

Item No.: 5B\_Supp  
Date of Meeting: April 3, 2018

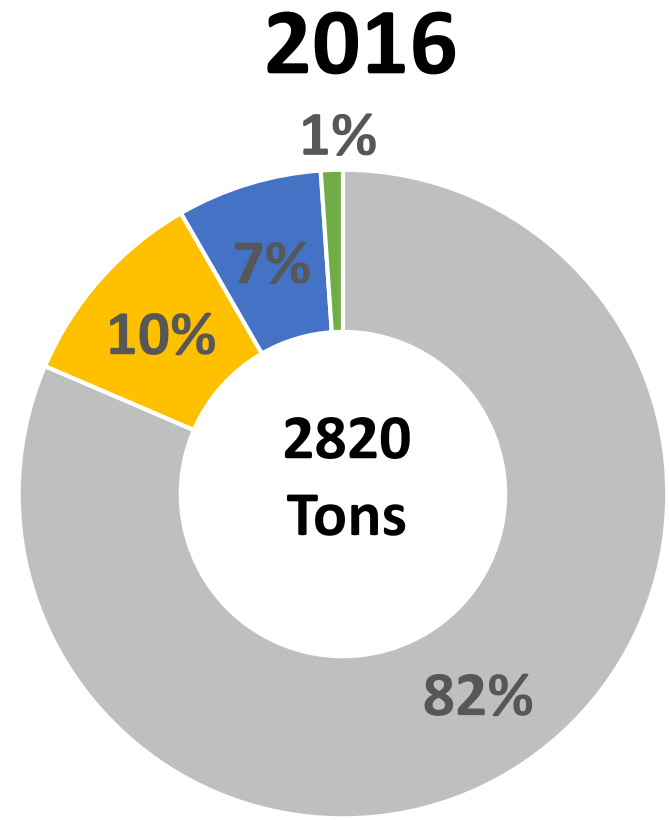
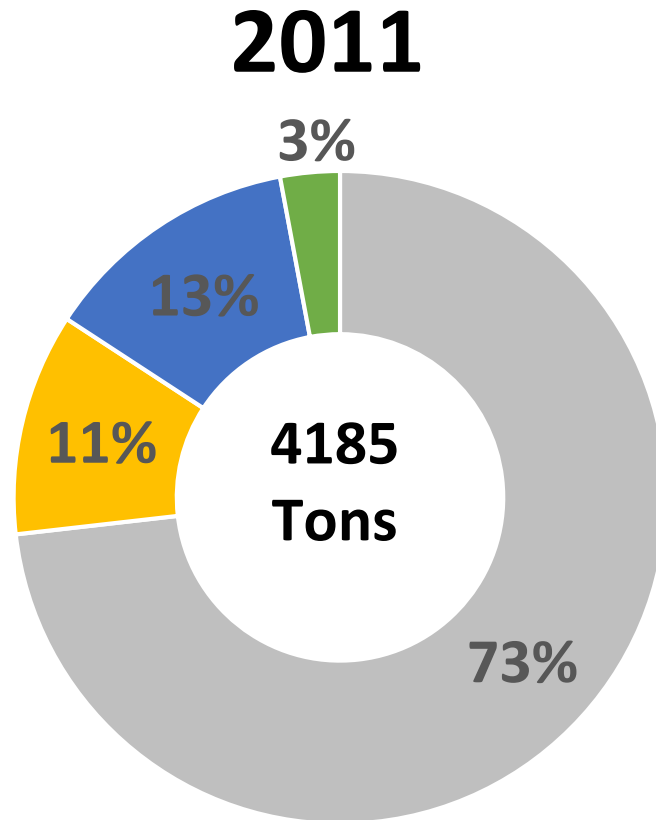


**THE NORTHWEST  
SEAPORT ALLIANCE**  
*Gateway to Solutions*

**2016 Puget Sound  
Maritime Emission  
Inventory;  
2016 NWSA Greenhouse  
Gas Inventory;  
and NWSA Greenhouse  
Gas Glidepath**

# Maritime Emissions Regional Context

## Diesel Particulate Matter



■ Non Maritime   ■ Other Maritime   ■ NWSA   ■ POT + POS (Non NWSA)



# Summary and Highlights

- **Results of the Puget Sound Maritime Air Emissions Inventory (PSEI) showed that NWSA and regional maritime emissions decreased significantly for all pollutants.**
  - DPM down 80% and GHG down 17% per ton of cargo since 2005
  - Achieves 2020 reduction targets for NWPCAS
- **Results of the NWSA 2016 Greenhouse Gas Inventory indicate that mobile sources make up over 98% of total GHG Emissions**
- **NWSA GHG Glidepath shows that GHG Resolution targets require significant decreases in carbon intensity across operations**
- **Upcoming clean air programs:**
  - Shore Power
    - 33% of ships calling are shore power capable (Starcrest, 2016)
  - Clean Cargo Handling Equipment
    - 39% meet tier 4i (2016 NWPCAS implementation report)
  - Clean Trucks
    - 53% meeting 2007 EPA emission standards (as of Dec 31 2017)



# Importance of Emissions Inventories

- **Data collection is the starting place for air quality programs**
  - Can't manage what you don't measure
- **Demonstrates our commitment to transparency**
- **Tracks progress towards goals**
- **Helps prioritize emission reduction programs and policies**
  - Allows emission reductions, environmental benefits, and societal benefits to be weighed against cost
  - Identifies areas where emissions are greatest and where they are easiest to control



# Analytical Method of Emissions Inventories

- **Activity Based: Calculate emissions based on recorded and estimated “activity levels”**
  - Use surveys and vessel, vehicle, and equipment records to determine activity levels
    - Type of equipment (e.g., top pick)
    - Intensity of operation (average horsepower)
    - Duration of operation (hours)
- **Emission factor translates activity level to emissions**
  - Emissions per activity
- **Emissions = A [hp-hr] x EF [grams/hp-hr]**



The background of the slide is a photograph of a port. On the left side, there is a large orange gantry crane. Below it, a stack of red and blue shipping containers is visible. In the foreground, a blue and white boat is docked. The right side of the slide is a large white semi-circle that contains the title text.

# 2016 Puget Sound Maritime Emission Inventory

3/29/2018

# Puget Sound Maritime Air Forum

The Air Forum is a partnership between Ports, government agencies, and industrial partners.

- **The Northwest Seaport Alliance**
- **Port of Anacortes**
- **Port of Everett**
- **Port of Olympia**
- **Port of Port Angeles**
- **Port of Tacoma**
- **Port of Seattle**
- **Northwest Clean Air Agency**
- **Puget Sound Clean Air Agency**
- **Puget Sound Regional Council**
- **U.S. Environmental Protection Agency (EPA)**
- **Washington State Department of Ecology**
- **Washington State Department of Transportation**
- **North West and Canada Cruise Association**
- **Pacific Merchant Shipping Association**
- **Western States Petroleum Association**



# Geographical Extent

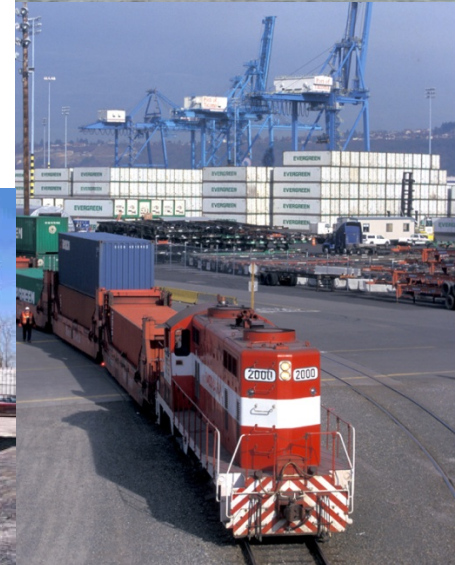
- **U.S. Portion of the Puget Sound/ Georgia Basin Airshed (we'll call this the Puget Sound Airshed)**
  - From the Cascade to the Olympic Mountains and from Olympia to the Canadian border
- **NWSA Emission Scale**
  - We focus on “Airshed scale” emissions
    - Includes all truck, train, OGV, and harbor craft emissions on and off port within the Airshed boundary
- **Maritime Industry-Wide Emissions**
  - Emissions from all maritime related activity within the Airshed boundaries (not just NWSA)





# Source Categories

- Ocean Going Vessels (OGV)
- Cargo Handling Equipment (CHE)
- Locomotives
- Harbor Vessels
- Trucks
- Fleet Vehicles



# Pollutants Inventoried

- **Criteria Air Pollutants**

- Particulate Matter (PM)
  - Fine PM (PM<sub>2.5</sub>)
  - Coarse PM (PM<sub>10</sub>)
  - Diesel PM (DPM)
- Sulfur Dioxide (SO<sub>2</sub>)
- Nitrogen Oxides (NO<sub>x</sub>)
- Carbon Monoxide (CO)
- Volatile Organic Compounds (VOCs)

- **Greenhouse Gasses (GHG)**

- Carbon Dioxide (CO<sub>2</sub>)
- Methane (CH<sub>4</sub>)
- Nitrous Oxide (N<sub>2</sub>O)
- GHG are reported together in CO<sub>2</sub> equivalents (CO<sub>2</sub>e)

