

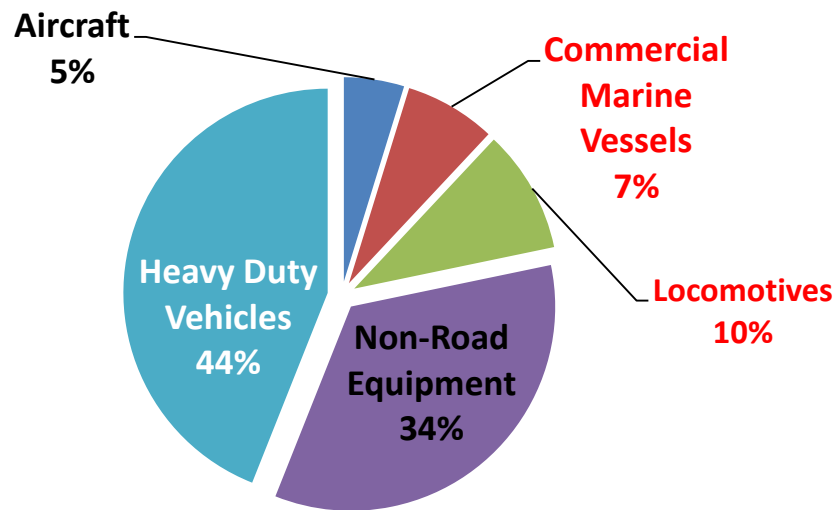
Maximizing Emission Reduction Investments – Large Engines that Power Locomotives & Marine Workboats

NORTHEAST DIESEL COLLABORATIVE PARTNERS MEETING
SEPTEMBER 26, 2017

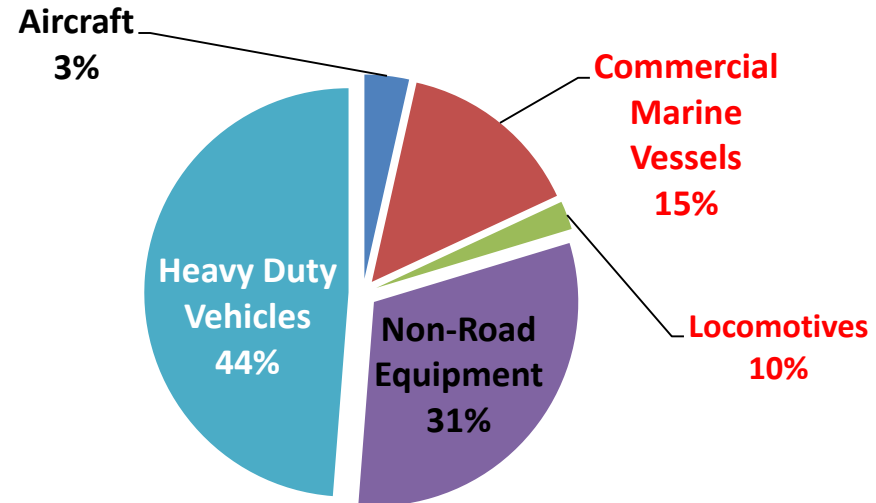


...and Trucks, Equipment, Locomotives and Marine Make Up the Heavy-Duty Category

NY: Heavy Duty Sources of NOX Emissions (2014)



NJ: Heavy Duty Sources of NOX Emissions (2014)

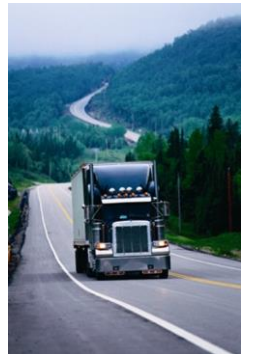


SOURCE: National Emissions Inventory, U.S. EPA

Eligibility for Project Funding in the VW “Appendix D” Program



**WHAT CATEGORIES OF
VEHICLES AND EQUIPMENT
ARE ELIGIBLE FOR NOX
MITIGATION FUNDING?**



A Wide Variety of Options Are Eligible for Funding to Reduce NOx Emissions



Off Road Engines & Equipment

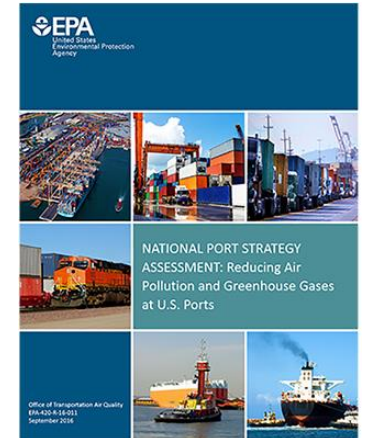
LARGE ENGINES
LARGE OPPORTUNITIES
LARGE BENEFITS



EPA 2016 Port Strategy Assessment outlines the advantages of clean diesel



- ▶ “Older trucks and equipment are longstanding fixtures of many port operations, and it will take many years before these fleets turn over to newer technology. “
- ▶ “Accelerating the retirement of older port vehicles and equipment and replacing them with the cleanest technology will reduce emissions and increase public health benefits beyond what would be achieved without further voluntary actions.”
- ▶ “For example, the emission reductions from replacing older drayage trucks with cleaner diesel trucks is significant, with NOx emissions being reduced by up to 48% in 2020 and PM2.5 emissions being reduced by up to 62% as compared to the Business as Usual case.”



