

Mobile Source Pollution Reduction Success Stories

Introduction

Great strides have been made in the past decade to reduce pollution from onroad and nonroad mobile sources in the Ozone Transport Region. A major focus has been on reducing pollution by retrofitting vehicles in the existing fleet, due to the fact that many nonroad and heavy duty onroad vehicles have a much longer usage life than do light duty onroad vehicles. Many of these retrofit programs have been funded through state and federal Diesel Emission Reduction Act (“DERA”), the American Recovery and Restoration Act (“ARRA”), and state governments. These projects have been undertaken by State agencies individually and in collaboration with private entities. While the primary objective of these retrofit projects is the reduction of particulate matter, many also provide great reductions in NO_x.

This document has been produced in order to share information about successful retrofit programs in the OTC member states, the cost associated with the retrofits, and the amount of reduced emissions. The objective of preparing this report is to provide OTC member states with a compilation of successful mobile source emission reduction projects that can be used as a blueprint for future grant funded work.

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CONNECTICUT

School Bus Retrofits

Using State DERA funds in conjunction with a State legislative allocation from Public Act 07-4, the Connecticut Department of Energy and Environmental Protection (“DEEP”) retrofitted 353 school buses with Diesel Oxidation Catalyst (“DOC”) and Closed Crankcase Ventilation (“CCV”) systems. This program successfully met the demand for school bus retrofits in the state.

Total cost: \$870,044

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total reduction
Emission Reduction	0	8.39	25.59	95.93	129.91

Ferry Engine Upgrade

Using ARRA and State DERA funds, with a significant contribution by the vessel owner, DEEP upgraded two propulsion engines on Cross Sound Ferry’s *MV Susan Anne* from Tier 0 to Tier 2 emission level.

While the first Tier 2 engine upgrade of a ferry in the United States was the most expensive project that DEEP has funded through the DERA program, it yielded impressive NO_x and PM reductions with remarkable cost effectiveness. The cost of replacing an engine on a boat the size of the *MV Susan Anne* is estimated to be nearly twice the cost of upgrading the engine, which would have seriously reduced the cost effectiveness of the pollution reduction. In addition, the fact that the engine upgrade could be accomplished without putting the large vessel in dry dock saved the owners a great deal of time and money, allowing the ferry to be back in operation quickly, an additional economic benefit to this Connecticut business. The engine upgrade is projected to save 5,758 gallons of diesel fuel per year.

Total cost: \$1,331,116.

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	719.4	22.5	See note*	157.7	899.6

*Neither the upgrade kit manufacturer nor EPA’s DEQ provided a number for HC reductions.

Tugboat Repower

Using State DERA funds and a contribution from the vessel owner, D. Brake Marine, LLC, DEEP is replacing the propulsion engines on tugboat *Gotham*, bringing it from Tier 0 to Tier 2 emissions level.

Total cost: \$191,013

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	101.85	1.09	See note*	9.78	112.72

*The DEQ does not provide a number for HC reductions from a marine engine repower.

Recycling Truck Replacement

Using State DERA and municipal funds, DEEP replaced four standard recycling trucks owned by the Town of Enfield, with two larger, fully automated, recycling trucks. The automated systems reduce idling time, allowing the two new trucks to cover all the routes previously served by four trucks. Air quality benefits accrue from improved emissions standards, from the decreased number of trucks and from reducing the amount of idling.

Total cost: \$587,938

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	85.19	4.26	3.95	22.66	116.06

Highway Maintenance Truck Retrofits

Using ARRA and National DERA funds, in two, separate projects, DEEP retrofitted the Connecticut Department of Transportation’s (“ConnDOT”) entire fleet of 175 highway maintenance trucks with DOCs.