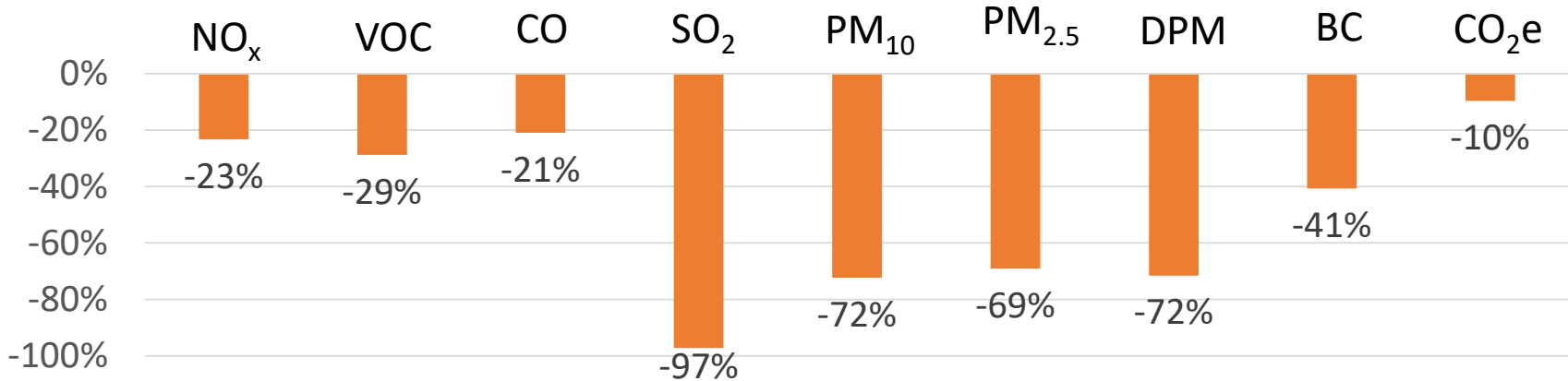
- **Other**

- Black Carbon (soot)
  - Part of PM<sub>2.5</sub>
  - Climate forcer

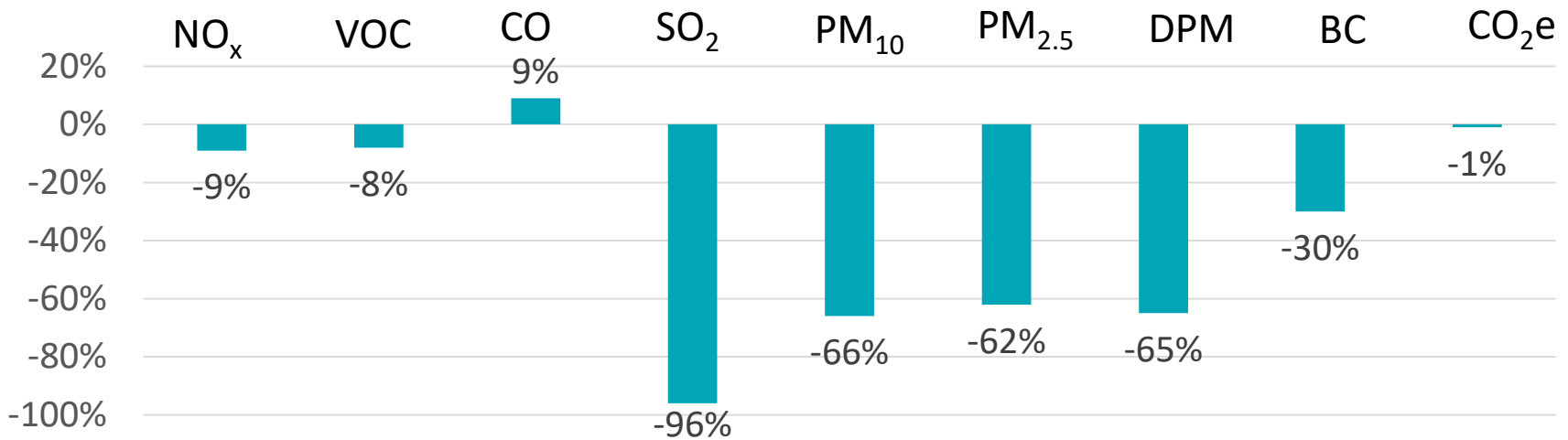


# Maritime Industry-Wide Airshed Emission Changes

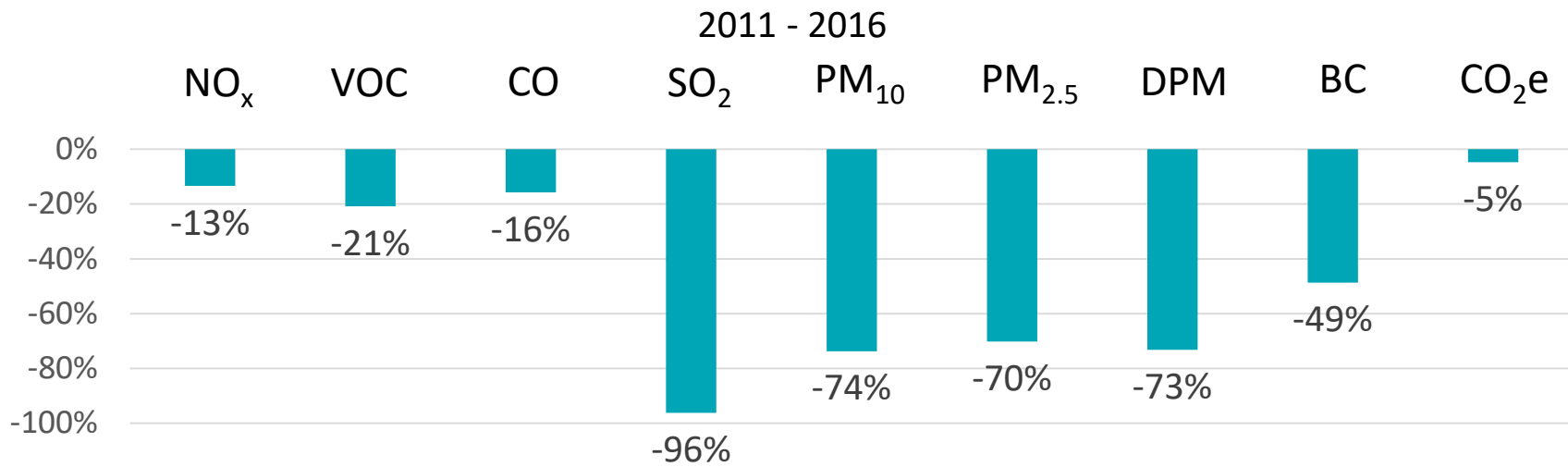
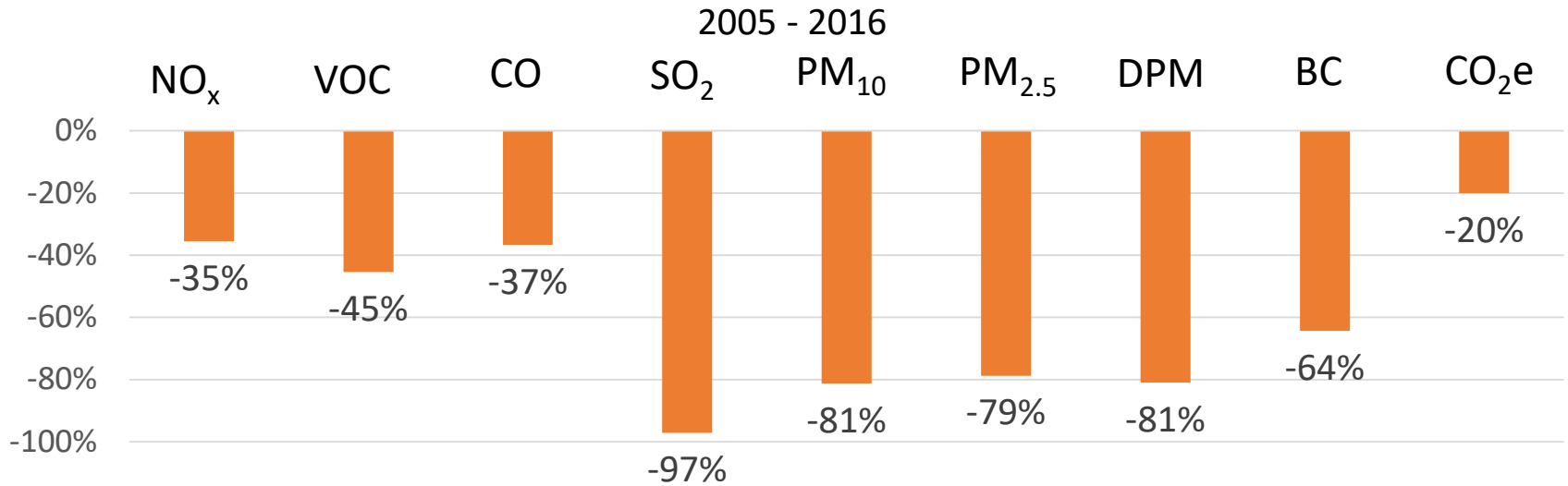
2005 - 2016



