High	Medium	Low	Medium
5. Locker Building				
5.a Eletrical Panels/ Switches/ Receptacles	Medium	High	Low	Medium
5.b Hazardous Material Storage	Medium	Medium	Low	Medium
5.c Portable/Non-Fixed Equipment	Medium	High	Low	Medium
6. Shoreline Assets and Infiltration Galleries				
6.a Rock/Rubble Shore Armoring	High	Medium	High	High
6.b Infiltration Galleries	High	Low	High	High



# Coastal Resilience

- § Nationwide National Park Service Coastal Engineering Contract
  - § Initial locations Great Lakes, Boston, NYC, FL, AK, CA, TX, GA, WA
  - § Developing new Beach Nourishment Guidance & National Disaster Planning, Response, and Recovery products
- § Audubon – Coastal Resilience Designs in Outer banks, NC
- § USACE Swan Island Beneficial Reuse project – UAV and marsh assessment
- § Massachusetts DOT – Guidance development on assessing impacts from sea level rise
- § Ecological Effects of Sea Level Rise, NC & FL – UNC Chapel Hill, USACE and NOAA
- § Washington State
  - § San Juan Islands support for NPS
  - § Port of Bellingham Vulnerability and Risk Analysis
  - § NAVFAC – Indian Island Coastal Assessment





# Thin Layer Placement



# Spotlight on Point Hope

- § Native Village of Point Hope is the “home” village of AES, Inc. (Tikigaq Corporation) with whom EA has a Mentor/Protegee relationship
- § Village has just over 700 residents, 93 percent of whom identifying as indigenous Iñupiat
- § Elevation of just 13 to 18 feet above mean sea level and reliance upon subsistence hunting/fishing for a significant portion of their food source and cultural identity



# Spotlight on Point Hope

- § EA developed \$400k grant application on behalf of the community
  - § Focused on use of traditional ecological knowledge (TEK) and nature-based solutions
  - § Vulnerability assessment and conceptual design development
- § USACE ERDC is now contributing services in support of the research
  - § EA submitted ~\$2M proposal to ERDC for Alaska and Atlantic research support





# Thoughts for Your Port?

## q Overlapping Regulations/Commitments

- Ø International

- Ø Federal

- Ø State

- Ø Regional

- Ø Local

## q Impact on other Air Pollutant Strategies

# Thoughts for Your Port?

q What are my Goals?

- Ø Regulatory compliance
- Ø Community collaboration
- Ø Leadership by example
- Ø Chase tenants away?!?

# Thank You



[www.eaest.com](http://www.eaest.com)

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