

Mobile Source Pollution Reduction Success Stories

November 1, 2012

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Introduction

Great strides have been made in the past decade to reduce pollution from onroad and nonroad mobile sources in the Ozone Transport Region (OTR). A major focus has been on reducing pollution by retrofitting, repowering, and modernizing 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 programs have been funded through state and federal Diesel Emission Reduction Acts (“DERA”) funds, 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 projects is the reduction of particulate matter (PM), many also provide reductions in NO_x as well.

This document has been produced in order to share information about successful retrofit, repowering, fleet modernization, and idle reduction programs in the OTC member states, the cost associated with these programs, and the amount of reduced emissions. The objective of 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 projects.

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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 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 nonattainment for PM. The total emission reduction was small, but achieved cost effectively. The cost to reduce PM 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 in Middlebury that will have auto-shut-off technology to reduce idling, 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 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

DELAWARE

The Department of Natural Resources and Environmental Control has been the project leader on a variety of clean diesel projects using funds from the Diesel Emission Reduction Act, the American Recovery and Reinvestment Act, Clean School Bus USA and other state funding sources. Below are the projects that have been completed, with a brief description.

DIESEL AFTER-TREATMENT SYSTEMS (DPF, DOC, CCV)

Delaware Transit Corporation

7 Gillig Low Floor buses with 2006 Cummins ISM engines and 7 Gillig Low Floor buses with 2000 Cummins ISM engines were retrofitted with diesel particulate filters. These buses are operated by the State of Delaware's DTC in northern Delaware in New Castle County.

Total cost: \$160,000

Seven School Bus Owners

118 buses ranging in engine model years 2002 -2006 were retrofitted with diesel particulate filters. 56 of those buses also had closed crankcase ventilation systems installed. The school buses are operated throughout the state in all three counties by school districts and one private company.

Total cost: \$1,425,000

Three Municipal Public Works Departments

32 heavy duty utility trucks were retrofitted with diesel particulate filters. These trucks are operated in New Castle and Kent Counties for the cities of Wilmington, Newark and Dover.

Total cost: \$520,000

Port of Wilmington

2 ship-to-shore cranes and 2 yard jockeys were retrofitted with diesel oxidation catalysts. The cranes and yard jockeys are operated by the Diamond State and are primarily used during the months of October to March for unloading and transporting freight from ocean going vessels.

Total cost: \$492,200.00

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	N/A	13.5	43.4	141	198

DIESEL ENGINE REPLACEMENTS

Port of Wilmington

1 Terex payloader, 1 Top Pick loading vehicle and 2 Raygo loading vehicles with Tier 0 engines were replaced with Tier 3 engines. The loading vehicles are primarily used during the months of October to March for unloading freight from ocean going vessels. The Terex is primarily used for snow removal.

Total cost: \$288,000

Wilmington Tug Company

Tug boat with two Tier 0 propulsion engines were replaced with two Tier 2 propulsion engines.

Total cost: \$770,000.

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	497	27	18	112	654

DIESEL ENGINE IDLE REDUCTION

Smyrna Rest Area

24 electrified truck parking spaces were installed at this rest area where the majority of the long haul truck traffic makes deliveries to the Walmart distribution center, two miles away.

Total cost: \$548,000

Trinity Trucking

20 reefer electrification outlets were installed. The electrical outlets replaced the need for truck idling that previously supplied the power to the trailer refrigeration units parked at the trucking company's facility in Wilmington which operated primarily on the weekend.

Total cost: \$250,000

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	CO ₂	Total Reduction
Emission Reduction	2,013	6	12,355	14,374

DIESEL EQUIPMENT REPLACEMENT

Fort Delaware

Two diesel reciprocating piston generators were replaced with a microturbine diesel powered generator. The microturbine generator will provide electricity to the Fort Delaware State Park on Pea Patch Island.

Total cost: \$160,000

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	Total Reduction
Emission Reduction	1,112	5	1,117

DISTRICT OF COLUMBIA

Marine Vessel Retrofit

Using DERA funds, in 2012 DDOE and MWCOG began a project to retrofit four diesel engines on the Passenger Vessel Spirit of Mt Vernon that operates on the Potomac River in the District of Columbia. Two propulsion engines and two gensets will be replaced. The engines have been purchased and will be installed in early 2013.

Total Cost: \$724,935 (grant funding of approximately \$427,000, remainder funded by the owner)

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	Total Reduction
Emission Reduction	31.3	1.5	32.8

MARAMA

City of Annapolis Diesel Emission Reduction Project

With an ARRA-funded sub-award from MARAMA, the Annapolis Harbormaster retrofitted two diesel-

powered boats with Steyr Hybrid D electric-diesel propulsion systems. The systems operate the boats on 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 harbor is subject to a six knot speed limit imposed by state law. It takes approximately three to four hours to conduct a routine harbor patrol.

Total cost: \$400,575 (\$299,519 grant funding)

Lifetime Emission Reduction (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	5.75	1.09	2.10	8.69	17.63

Alexandria VA DASH Transit Bus Replacements

Supported by an ARRA sub-award from MARAMA, Alexandria Transit Company replaced seven model-year 1996 – 1998 transit diesel buses with hybrid electric transit buses.