Total cost: \$196,905

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	0	1.19	13.90	34.73	50.54

Highway Construction Equipment Retrofits

Using ARRA funds, DEEP retrofitted 19 pieces of highway construction equipment with DOCs, and five with DPFs. The equipment is working on ConnDOT projects in Fairfield County, which is in nonattainment for PM. The total emission reduction was small, but achieved cost effectively. The cost to reduce PM emission in the retrofitted equipment was \$65,000/ton,; and for the DOCs alone, the cost was \$35,000/ton.

Total cost: \$198,463

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	0	3.06	4.61	15.75	23.42

Maintenance Truck Replacement

Using State DERA and municipal funds, DEEP is replacing two maintenance trucks for the Town of Middlebury. Trucks will have auto-shut-off technology to reduce idling, thus saving fuel and decreasing emissions.

Total cost: \$140,000

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	19.28	1.20	1.55	7.01	29.04

Shuttle Bus Replacement

Using State DERA and university funds, DEEP replaced one shuttle bus for the University of Hartford.

Total cost: \$143,512

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	1.14	0.09	0.15	See note*	1.38

*While there is an annual reduction of CO, the lifetime emissions appeared to increase due to the fact that the lifetime of the old bus is only 12 years, while the new bus’s projected lifetime is 29 years.

CNG Replacement

Using State DERA funds and a significant contribution from the owner, Enviro Express, LLC, DEEP replaced a diesel-powered roll-off truck with a CNG-powered roll-off truck.

Total cost: \$165,077

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	0.77	0.09	0.11	0.75	1.72

DEEP Truck Retrofit

Using National DERA funds, DEEP retrofitted all thirteen of the eligible trucks in its fleet with DOCs.

Total cost: \$19,097

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	0	0.13	0.48	0.99	1.60

MARAMA

Marine engine retrofit

MARAMA provided a grant to the Annapolis Harbormaster to retrofit the Harbormaster’s patrol boat with a new hybrid diesel engine with an electric drive and solar panels. Estimates are that the new engine will use 30% less diesel fuel and 50% of the time no fuel will be burned because it will run on an electric motor. The project was funded by MARAMA’s ARRA grant from EPA Region 3 and the City of Annapolis.

Schedule:

Patrol Boat One entered service in October 2011. A second boat, the pumpout boat Dahlgren, is currently undergoing repowering. Engines from both old boats are being scrapped, and final grant payment awaits documentation of scrappage.

Specifications

The City of Annapolis’ two diesel powered harbor boats are being repowered with a Steyr Hybrid D solarelectric-diesel hybrid propulsion system. The system operates the boats on solar power and batteries for up to three hours at speeds up to six knots without a requirement to turn the diesel engine on. Three-quarters of the Annapolis harbor is subject to a six knot speed limit imposed by state law. By using emergent solar and renewable fuel technologies fuel consumption is reduced by up to 50% and emissions by over 50% in a given period.

Total cost \$214,165

Estimated Patrol Boat Emission and Fuel Reductions

Pollutant	NO _x	PM	HC	CO	CO ₂	Diesel Fuel
Estimated Emission and Fuel Reduction	0.13 (tons per year)	0.020(tons per year)	0.040 (tons per year)	0.59 (tons per year)	4 (tons per year)	370 (gallons per year)

Repower of 37 Year-old Tug “Bering Sea”

The Mid-Atlantic regional Marine Diesel Emission Reduction Project supported K-Sea Transportation Partners L.P.’s early replacement of two model year 1975 propulsion engines and two model year 1975 auxiliary engines with new model year 2010 EPA Tier II engines. With an estimated 75 % of the tug’s operations in EPA Region 3 waters, 75 % of the reductions will occur in Region 3.

Estimated Pollution Reductions (years 1-5)

Pollutant	NO _x	PM
Estimated Emission Reductions	27.14	.93

MARYLAND

Locomotives

Using ARRA funds, installed start/stop idle control devices on 10 locomotives. The retrofit resulted in idle reduction of 5,877 hours/year.

