

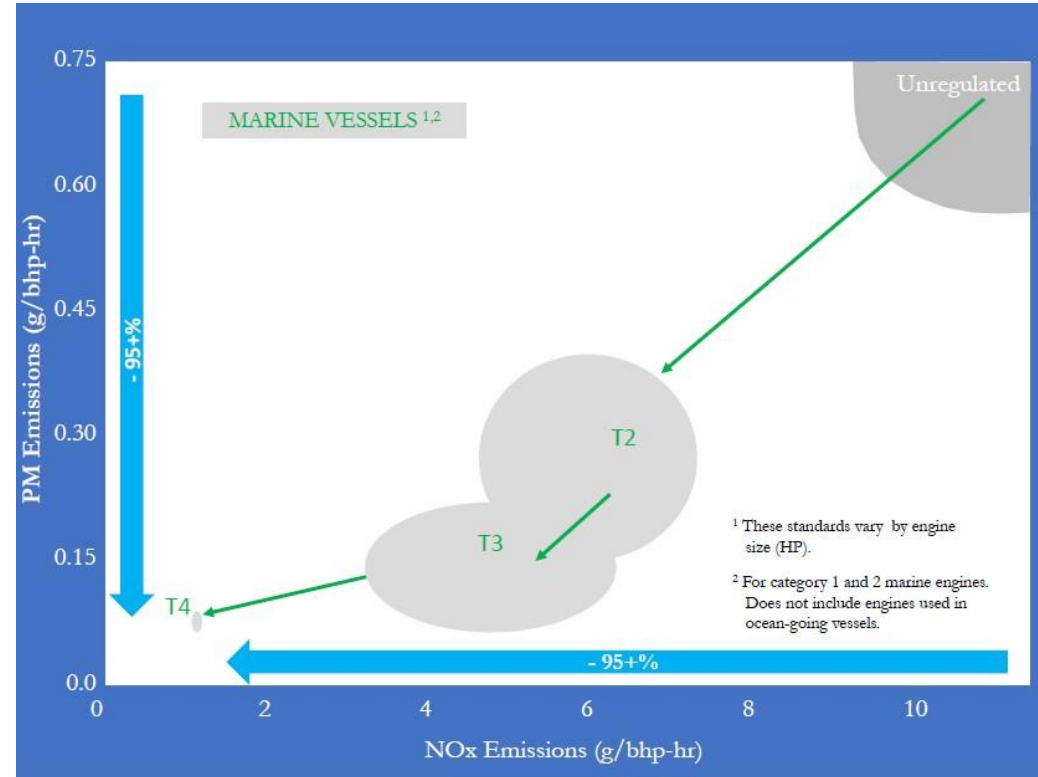


Marine Emission Reductions

Clean Air Northeast Partners Meeting
October 18, 2023

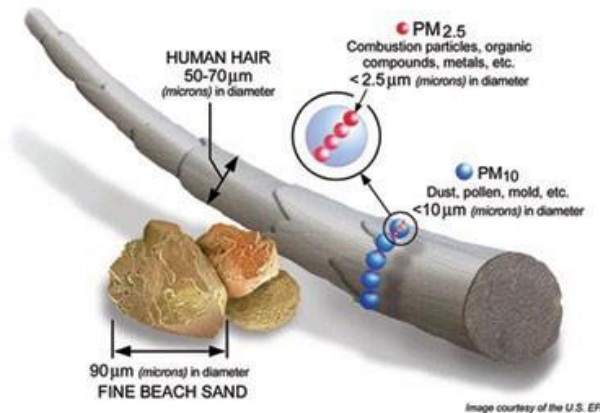
Background / History

- Evolving regulations
 - Tier 1 – Tier 4
 - + Requirements
 - IMO Tier 3 ECA
- Criteria pollutants (NO_x & PM focus)
- Longevity