<https://www.epa.gov/ports-initiative/national-port-strategy-assessment>

Large Engine Upgrades Deliver Enormous Emission Reduction Benefits



UPGRADING BIG ENGINES BRINGS BIG CLEAN AIR BENEFITS, FAST

New Clean Diesel Engines for Ferries, Tugs and Switch Locomotives Generate Substantial Clean Air Benefits

The \$2.7 billion Environmental Mitigation Trust included in the VW settlement provides funding for states to upgrade or repower older vehicles and equipment to rapidly reduce emissions of oxides of nitrogen (NOx) that contribute to ground level ozone, or smog. The emission reductions from replacing just one of the oldest engines that powers some of the largest diesel equipment is equivalent to converting hundreds of thousands of passenger vehicles to a zero emission option. States are gearing up **NOW** to decide how to invest their Trust revenue and while charging infrastructure is on the planning books and consumers wait to make the investment in an EV, clean diesel is ready **TODAY** to deliver immediate air quality benefits.

TUG BOATS



Replacing **1** of the oldest engines with the newest clean diesel Tier 4 engines removes

96,000 lbs of NOx / Year.

This is equivalent to...

Replacing **76** older trucks

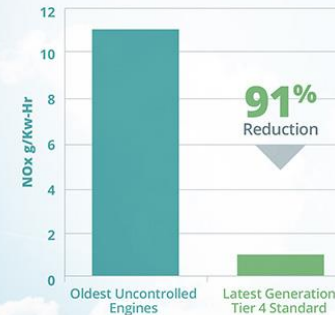


OR



Removing **74,000** cars for 1 year

Tier 4 = Near Zero Emissions



Upgrading Tug Boat Engines Delivers Cleaner Air Faster

By 2020, the EPA estimates that only 3% of tug boats will be powered by the latest clean technology. The VW Environmental Mitigation Trust represents an opportunity to get the latest clean diesel technology into service faster to generate significant air quality benefits.

Source: U.S. EPA Office of Transportation Air Quality – National Port Strategy Assessment
 (Car) Assumes T2 BS NOx emissions of 0.05 g/mi; average annual mileage of 12,000 miles per year
 (Truck) Replaces a pre-1992 truck with a 2010 MY or newer truck.




Switch Locomotive “Repowers” are a Cost Effective NOx Reduction Strategy

SWITCH LOCOMOTIVES



Replacing **1** of the oldest engines with the newest clean diesel Tier 4 engines removes

37,602 lbs of NOx / Year.

This is equivalent to... 

Replacing **29** older trucks

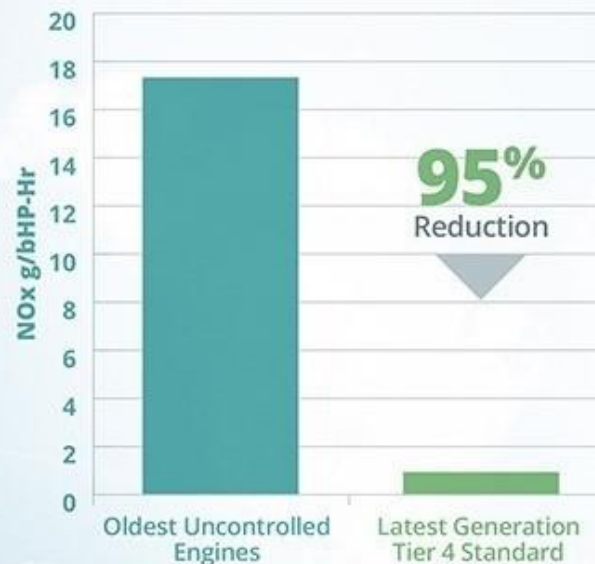


OR



Removing **30,000** cars for 1 year

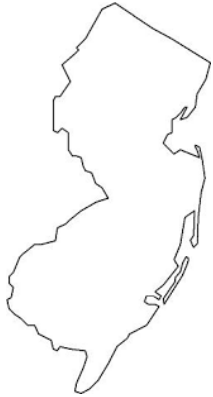
Tier 4 = Near Zero Emissions



Upgrading Locomotive Switch Engines Delivers Cleaner Air Faster

By 2020, the U.S. EPA estimates that only 5% of switch engines in service will be powered by the latest clean diesel engine. The VW Environmental Mitigation Trust represents an opportunity to get the latest clean diesel technology into service faster to generate significant air quality benefits immediately.