Total cost: \$309,476

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	73.5	3.93	11.67	35.40	124.49

Harbor Craft

Using ARRA funds, replaced the main and auxiliary engines of tugboat Kaleen McAllister (1 main, 2 auxiliary engines), dinner cruise vessel Inner Harbor Spirit (2 main, 2 auxiliary engines), and Maryland Port Authority harborcraft Endeavour (1 main, 2 auxiliary engines). A total of 10 engines were replaced. All engines were upgraded from Tier 0 to Tier 2 emission levels.

Total cost: \$1,599,730

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	435.02	19.06	1.15	46.82	502.05

MASSACHUSETTS

MBTA Locomotive HEP Repower Program

Repowered 18 head end power units on commuter rail locomotives with ARRA, DERA and SEP funds.

Total cost: \$1,793,000

Providence and Worcester Railroad Idle Reduction Program

Installed idling reduction technologies on 22 locomotives with SEP funds.

Total cost: \$475,000

NESCAUM

Uncontrolled Diesel Engines

Under two separate ARRA-DEIRA grants, 30 older, uncontrolled diesel engines were replaced with new, cleaner engines on 11 marine vessels based in Maine, New Hampshire, New York, Puerto Rico, and Vermont.

Idle Reduction Technology

Auxiliary power units were installed, on 17 locomotives, owned by a regional railroad operating in Massachusetts, Rhode Island, Connecticut, and New York.

NEW JERSEY

New York/New Jersey Harbor Deepening Project

The NY/NJ Harbor Deepening Project is a 13 year (2005 - 2017) dredging project that will deepen several channels in the Port to a depth of approximately 50 feet below mean sea level. The channels include: Ambrose, Anchorage, Kill Van Kull, Newark Bay, Arthur Kill, Bay Ridge and Port Jersey. In order for the project to meet the requirements of the Federal General Conformity regulation, a mitigation plan to reduce the annual NOx emissions to zero was required. The Port Authority of New York/New Jersey, Army Corps of Engineers, United States Environmental Protection Agency, New Jersey Department of Environmental Protection (“NJDEP”), New Jersey Department of Transportation's Office of Maritime Resources, New York State Department of Environmental Conservation (“NYSDEC”) and the New York City Department of Transportation collaborated to develop the Harbor Air Management Plan. Since the beginning of the project, the strategies in the Harbor Air Management Plan have been utilized to mitigate 2,661 tons of NOx.

The Harbor Air Mitigation Plan strategies include:

1. The installation of Selective Catalytic Reduction technology on two Staten Island ferries
2. The installation of Tier 1 kits on 3 Staten Island ferries and the installation of Tier II kits on 3 Staten Island ferries.

3. Main and/or auxiliary engines replaced on 20 marine vessels in the Marine Vessel Engine Replacement Program I and II (MVERP I and II)
4. Main engines replaced on 3 tugs for Port Jersey's Tug Engine Vessel Replacement Program (TERP)
5. Main/auxiliary engines replaced on 2 tugs for Kill Van Kull channel

Diesel Exhaust Reduction Plan

The Port Authority of New York and New Jersey, in collaboration with NJDEP, NYSDEC, and other stakeholders, developed a plan to reduce diesel exhaust, criteria pollutants and greenhouse gas emissions from maritime operations at the port. The resulting Clean Air Strategy Plan's goal is to achieve a minimum 30% net reduction of criteria pollutants and 50% net reduction of local greenhouse gases over 10 years. Modeling of the port area indicates significant improvements in air quality will result from these measures. The measures include incentivizing ships to use cleaner fuel (already underway) and modernizing the drayage trucks that call on the port (already underway).

Switcher Locomotives

Two switcher locomotives owned by CSX Transportation and Norfolk Southern Railway Company were upgraded through the installation of GenSet technology, which reduced fuel consumption by 25%. Emission benefits over a five-year period include 185 tons of NOx and 4.7 tons of PM2.5. A similar project was also completed involving 3 switcher locomotives operating at Port Newark and Elizabeth.