Total cost: \$3,652,621 (\$913,155 grant funded)

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	28.61	1.33	1.72	12.23	186.61

Cleveland Brothers Off-Road Construction Project (Pennsylvania)

With an ARRA-funded sub-award from MARAMA, Cleveland Brothers upgraded two pieces of off-road construction equipment to a higher EPA Tier level using EPA Verified components, and repowered 15 pieces of off-road construction equipment, i.e., replaced older engines with higher EPA Tier engines.

Total cost: \$1,095,483 (\$821,691 grant funded)

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	524.94	41.35	54.38	317.31	937.98

Chaney Enterprises Cement Truck Replacements (Maryland)

Chaney Enterprises used an ARRA grant from MARAMA to prematurely retire from service seven heavy duty cement trucks, model years 1997 – 1999, with essentially no emission reduction equipment, and replaced them with new, clean more fuel efficient 2010 vehicles.

Total cost: \$1,327,696 (\$306,465 grant funded)

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
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Emission Reduction	124.39	3.91	4.44	31.42	164.16
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CSXT Switch Locomotive Engine Repower (Maryland)

With support from an ARRA-funded sub-award from MARAMA, CSXT repowered an old switch locomotive from a single engine to a multi-engine genset locomotive. A switch locomotive (switcher) is used primarily for rail yard operations, and is typically an older locomotive that was underpowered for modern line haul duty. This engine is used in the Baltimore area.

Total cost: \$1,425,000 (\$947,625 grant funded)

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	Total Reduction
Emission Reduction	325.7	11.42	30.41	367.53

Maryland State Highway Administration (SHA) On-Road Retrofits

With an ARRA-funded sub-award from MARAMA, SHA retrofitted 181 dump trucks, model years 1990 – 2004, with high-efficiency diesel oxidation catalysts (DOCs). The dump trucks operate in eleven counties throughout Maryland: Anne Arundel, Baltimore (including Baltimore City), Calvert, Carroll, Charles, Frederick, Harford, Howard, Montgomery, Prince George’s, and St. Mary’s.

Total cost: \$251,764 (\$231,154 grant funded)

Lifetime Emission Reductions (tons)

Pollutant	PM	HC	CO	Total Reduction
Emission Reduction	10.54	12.75	52.87	76.16

Montgomery County Equipment Retrofits

With an ARRA-funded sub-award from MARAMA, Montgomery County retrofitted county vehicles and off-road engines with Diesel Particulate Filters (DPFs) and Diesel Oxidation Catalysts (DOCs) to reduce the diesel emissions. Specifically, 15 dump trucks, 12 delivery trucks, and five off-road engines were retrofitted with DPFs; and DOCs were fitted to 26 dump trucks and 14 delivery trucks. Montgomery County also installed cleaning units and DPF monitoring panels in several locations.

Total cost: \$531,019 (\$523,607 grant funded)

Lifetime Emission Reductions (tons)

Pollutant	PM	HC	CO	Total Reduction
Emission Reduction	30.23	42.57	207.63	280.43

Repower of 37 Year-old Tug “Bering Sea”

With National DERA funds, 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. It's estimated that 50% of the Bering Sea's operations will be in the Philadelphia area, 25% in the upper Chesapeake Bay, and 25% in the Hampton Roads area.

Total cost: \$1,145,393 (\$486,800 grant funded)

Lifetime Emission Reductions, Region 3 (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	203.5	6.08	3.25	28.72	241.55

MDE DERA Dray Truck Replacements

With a State DERA fund sub-award, MARAMA worked with the Maryland Department of the Environment to replace 10 drayage trucks serving Baltimore ports at a cost of \$20,000 per truck.

Total cost: \$546,940 (\$200,000 grant funded)

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	140.95	6.37	5.02	34.27	186.61

Pittsburgh Waste Hauler Retrofits

With a sub-award funded by an EPA Region 3 grant to MARAMA, the City of Pittsburgh retrofitted 13 waste haulers with diesel particulate filters (DPFs). This demonstration project highlighted the emission reduction capability of DPFs on waste haulers and addressed potential installation and operational barriers. Based on the success of this demonstration, the City of Pittsburgh applied for EPA funds to retrofit 33 additional waste haulers.

Total cost: \$163,000 (\$163,000 grant funded; the City of Pittsburgh provided in-kind staff resources and expertise to facilitate the program)

Lifetime Emission Reductions (tons)

Pollutant	PM	HC	CO	Total Reduction
Emission Reduction	0.69	0.87	4.14	5.7

Philadelphia Fire Truck Retrofits

With a sub-award funded by an EPA Region 3 grant to MARAMA, the City of Philadelphia retrofitted 68 fire engines with diesel oxidation catalysts (DOCs). The retrofitted fire trucks serve 53 fire houses throughout Philadelphia. This demonstration project highlighted the emission reduction capability of DOCs on fire trucks and addressed potential installation and operational barriers.