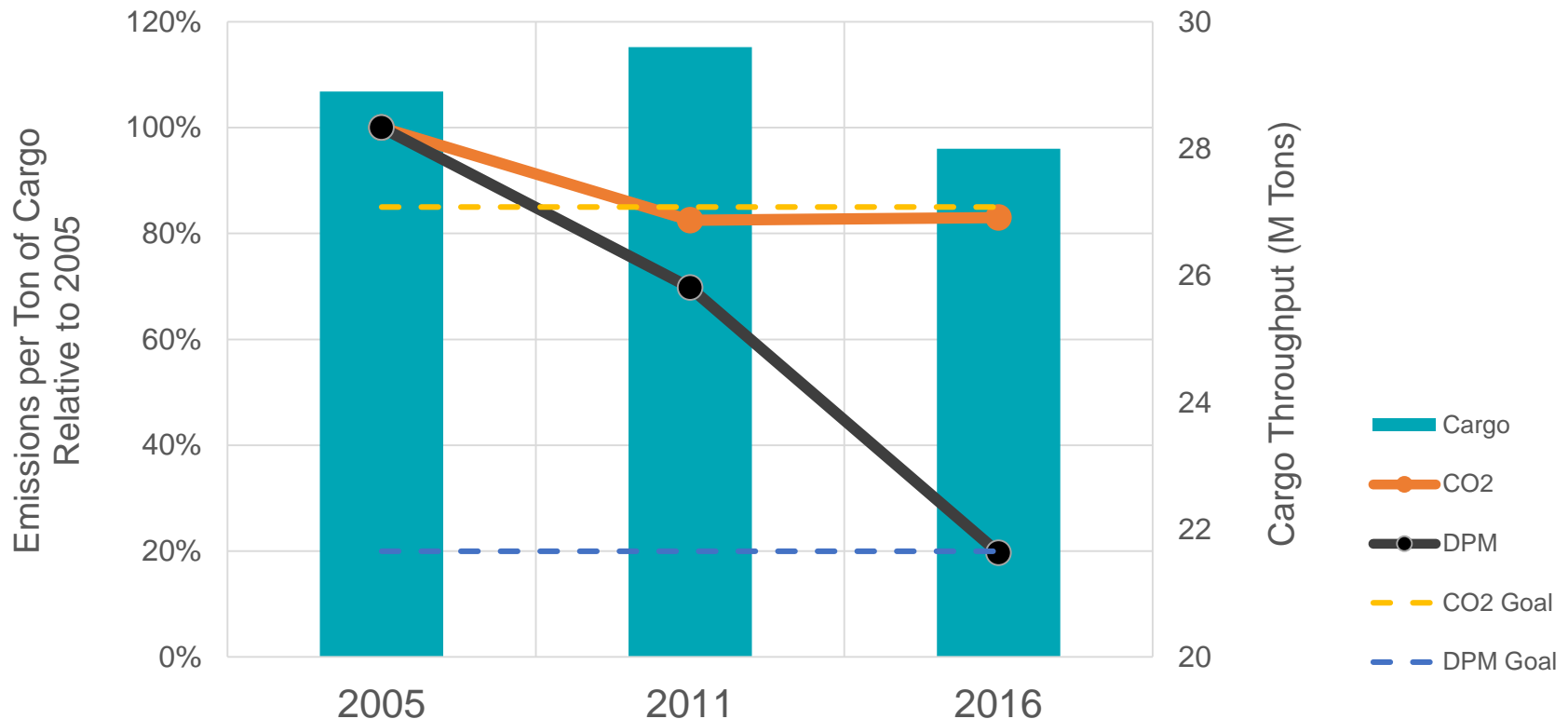
2011 - 2016



# NWSA Airshed Emission Changes



# Summary of Progress Towards NWPCAS Goals



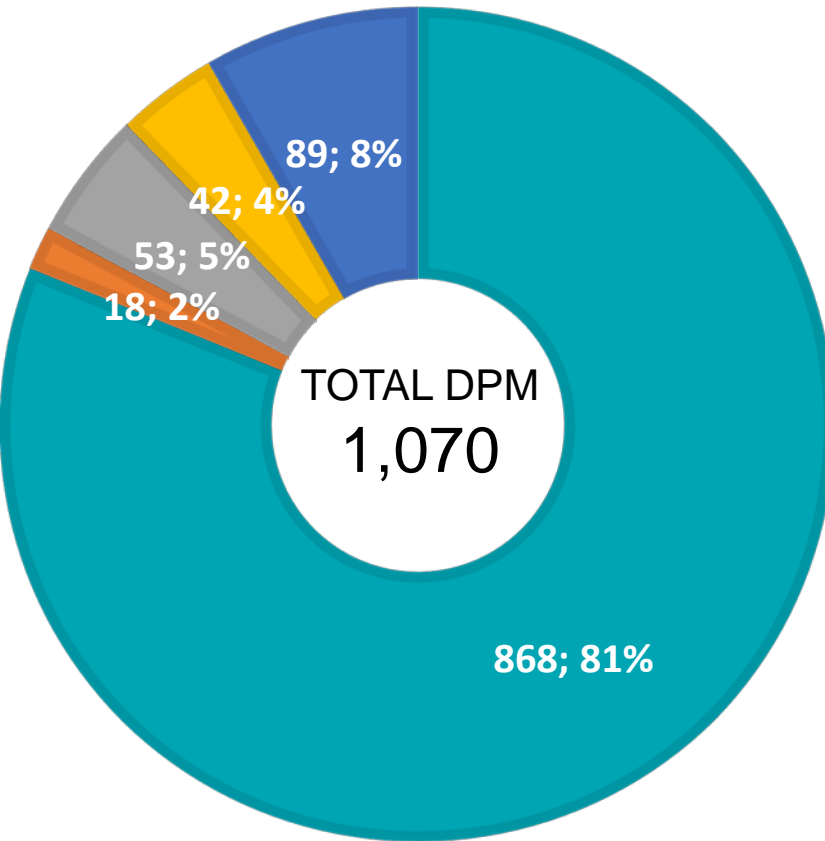
- Northwest Ports Clean Air Strategy (NWPCAS) goals are 15% reduction of CO<sub>2</sub>e and 80% of DPM emissions per ton relative to 2005 levels of cargo by 2020.
- NWSA achieved **17%** and **80%** reductions for CO<sub>2</sub>e and DPM respectively on airshed scale. **Met goals 4 years ahead of schedule.**



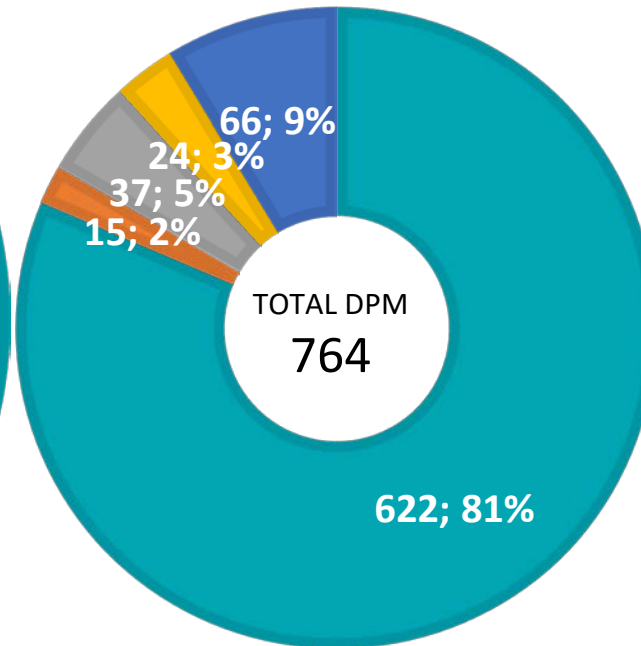
# NWSA Airshed DPM Emissions

## DPM EMISSIONS IN TONS/YEAR AND % OF TOTAL

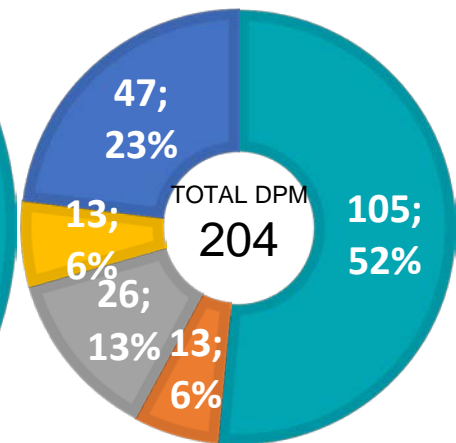
■ Ocean Going Vessels ■ Harbor Craft ■ Locomotives ■ CHE ■ Trucks