Other Projects

NJ Clean Cities Coalition received a grant in 2011 to replace 21 engines on 8 marine vessels with Tier 2 standard engines.

Repowered cargo handling equipment at South Jersey Port Corporation in Camden, NJ

NEW HAMPSHIRE

Locomotive Idle Reduction Project

Using DERA funds, the New Hampshire Department of Environmental Services (DES) provided the New England Southern Railroad Co., Inc. ("NES") \$28,000 to purchase and install a Hotstart[®] DV coolant heating system and battery charger. Locomotive engines are typically designed to use water for engine cooling. However, the water can freeze in cold weather and crack the engine block. As a result, shutting locomotives off in cold weather has historically been avoided as much as possible. The coolant heating system eliminates that idling completely and has the potential to save of 6,000 gallons of fuel annually and avoid 25 tons of nitrous oxide emissions.

Compressed Natural Gas Refuse Trucks

The City of Nashua, NH was provided with \$411,000 in DERA funds to help purchase nine CNG refuse trucks. The new trucks replaced older diesel vehicles from model years 1991 through 2005. Funds covered the cost of converting functionally equivalent diesel vehicles to run on CNG. The investment in CNG vehicles leveraged considerable private sector investment in CNG fueling infrastructure in Nashua. The City has since purchased several more CNG vehicles using funds provided by CMAQ through the

Granite State Clean Cities Coalition. Nashua’s new CNG fueling station is open to the public, enabling other local businesses to convert to CNG.

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	CO	Total reduction
Emission Reduction	22	0.4	1.8	24.2

Idle Reduction Technology

Using \$232,000 of ARRA funds, idle reduction equipment was supplied to eleven long haul trucks, nine transit buses, seven intercity buses and eight school buses. Combined, these four projects will yield:

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	CO ₂	Total Reduction
Emission reduction	117	2.9	5227	5347

New Hampshire is also funding additional idle reduction technology to schools buses via its DERA state program.

Marine Engine Replacements

Also using ARRA funds, four boats including two fishing and two excursion vessels were provided with \$239,200 to help fund the early replacement of their six engines.

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	CO ₂	Total Reduction
Emission Reduction	61	1.4	6.4	69.4

NEW YORK

Upstate Transit Buses Project

Using a \$1,635,087 ARRA-DEIRA grant, NYSDEC managed a project to successfully retrofit 170 diesel powered transit buses. The purpose of the project was to reduce diesel emissions and improve air

quality. The three upstate regional transportation authorities selected for funding under this project were: Central New York Regional Transportation Authority (CNYRTA), Rochester-Genesee Regional Transportation Authority (RGRTA), and the Niagara Frontier Transportation Authority (NFTA). Project funding was allocated to the three authorities based on the number of buses in their respective fleets that were required to be retrofitted and the financial resources available to each authority. There were 170 buses in total retrofitted with diesel particulate filters (DPF), with 33 from CNYRTA, 36 from NFTA and 101 from RGRTA. The DPFs reduced diesel emissions of PM by 90%, HC by 85%, and CO by 75% from the selected transit buses.

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	0	12.51	27,018	351.08	390.77

NYS Clean School Bus Project

Using \$885,886 of an ongoing DERA grant, NYSDEC in cooperation with the New York State Energy Research and Development Authority (“NYSERDA”) managed a project to successfully retrofit 199 school buses with a combination of DPFs, DOCs and CCVs. The purpose of this project is to reduce diesel emissions from school buses operating in New York State. This continuing project has recently been expanded statewide to include more school districts and add idle reduction technologies such as diesel fired coolant heaters in order to further reduce diesel emissions from school buses.

PENNSYLVANIA

The Pennsylvania Department of Environmental Protection has funded numerous projects to reduce emissions produced by diesel engines. Companies receiving funding have installed, retrofitted, re-powered, or replaced a wide-range of equipment including airport ground support equipment, locomotives, tugboats, school buses, refuse haulers, construction equipment and truck stop electrification equipment. The best of these projects are described below.