Preliminary Data Shows Big NOx Reduction Opportunities with Locomotives Investments for NJ



How to Make the Most of a \$72 million Investment for Immediate NOx Reduction

Price Per Application	# of Vehicles or Equipment placed into Service for \$72 million	Anticipated NOx Reduction per Year per Project	Total Cost to Exclusively Fund a Particular Project	Cost to Remove Each lb of NOx (\$/lb)	Total NOx Reduction (lbs) per year	
pre 1991 port truck replacement with Clean Diesel	\$110,000	655	1,282	\$72,000,000	\$86	839,127
pre 1991 port truck replacement with CNG	\$140,000	514	1,292	\$72,000,000	\$108	664,457
MY2000 bus replacement with Hydrogen	\$1,200,000	60	1,162	\$72,000,000	\$1,033	69,720
MY2000 bus replacement with Battery-Electric	\$880,000	82	1,162	\$72,000,000	\$757	95,073
MY2000 bus with Clean Diesel	\$370,000	195	1,062	\$72,000,000	\$348	206,659
T0 to T4 Clean Diesel switch locomotive	\$3,000,000	24	37,602	\$72,000,000	\$80	902,448

Source: (1) National Port Strategy Assessment: Reducing Air Pollution and Greenhouse Gases and U.S. Ports". U.S. EPA (September 21, 2016), (2) "clean Diesel Versus CNG Buses: Cost, Air Quality and Climate Impacts." Clean Air Task Force (2012). (3) "From Deceit to Transformation: How Connecticut Can Leverage Volkswagen Settlement Funds to Accelerate Progress to a Clean Transportation System. CONN PIRG. January 18, 2017. (4) "Consortium to Fund New Flyer Hydrogen Buses to ACTransit", Passenger Transport, February 24, 2017. (5) Locomotive engine upgrade cost based on a range of industry estimates.

Preliminary Data Shows Big NOx Reduction Opportunities with Locomotives Investments for New York



How to Make the Most of a \$127 million Investment for Immediate NOx Reduction

pre 1991 port truck replacement with **Clean Diesel**
 pre 1991 port truck replacement with CNG
 MY2000 bus replacement with Hydrogen
 MY2000 bus replacement with Battery-Electric
 MY2000 bus with **Clean Diesel**
 T0 to T4 **Clean Diesel** switch locomotive

Price Per Application	# of Vehicles or Equipment placed into Service for \$127 million	Anticipated NOx Reduction per Year per Project	Total Cost to Exclusively Fund a Particular Project	Cost to Remove Each lb of NOx (\$/lb)	Total NOx Reduction (lbs) per year
\$110,000	1,155	1,282	\$127,000,000	\$86	1,480,127
\$140,000	907	1,292	\$127,000,000	\$108	1,172,029
\$1,200,000	106	1,162	\$127,000,000	\$1,033	122,978
\$880,000	144	1,162	\$127,000,000	\$757	167,698
\$370,000	343	1,062	\$127,000,000	\$348	364,524
\$3,000,000	42	37,602	\$127,000,000	\$80	1,591,818



Source: (1) National Port Strategy Assessment: Reducing Air Pollution and Greenhouse Gases and U.S. Ports". U.S. EPA (September 21, 2016), (2) "clean Diesel Versus CNG Buses: Cost, Air Quality and Climate Impacts." Clean Air Task Force (2012). (3) "From Deceit to Transformation: How Connecticut Can Leverage Volkswagen Settlement Funds to Accelerate Progress to a Clean Transportation System. CONN PIRG. January 18, 2017. (4) "Consortium to Fund New Flyer Hydrogen Buses to ACTransit", Passenger Transport, February 24, 2017. (5) Locomotive engine upgrade cost based on a range of industry estimates.

New Research: Cost Effectivity of Large Engine Replacement Projects

- ▶ Task 1: What does it cost to reduce NOx on a \$ per ton basis
 - ▶ Confidential sampling of manufacturer data
- ▶ Task 2: What is the asset inventory of older engines in-use in 3 locations: Houston Ship Chanel, Baltimore, Port Authority NY&NJ
 - ▶ Preliminary data confirms asset inventory is much older than assumed
- ▶ Task 3: What are the anticipated NOx reduction benefits of replacing older larger engines with Tier 4 clean diesel models.
 - ▶ Houston Ship Chanel, Baltimore, Port Authority NY&NJ
- ▶ **Timing: Task 1 - Imminently**



Thank you for attending!

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