2005



2011



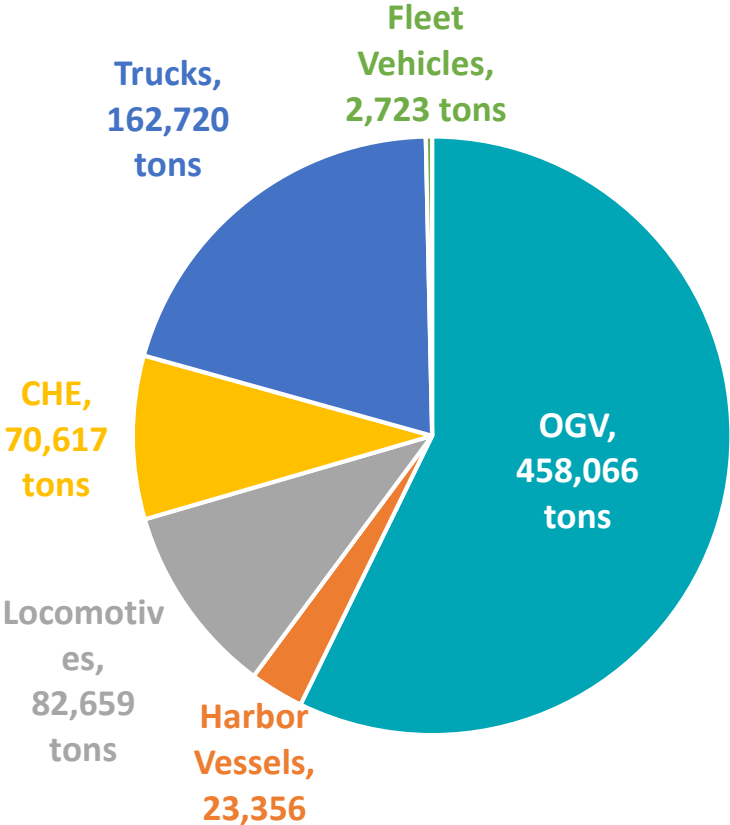
2016



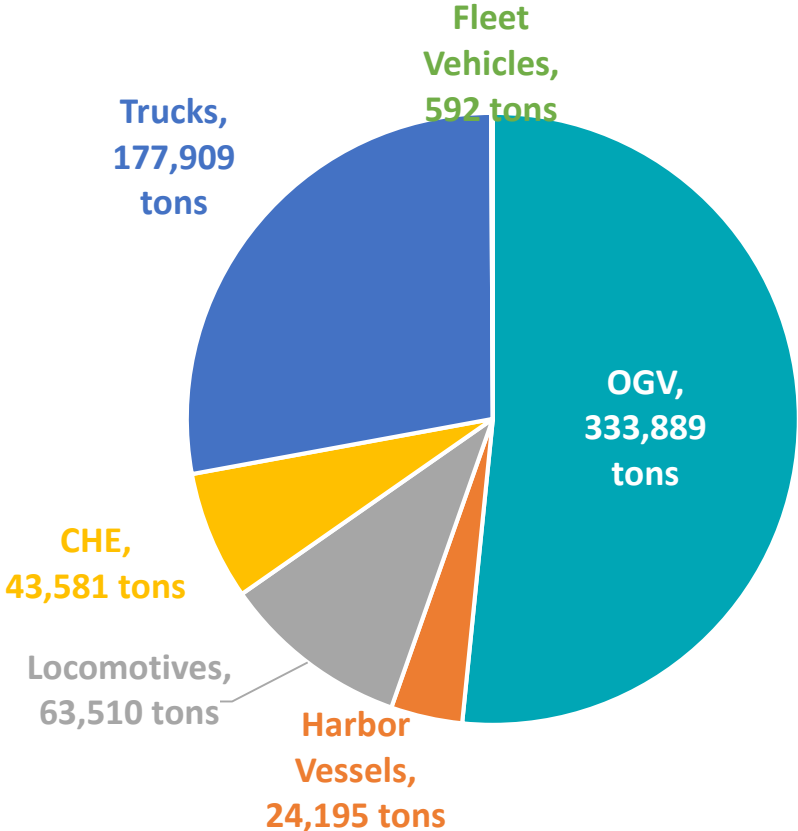
# NWSA Airshed Scale GHG Emissions Distribution

Down  
20% Overall  
17% per Ton of Cargo

**2005**



**2016**



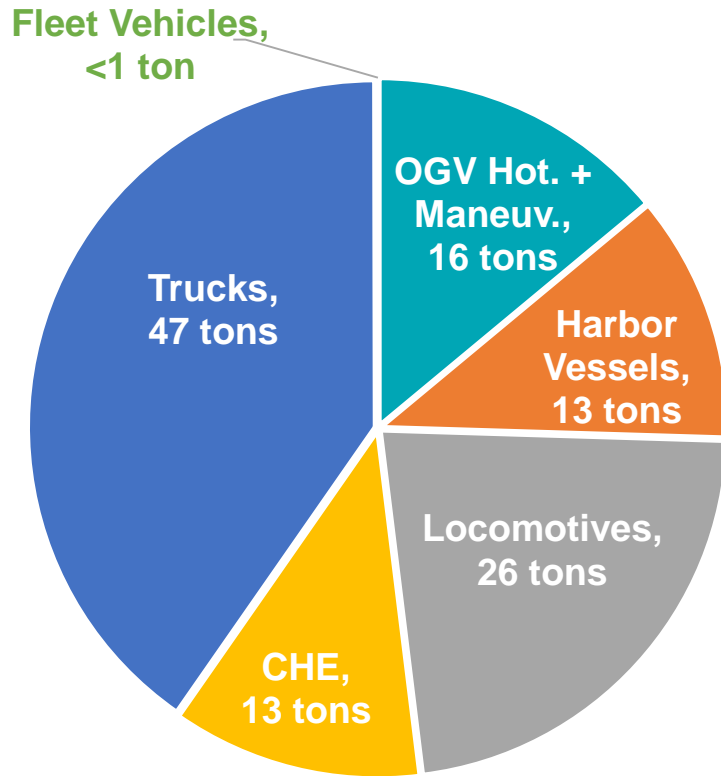
# Reasons for NWSA Emission Changes

- **ECA: Fuel switched from bunker fuel (max 3.5% Sulphur) to low sulfur fuel oil (maximum 0.1% Sulphur)**
  - Model fuel correction factors indicate: reduces vessel emissions of DPM by 83%, SO<sub>2</sub> by 97%, NO<sub>x</sub> by 6%, and CO<sub>2</sub> by 5%.
- **Use of ULSD in equipment, harbor vessels, and trucks**
  - Nonroad, locomotive, and marine fuel:
    - Pre 2007: unregulated
    - 2007 – 2014: Low sulphur diesel (500 ppm S)
    - 2014 ULSD (15 ppm S)
  - On-road (trucks)
    - Pre 2006 : Low sulphur diesel (500 ppm S)
    - 2010: ULSD (15 ppm S)
- **Fleet turnover, stricter controls on PM, NO<sub>x</sub>, VOC**
  - 2007 newer truck PM 90% lower than pre 2007
  - 2010 newer truck NO<sub>x</sub> 95% lower than pre 2010
  - Tier 4 equipment PM and NO<sub>x</sub> 90% lower than tier 3
- **Lower activity for locomotives, CHE, OGV**

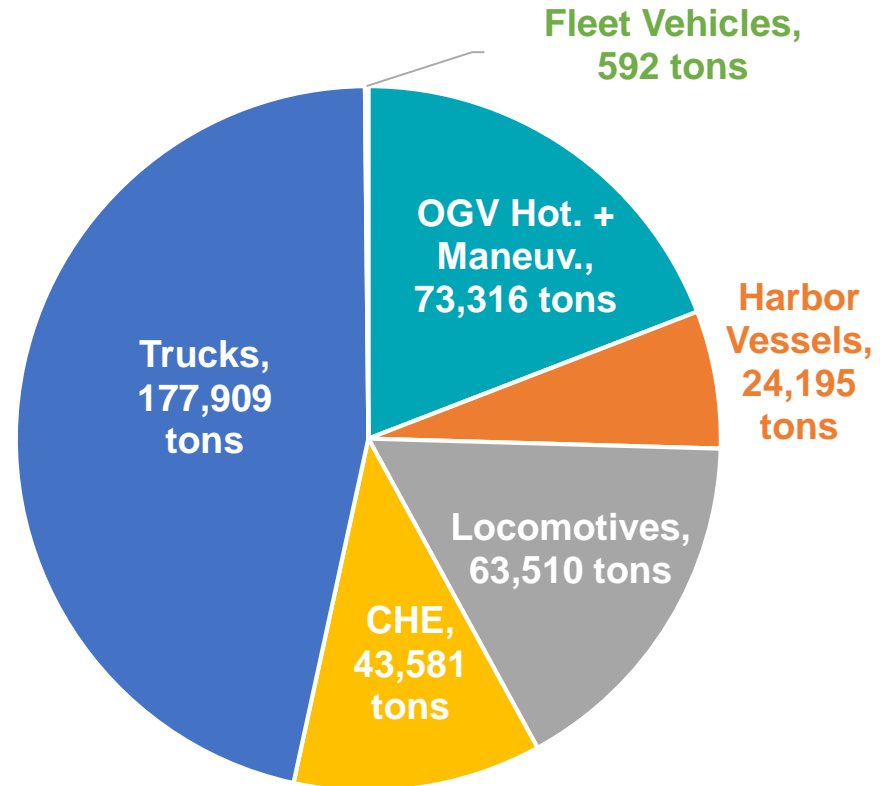




# 2016 Near Shore Emission Distributions



**DPM**



**GHG**



The background of the slide is a photograph of a port or shipping yard. It features several large orange gantry cranes, stacks of colorful shipping containers (red, blue, green), and a blue and white tugboat in the water. A large white circular graphic is overlaid on the left side of the image, containing the title text.