Total lifetime emission reductions from all diesel reduction projects funded are estimated to be (tons)

Pollutant	NO _x	PM	CO	VOC
Emission Reduction	4,027	2334	6,307	374

Locomotives – National Clean Diesel Grant Program

Norfolk Southern received a \$1.5 million dollar grant for their \$3.4 million Mother/Slug Re-power Project. The Mother/Slug Re-power Project replaces a total of four pre-1973 four-axle 2000 horsepower

engines with two larger engines with advanced technology, resulting in reduced fuel consumption and accelerated diesel emission reductions. This Mother/Slug pair effectively replaces two existing pre-1973 locomotives performing the same function, but uses one engine. The single engine that replaced the two older engines is 25% to 38% more fuel efficient depending on duty cycle and has reduced emissions.

Lifetime emission reductions

Pollutant	NO _x	PM	VOC
Emission Reduction	1,890	44	99

Long-Haul Trucking - State Clean Diesel Program

Using Diesel Emissions Reduction Grant funds, Hoopes Turf Farm (HTF), Inc. was awarded a 2011 PA State Clean Diesel Grant of \$285,000. HTF has replaced six heavy-duty, long-haul, diesel-powered trucks in their fleet with six liquefied natural gas (LNG) fueled trucks. Each of the six LNG-fuel trucks has a working radius of 300-350 miles. The project entails the purchasing of six 2013 Peterbilt™ Model 388 LNG-fueled tractors each with two fuel tanks, that offer longer range. HTF spent an additional \$450,000 on a 6,000-gallon Automated LNG Mobile Fueling System that will be made available for public access. HTF’s public-access LNG fueling system will be the first in Pennsylvania and only the second in the nation east of the Mississippi River. HTF will also save about 120,000 gallons of fuel annually.

Lifetime emission reductions

Pollutant	NO _x	PM	CO
Emission Reduction	13	0.5	1,1110

Marine Diesel Engines – Emerging Technology Grant

CONSOL Energy, operating in the Pittsburgh area, upgraded the engines on a Pittsburgh based towboat, Champion Coal. This included field testing an engine emissions upgrade kit manufactured by Caterpillar that was developed to satisfy the U.S. Environmental Protection Agency’s (EPA) new emission standards for class 2 marine engines. This project was a continuation of previous phases of work on upgrading the engine by Caterpillar and will reduce air pollution in the Pittsburgh area which has some of the highest concentrations of pollution in Pennsylvania. Testing showed that the kit not only met but exceeded EPA requirements.

Pollutant	NO _x	PM	CO	VOC
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Emission Reduction	650	16	90	9
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Philadelphia International Airport - VALE Projects

The Philadelphia International Airport (PHL) has either begun to implement or implemented a number of emission reduction projects between 2008 and the present. These projects were primarily funded through the Federal Aviation Administration’s (FAA) Voluntary Airport Low Emission (VALE) grant funding. VALE helps airport sponsors meet their state-related air quality responsibilities under the Clean Air Act. Through VALE, airport sponsors can use Airport Improvement Program funds and Passenger Facility Charges to finance low emission vehicles, refueling and recharging stations, gate electrification, and other airport air quality improvements. The projects completed at PHL include: purchase of electric-hybrid and full electric vehicles, purchase and installation of preconditioned air units at airport terminals, installation of ground power for a maintenance hangar, purchase and installation of electric ground service equipment charging infrastructure, and purchase and installation hydrant refueling system for airport equipment and vehicles. The intent of all of these projects is to reduce diesel emissions and fuel use in and around PHL. The lifetimes of the individual airport projects vary from 10 to 40 years.

Emissions reductions over the projects’ lifetime

Pollutant	NO _x	PM	CO	VOC	SO ₂
Emission Reduction	1,179	104	4,532	2,214	174