Why Reduce Diesel Emissions

- Combustion byproducts such as particulate matter (PM), nitrogen oxides (NO_x), volatile organic compounds (VOC) / hydrocarbons (HC) and carbon dioxide (CO₂) have negative health effects to humans.
- Emissions also effect the environment and are linked to climate change
- **PM:** can cause cancer and non-cancerous related health problems. Fine and “ultra-fine” particles with diameters of 2.5 microns or less (i.e., PM_{2.5}) are of greatest concern. They stay suspended in the air stream and can embed deep in the lungs when inhaled—the smallest of these particles can also enter the bloodstream directly through the lungs. The vast majority of PM particles emitted by diesel engines are small enough to be classified as PM_{2.5}.
- **NO_x & VOC/HC:** precursors to ozone formation (smog)
- **CO₂:** a greenhouse gas that contributes to climate change



EPA Concludes Fine Particle Pollution Poses Serious Health Threats

- Causes early death (both short-term and long-term exposure)
- Causes cardiovascular harm (e.g., heart attacks, strokes, heart disease, congestive heart failure)
- Likely to cause respiratory harm (e.g., worsened asthma, worsened COPD, inflammation)
- May cause cancer
- May cause reproductive and developmental harm

—U.S. Environmental Protection Agency, *Integrated Science Assessment for Particulate Matter*, December 2009. EPA 600/R-08/139F.

Assistance Funding

- Federal/State DERA
- VW Consent Decree
- Tribal/Insular Grants
- Congestion Mitigation Air Quality
- MARAD US Marine Highways Program
- MARAD META
- Ferryboat Program
- U.S. DOJ and/or State Consent Decree SEP

Benefits Perspective

- Environmental Community
 - Emission reductions, NAAQS
 - Health benefits
 - GHG reductions
 - Accelerate fleet turnover
- Fleet
 - Extend useful life of vessel
 - Compete for contracts
 - Fuel savings
 - Lifecycle costs

DERA Programs 2008-2021

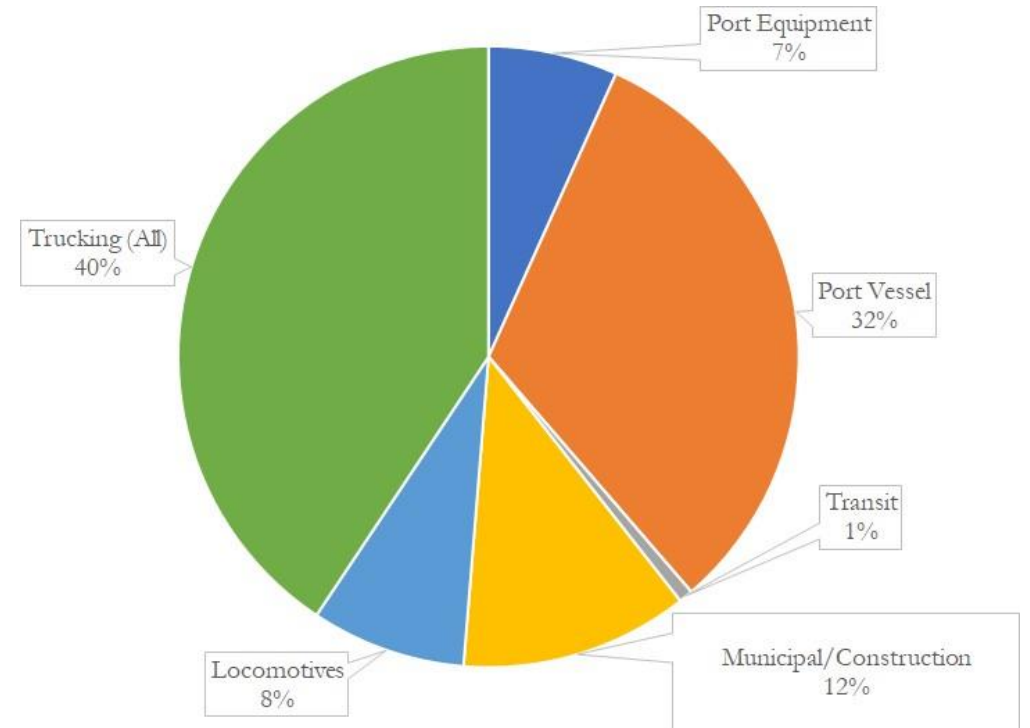
- National Competitive Programs

- ~\$681+ million awarded
- ~\$34.5 million (Region 1)
- ~\$62.4 million (Region 2)