# 2016 NWSA GHG Emission Inventory

# Greenhouse Gas Inventory: Greenhouse Gas Resolution

## GHG Reduction Resolution:

### By 2030:

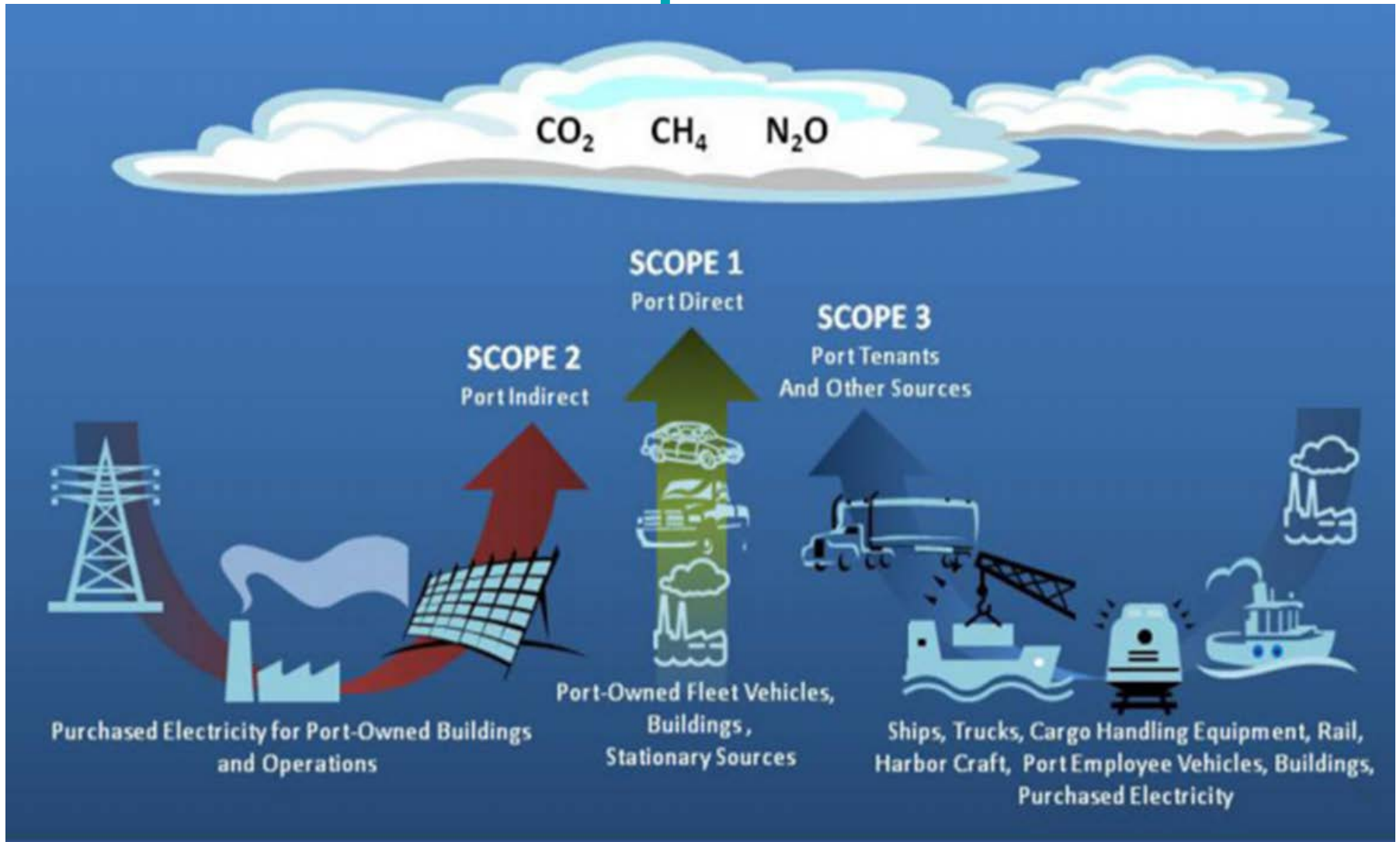
- **50% below 2005 levels (scopes 1, 2 & 3 emissions)**

### By 2050:

- **Carbon Neutral (scopes 1 & 2 emissions)**
- **80% below 2005 levels (scope 3 emissions)**
- **Why Perform another inventory?**
  - Fills in the gaps left by the PSEI, e.g. stationary sources
  - Assess strategies for meeting NWSA GHG Reduction Resolution



# GHG Emission Scopes



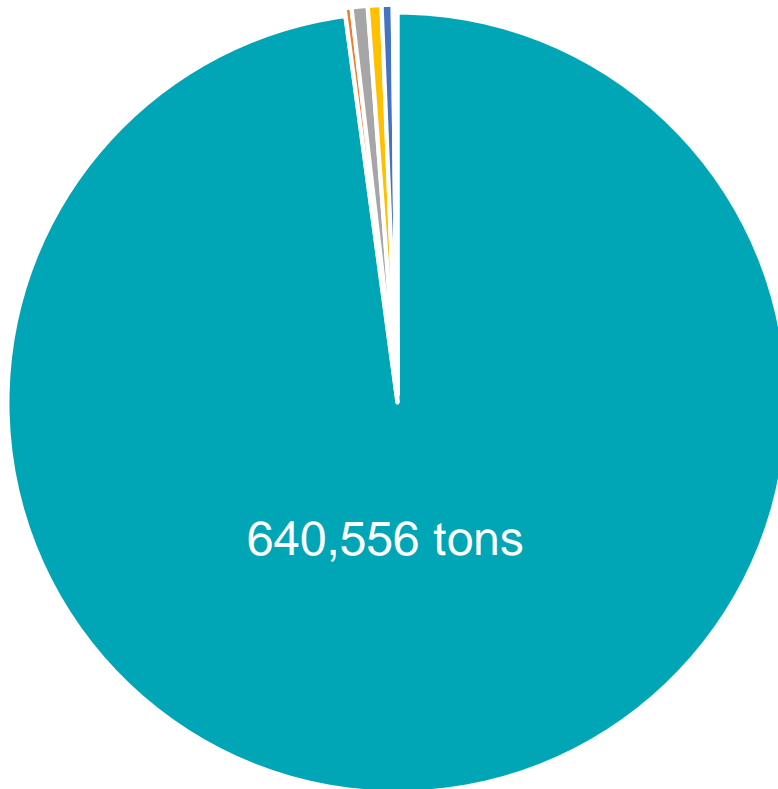
# NWSA 2016 GHG Emissions Inventory Results

## GHG Emissions (Tons CO<sub>2</sub>e)

Emissions Scope	Source	2005	2016
Scope 1	None	NA	NA
Scope 2	None	NA	NA

# NWSA 2016 GHG Emissions Inventory Results

## 2016 Scope 3 Emissions, tons



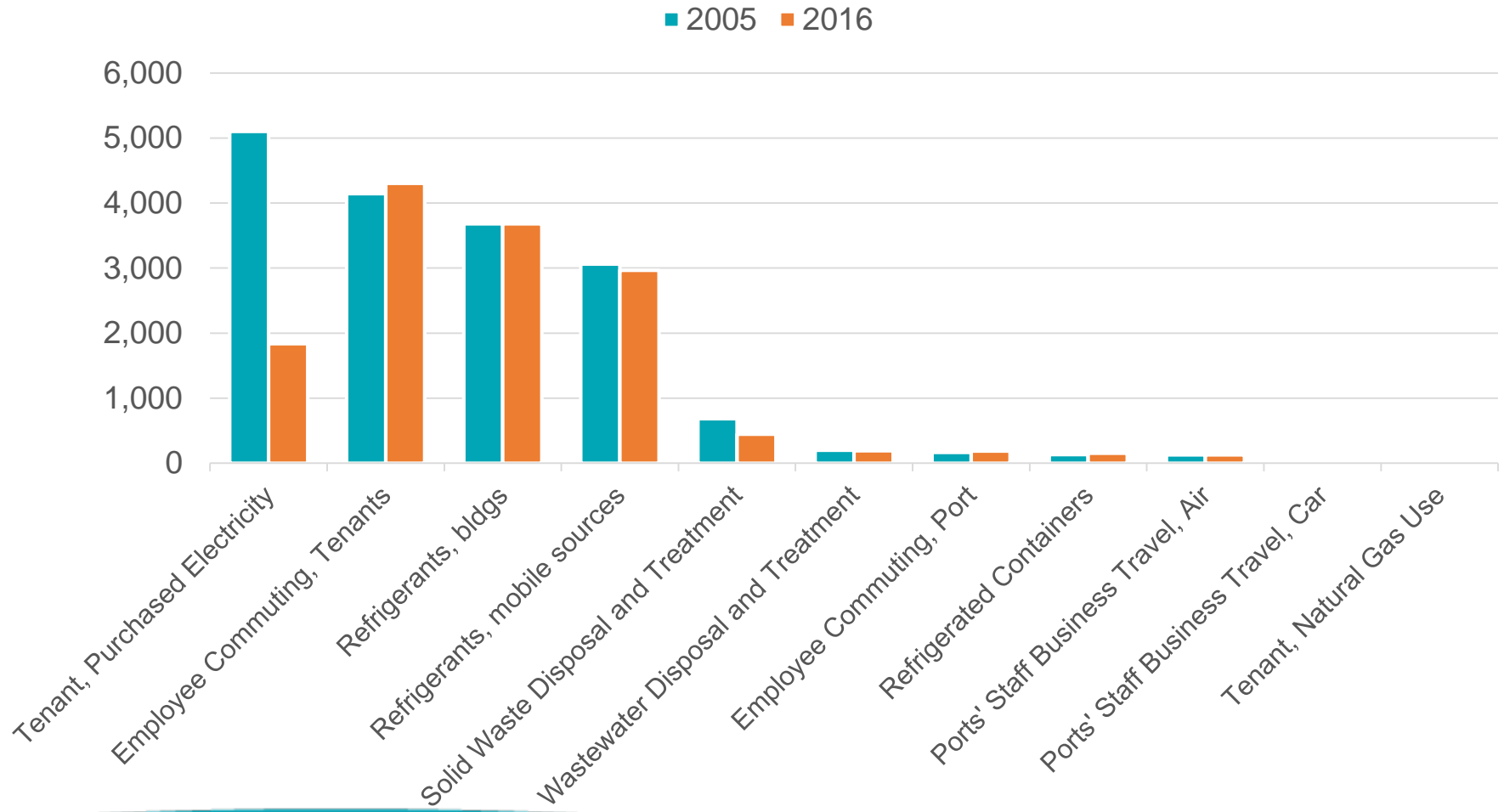
- Cargo Transportation
- Tenant, Purchased Electricity
- Employee Commuting, Tenants
- Refrigerants, bldgs
- Refrigerants, mobile sources
- Solid Waste Disposal and Treatment
- Wastewater Disposal and Treatment
- Employee Commuting, Port

\* Total: 654,518 tons



# NWSA 2016 GHG Emissions Inventory Results

## 2016 Scope 3 Emissions, tons



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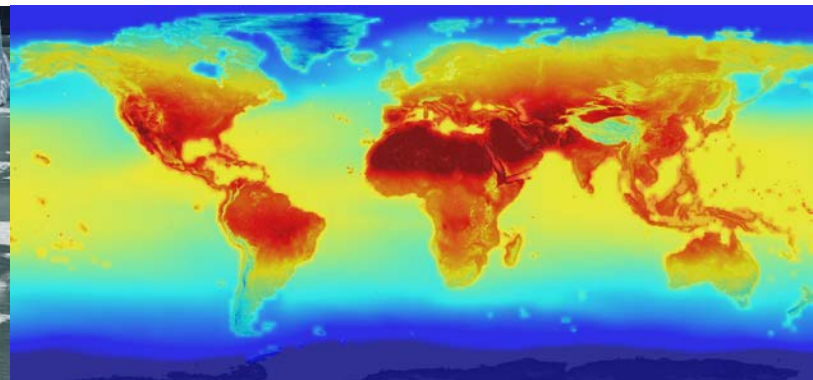
# NWSA GHG Glidepath



# Background – Why this is important

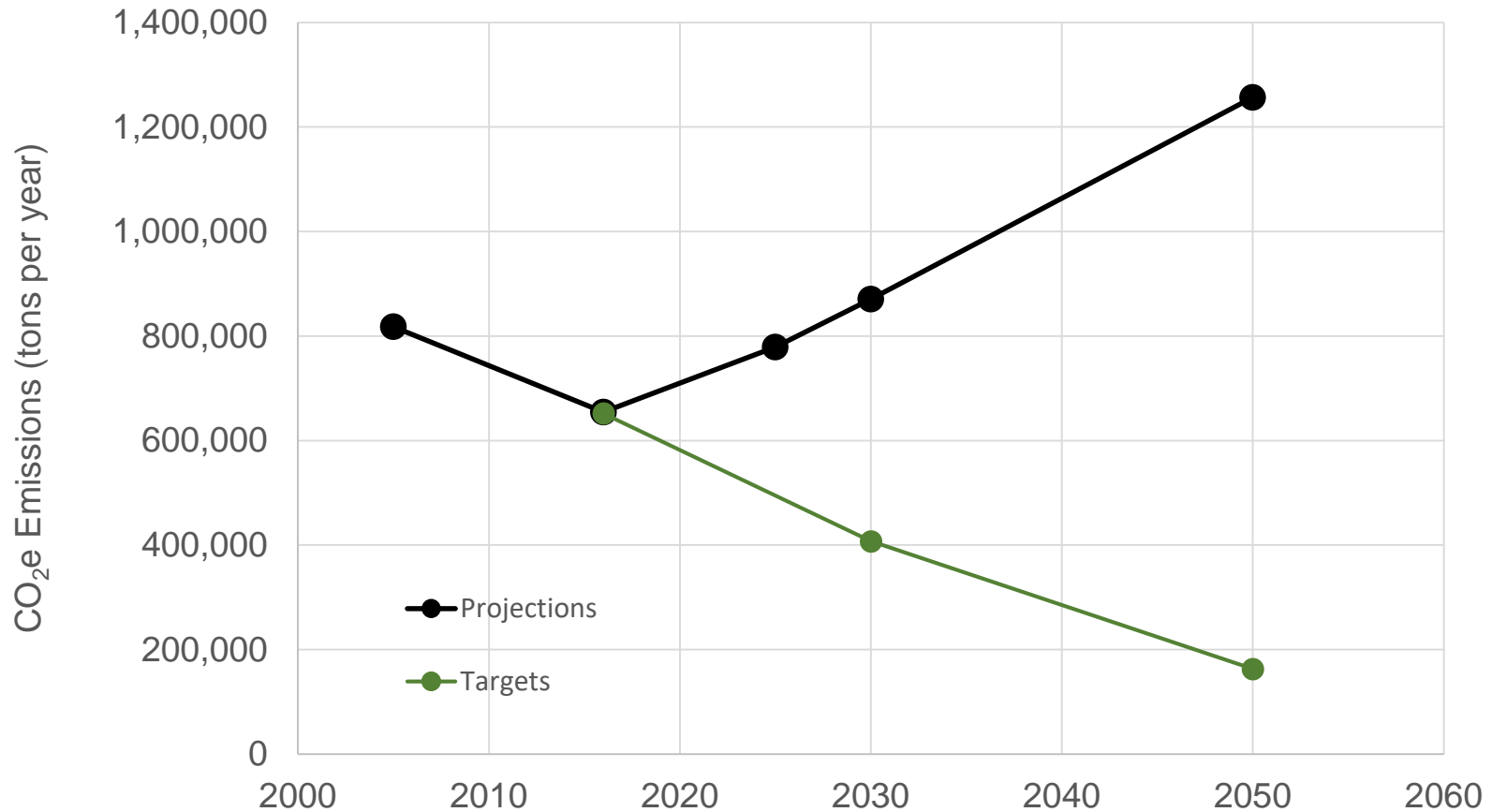
## Greenhouse Gas Reduction Resolution

- Scientific consensus is climate change is already happening
- Paris Agreement:
  - Countries aim to keep global temperature rise to below 2 degrees Celsius above pre-industrial levels
  - POT and POS have joined national ‘We Are Still In’ coalition in June 2017
- POT and POS early leaders by adopting GHG reduction goals in Northwest Ports Clean Air Strategy in 2008
- Public opinion – 71% Pierce Co. and 81% King Co. residents think global warming is happening, majority think caused by human activity