- EPA Region 1 (Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut)
- EPA Region 2 (New York, New Jersey, Puerto Rico, and the US Virgin Islands)

- EPA Region 1 & 2



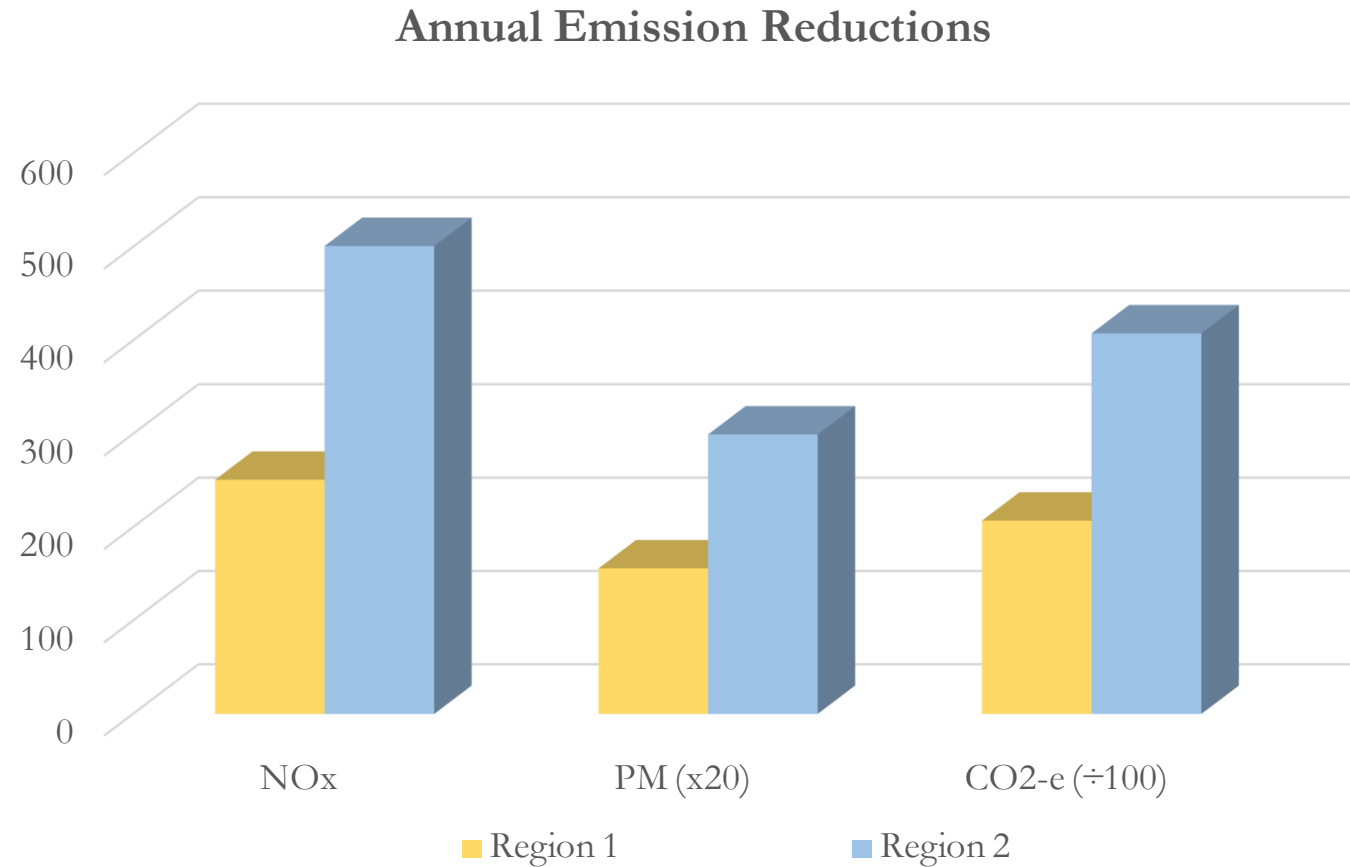
DERA Success

Significant benefits

- Emission reductions
- Cost-effective

Capital cost-effectiveness

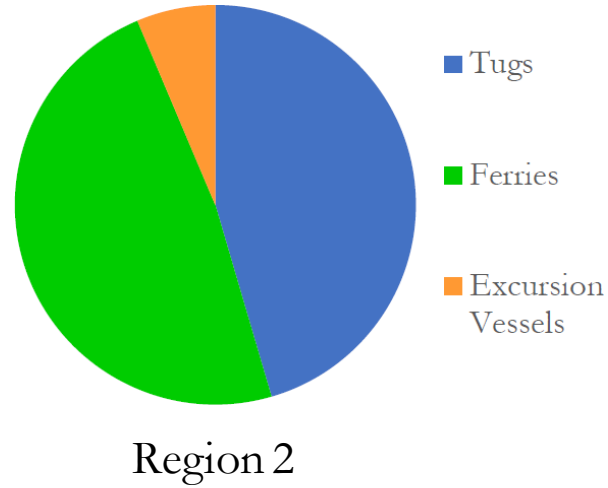
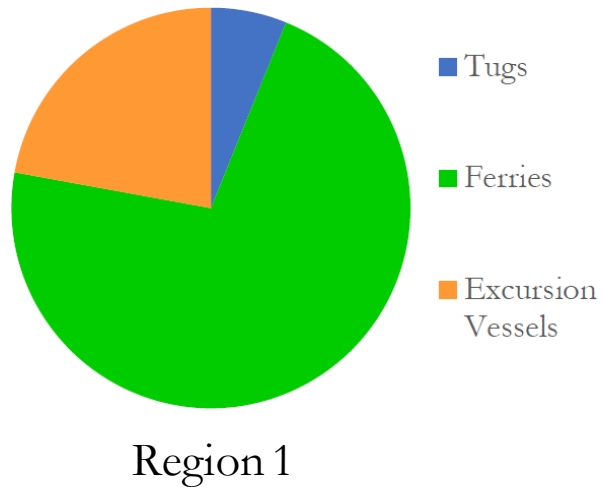
- NO_x: \$3,500 - \$8,500
- PM_{2.5}: \$110,000 - \$215,000



DERA Success

- Significant benefits
 - Cumulative health cost savings

Combined projects equivalent to taking >1,800 diesel tractor trailer trucks off the road



Project Profile – SeaStreak

- Northern New Jersey - Manhattan
- Cleaner engines & reduced fuel consumption
- 3 catamaran ferries
- 4 engines to 2
- Annual emission reductions per vessel
 - 131 tons NO_x
 - 3.3 tons PM_{2.5}
 - 10,400 tons CO₂-e
- Reduced weight = better fuel economy
 - 145,000 gallons diesel
 - 10,200 tons CO₂-e per year, per vessel



Project Partner: Connecticut Maritime Foundation

Project Profile – Buchanan Marine

- New York Harbor
- Tier 1 to Tier 3 engine replacement
- Reduced power 4,000 hp – 3,400 hp
- More efficient operation
- Annual emission reductions
 - 86.7 tons NO_x
 - 1.83 tons PM_{2.5}
 - 5,492 tons CO₂-e



Project Partner: Connecticut Maritime Foundation

Project Profile – Interstate Navigation

- Rhode Island
- 6 engine replacements
 - Carol Jean: Tier 1 to Tier 3
 - Anna C.: Tier 0 to Tier 3
- Better bang for the buck
- Annual emission reductions
 - 24.5 tons NO_x
 - 0.623 tons PM_{2.5}
 - 1,833 tons CO₂-e



Project Partner: CLF Ventures, Inc.