# Emission Projections

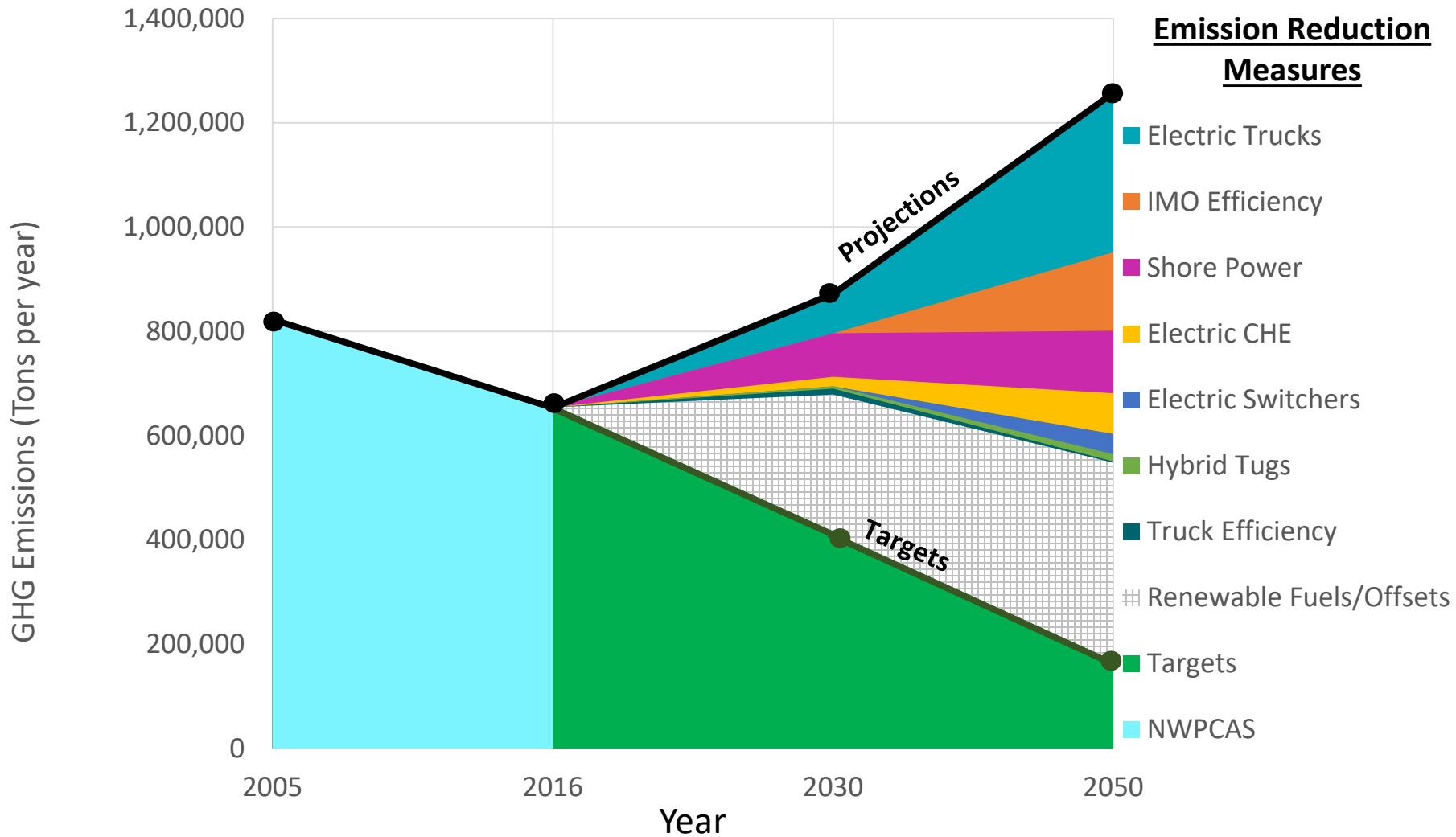
## NWSA GHG Emission Projections



\* 2.2% projected compound growth rate



# GHG Emission Reduction Glidepath

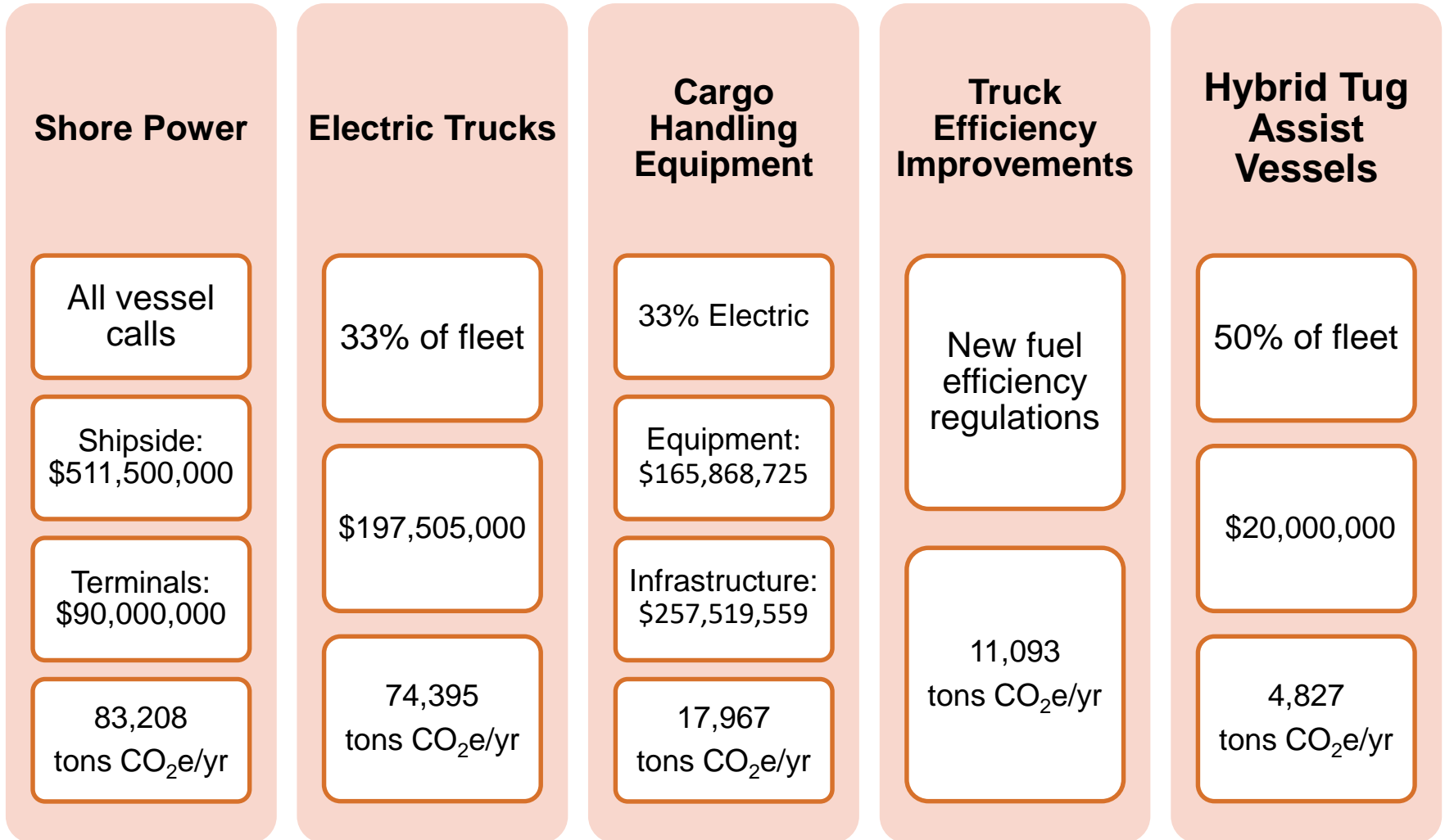


# High Level Cost Estimates of Emission Reduction Programs

- **High level estimates based on available information**
  - Most estimates are very conservative based on their speculative nature
  - Costs were taken from previous work done by LA/LB and CARB
- **Many factors play in to the actual future costs**
  - Technology development and penetration of the market
  - Public Policy
    - Carbon tax
    - Global shore power requirements
    - Global fuel requirements
- **Programs will be prioritized based on emission reductions required to meet targets, cost, and operational effectiveness**



# 2030 Emission Reduction Measures



\* Total Cost: \$1,242,393,284



# 2050 Emission Reduction Measures

## Electric Trucks

90% of fleet

\$580,095,000

305,163 tons  
CO<sub>2</sub>e per year

## IMO Efficiency Improvements

EEDI 30%  
improvement

150,090 tons  
CO<sub>2</sub>e per year

## Shore Power

All vessel  
calls

Shipside:  
\$549,360,000

120,120 tons  
CO<sub>2</sub>e per year

## Cargo Handling Equipment

100% Electric

Equipment:  
\$610,033,775

Infrastructure:  
\$947,290,341

77,811 tons  
CO<sub>2</sub>e per year

\* Total Cost: \$2,829,779,116



# 2050 Emission Reduction Measures

## Electric Switching Locomotives

100%

\$60,000,000

39,021  
tons CO<sub>2</sub>e per year

## Hybrid Tug Assist Vessels

100%

\$38,000,000

13,936  
tons CO<sub>2</sub>e per year

## Truck Efficiency Improvements

New fuel efficiency regulations

2,390  
tons CO<sub>2</sub>e per year

\* Total Cost: \$2,829,779,116



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# Future Emission Reduction Projects



# Future Emission Reduction Projects: Shore Power for Container Terminals

- **Terminal 5 – Seattle**
  - Permit condition expects 30% implementation in first 10 years, 50% in years 10-20, and 70% thereafter
- **Working with Seattle City Light to update a planning study for scoping shore power at T18 and T46.**
- **Working with Tacoma Public Utilities (TPU) to scope shore power in South Harbor**
  - PCT, Husky, WUT, and reefers (\$7 million infrastructure improvements from TPU)



# Hoteling Cost Analysis

- **Hoteling cost burning fuel: \$16,483**
- **Hoteling cost plugging in: \$15,119 (\$13,344 without additional labor)**
- **Sensitive to: Cost of fuel, cost of electricity, number of ships plugging in per month**
- **Goal: Work with utilities to create financial incentive for the shipping lines to plug in through electricity rates**



# Clean CHE Program

- **EDF Climate Corps Fellow, summer 2018**
- **Develop schemes to incentivize CHE fleet turnover without compromising performance for customers.**
- **Challenges are long equipment lifespans and high price point**
- **Focus on cost and financial sustainability**
- **Climate Smart**



# Trucks

- **Lessons learned from current clean truck program:**
  - It is difficult to convert the entire fleet at once
  - There is little data on trucks serving the gateway
  - There is opportunity to improve efficiency in the drayage system to reduce wait times.
    - Reduces emissions and increases number of turns for drivers
- **Staff developing truck study to evaluate fleet size**
- **Focus future efforts on Electric Trucks**
  - Prioritize electric trucks once technology is available due to reduced emissions, reduced fuel costs, reduced O & M costs
  - Diesel truck efficiency standards projected to reduce GHG emissions by 25% in new trucks by 2027, electric up to 100%



# Funding

- **Volkswagen Mitigation Fund**

- Total fund for Washington State: \$112.7 million
- Applications in late 2018
- Funding available:
  - Up to \$50.7 million for maritime projects (e.g. shore power)
  - Up to \$50.7 million for heavy duty vehicles
  - Up to \$5.6 million for cargo-handling equipment
  - 50% DERA grant match

- **2018 DERA Grants**

- Total fund for the U.S. is expected to be at least \$20 million
- Maximum project award for Region 10 TBD; Maximum award in 2017 was \$800,00
- Application criteria expected in Spring 2018
- Recommend applying for Clean CHE Program



# Conclusions/Next Steps

- **PSEI released 3/22 outreach through community presentations ongoing**
- **Emissions are down, we met 2020 goals of the NWPCAS in 2016**
- **Still work to be done to be done to address local impacts and meet GHG targets**
- **Work collaboratively with industry and other ports to accelerate technology development**
- **Developing emission scenario evaluation tool**
  - Allows staff to project the effects of implementing air quality programs
- **NWPCAS Update:**
  - Community outreach