Project Profile – Cross Sound Ferry

- Long Island Sound
- 5 vessels 2008-2020
- Tier 3 engine replacements
- Tier 2 engine upgrade
- Annual emission reductions
 - ~ 165 tons NO_x
 - ~4.1 tons PM_{2.5}
 - ~11,000 tons CO₂-e



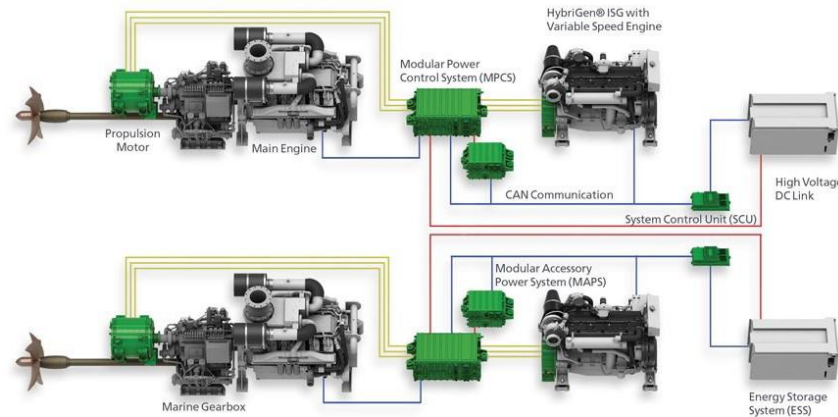
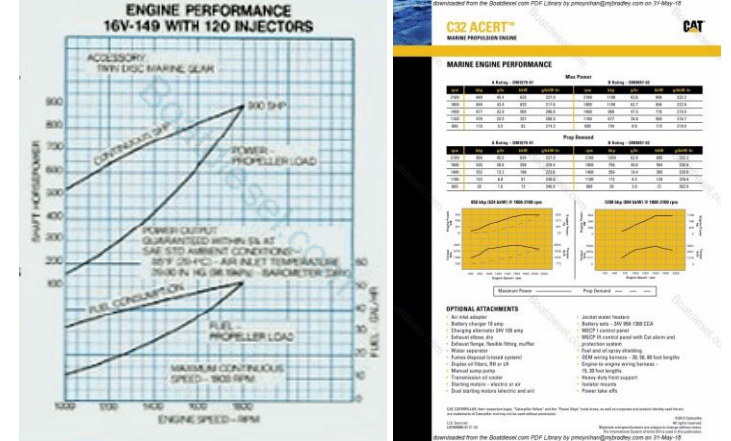
Project Partners: Connecticut Department of Energy & Environmental Protection; Connecticut Maritime Foundation

Active Projects

Partner / Fleet	Vessel Type	Vessel Name(s)	Budget		Annual Emission Reductions (tons)		
			Total Project	Grant Amount	NO _x	PM _{2.5}	CO ₂ -e
CLF Ventures, Inc.							
41 North Offshore	Tug	<i>Kodiak; SITKA; Grizzly</i>	\$ 1,846,870	\$ 579,991	7.55	0.386	962
Hornblower Cruises & Events	Excursion	<i>Spirit of Boston; Frederick L. Nolan</i>	\$ 1,407,488	\$ 546,610	9.18	0.390	976
Connecticut Maritime Foundation							
Blakeslee Arpaia Chapman	Tug	<i>David</i>	\$ 431,829	\$ 231,529	1.17	0.067	167
Interstate Navigation	Ferry	<i>Athena</i>	\$ 1,666,503	\$ 733,743	12.32	0.497	1,327
SeaStreak	Ferry	<i>Highlands</i>	\$ 4,489,567	\$ 1,832,567	130.66	3.304	10,425
Hornblower Metro Fleet	Ferry	<i>Straits Express</i>	\$ 2,402,393	\$ 1,037,213	69.91	1.164	2,834
New York Water Taxi	Ferry	<i>Marion S Heiskell; Gene Flatow</i>	\$ 1,057,764	\$ 490,164	12.56	0.400	1,002

Decarbonization

- Engine optimization, replacement
- Speed strategies
- Vessel replacements / right-sizing
- Hybridization
- Biofuel
 - Biodiesel
 - Renewable diesel
- Advanced Fuels
 - Methanol
 - Ammonia
 - Hydrogen



Schematic diagram courtesy BAE Systems

Thank You

Paul Moynihan

PJM Consulting, LLC

paulm@pjmconsulting-llc.com

978-302-6616