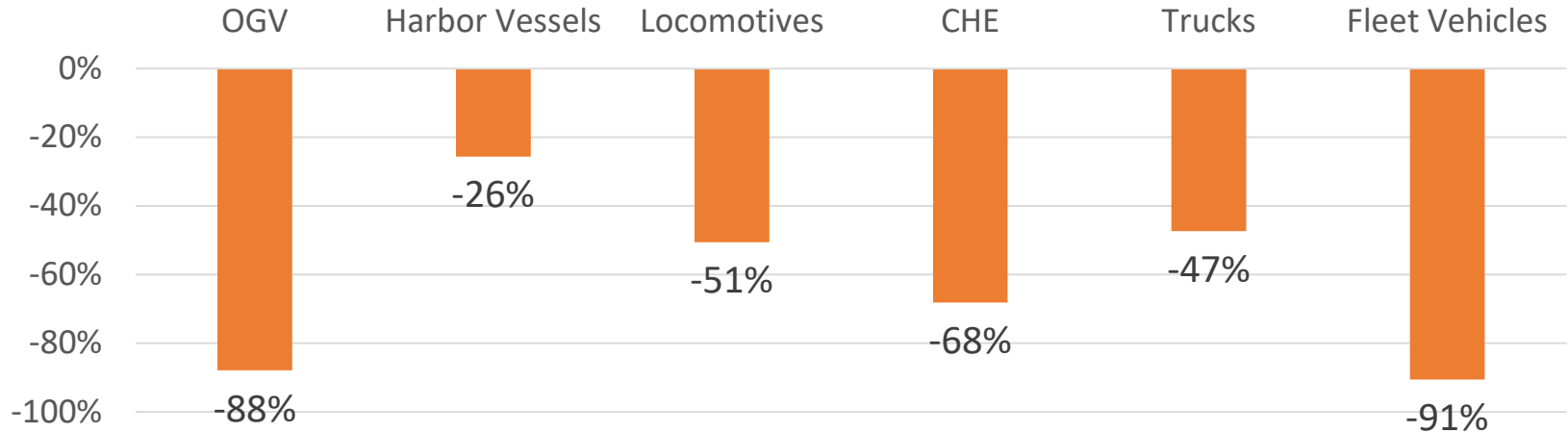


# Supplementary Slides

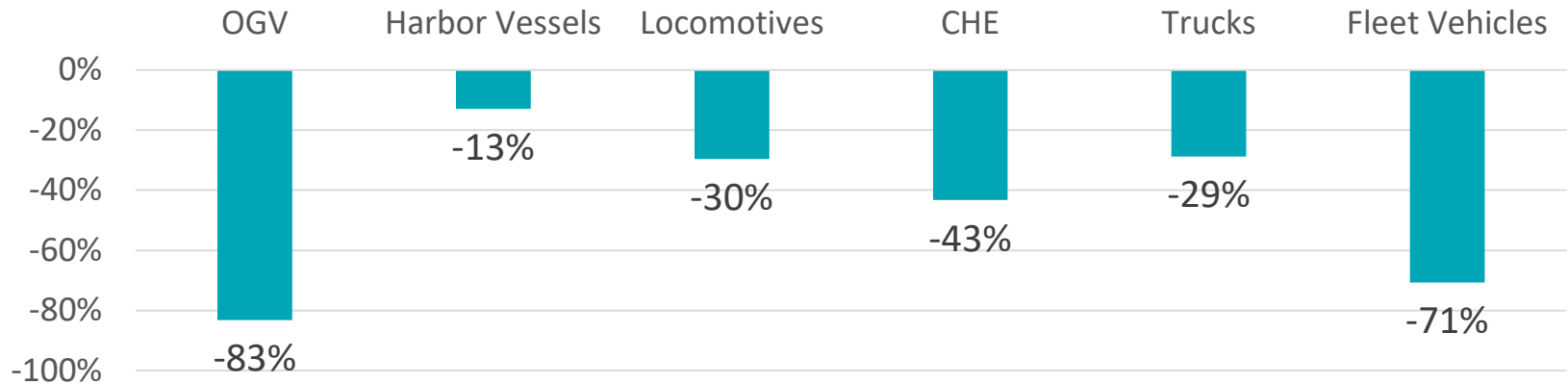


# DPM Emission Changes by Sector

2005 - 2016

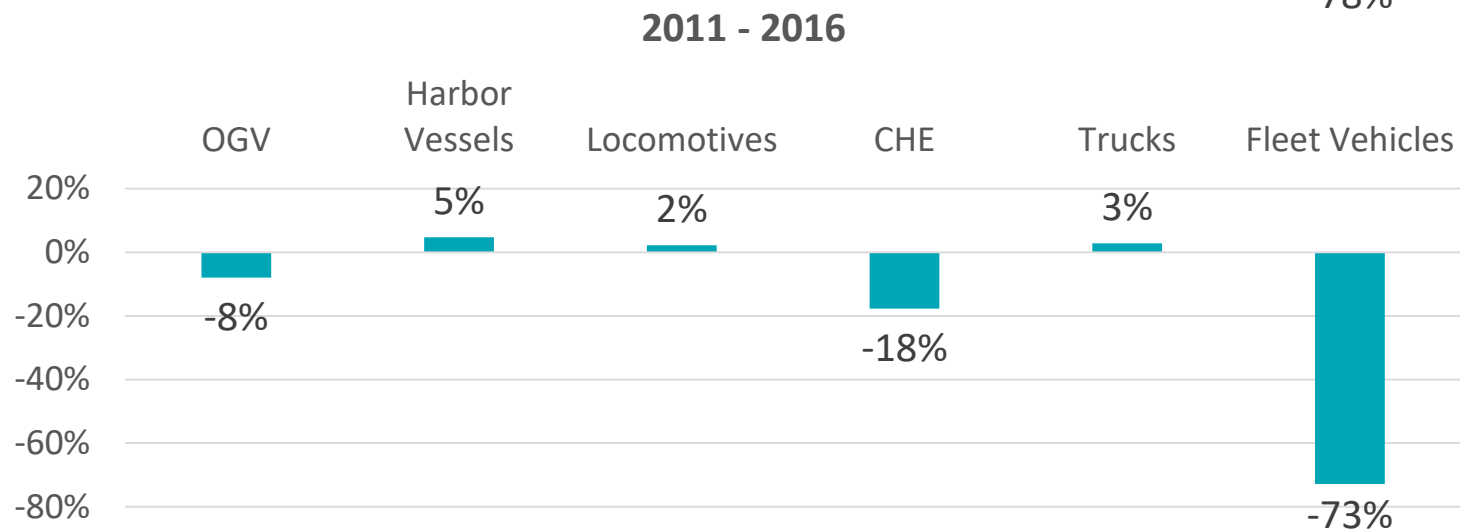
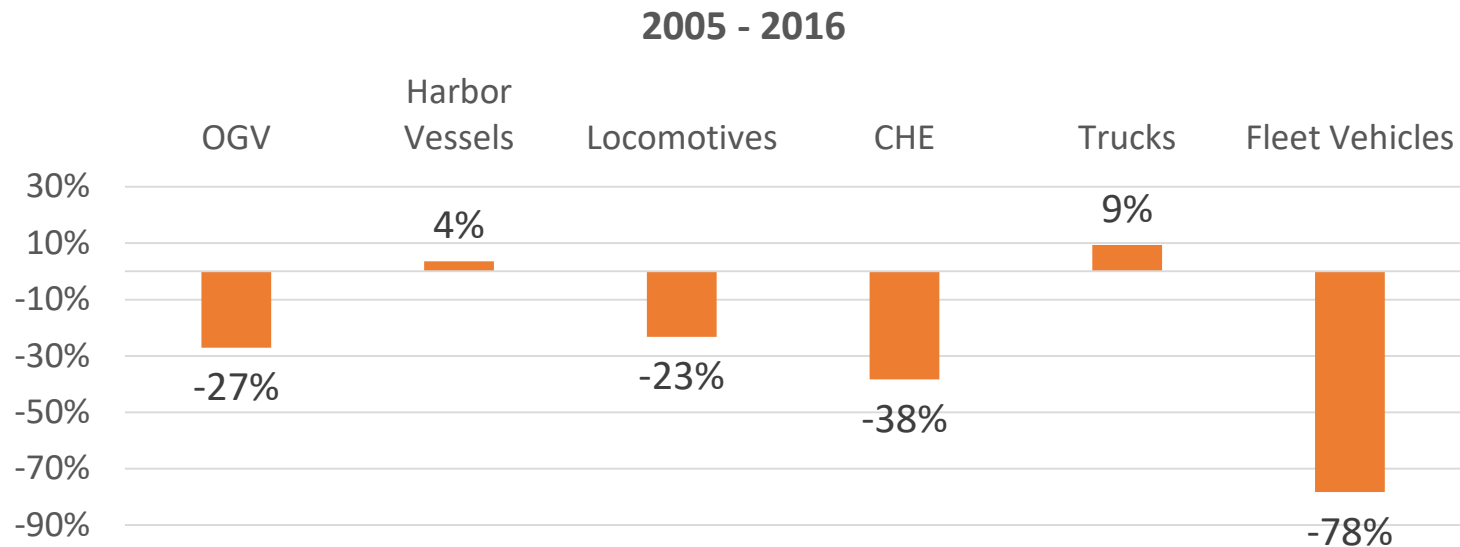


2011 - 2016





# GHG Emission Changes by Sector 2005 - 2016



# Potential for Current Implementation

Terminal	Percentage of Calls Shore Power Capable	Average Calls Per Month Shore Power Capable	Expected Shore Power Capable Hoteling Hours per Month
PCT	51%	4.55	252
Husky	23%	2.38	132
WUT	15%	1.75	77

- Fraction of shore power capable vessels is expected to increase over time
- Depends on global regulations, and technology