Total cost: \$148,447 (\$89,000 grant funded)

Lifetime Emission Reductions (tons)

Pollutant	PM	HC	CO	Total Reduction
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Emission Reduction	0.35	2.05	4.94	7.34
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Maryland Port Administration (MPA) Crane Retrofits

With a sub-award funded by an EPA Region 3 grant to MARAMA, the MPA retrofitted two cargo-handling cranes with diesel oxidation catalysts (DOCs). This demonstration project highlighted the emission reduction capability of DOCs on port cargo-handling equipment and addressed potential installation and operational barriers. Based on the success of this demonstration, MPA applied for and was awarded an ARRA grant that included funding for additional cargo-handling equipment retrofits.

Total cost: \$24,889 (\$12,500 grant funded)

Annual Emission Reductions (tons)

Pollutant	PM	VOC	CO	Total Reduction
Emission Reduction	0.0116	0.038	0.35	0.4

Truck Engine Idle Reduction

With funding from an EPA Region 3 grant, MARAMA provided 50 percent of the cost of auxiliary power units (APUs) to eligible and approved independent truck owner/operators and small transport company applicants in Delaware and Pennsylvania.

Total cost: \$84,000 (\$42,000 grant funded)

Annual Emission Reductions (tons)

Pollutant	NO _x	PM	Total Reduction
Emission Reduction	2.58	0.036	2.62

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

Cargo Handling Equipment

Using ARRA funds, installed 21 retrofits (DOCs), repowered 20 pieces of equipment and replaced 1 piece of equipment. This program was a joint effort between MDE, Maryland Environmental Service and Maryland Port Authority.

Total cost: \$ 498,659

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	72	9.6	n/c	n/c	81.6

*n/c not calculated.

Dray Truck Program

Using ARRA funds, installed 18 retrofits (14 DPF, 4 DOC), replaced 4 vehicles (2007 vehicles), and repowered 1 truck with 2007 engine. This program was a joint effort between MDE, Maryland Environmental Service and Maryland Port Authority.

Total cost: \$ 363,263

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	87.2	3.8	n/c	n/c	91.0

Maryland Idle Reduction Technology Grant Program

Using State DERA funds, MDE and MEA established an idle reduction technology grant program to provide financial assistance for the purchase and installation of idle reduction technology on trucks. Under the program auxiliary power units (APU) were installed on 54 trucks and fuel operated heaters (FOH) were installed on four trucks.

Total cost: \$225,000

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	CO ₂	Total Reduction	Fuel Savings
Emission Reduction	556	13.1	23,262	23,831	2,095,694

Maryland School Bus Grant Program

Using National and State ARRA funds, diesel particulate filters (DPF) and closed crankcase ventilation (CCV) systems were installed on 184 county owned school buses. Additionally, fuel operated heaters (FOH) and timers were installed on 50 school buses and FOH timers on 31 school buses. Baltimore, Frederick, Harford, Montgomery, Prince George’s, Queen Anne’s and Washington counties participated in the program.

Total cost: \$2,482,815

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	CO2	Total Reduction	Fuel Savings
Emission Reduction	4.7	9.1	16	87	155	207.6	13,946

Idle Reduction Campaign

ARRA funds, were used for a heavy-duty vehicle anti-idling (coach buses & trucks) outreach campaign in the state. The Metropolitan Washington Council of Governments (COG), Maryland Department of the Environment (MDE), District Department of the Environment (DDOE) and the District Department of Transportation (DDOT) formed a Steering Committee to develop and manage the Project. The campaign targeted trucking and bus companies, related trade associations and business groups. The campaign was implemented by a marketing consultant using a multi-jurisdictional approach.

Total cost: \$150,000

Driver Recognition Program

Using State DERA funds, the Driver Recognition Program was initiated as part of a broader Diesel Idle Reduction campaign which aimed to elevate awareness of the financial and environmental benefits of diesel idle reduction, and encourage compliance with idling regulations. The Driver Recognition Program engaged frontline personnel who ultimately make the decision to let their vehicles run or turn off their engines. The program acknowledged and rewarded those who comply with diesel idle reduction laws and set a good example for other drivers.

Total cost: \$20,145

School Bus Retrofit Grants

Using DERA funds, diesel particulate filters (DPF) and closed crankcase ventilation (CCV) systems were installed on 21 county owned school buses. Additionally, 3 closed crankcase ventilation (CCV) systems contracted school buses. Kent, Prince George’s and Washington counties participated in the program.

Total cost: \$187,056

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	0	0.7	1.6	8.0	10.3

Montgomery County DPF Cleaner

In order to properly maintain the filters used by the retrofitted vehicles, an Engine Control Systems Combiclean automated unit that automatically both bakes the filter and uses air to remove residual ash

was purchased. Recently DPF retrofitted vehicles include 3 rubber tire loaders used by Department of Solid Waste and 12 delivery trucks used by the Department of Liquor Control.

Total cost: \$17,149

County Fleet Retrofit Grants

Using EPA Grant and State DERA funds, diesel particulate filters and closed crankcase ventilation systems were installed on 17 local government trucks and diesel oxidation catalysts and closed crankcase ventilation systems were installed on 129 local government trucks. Participating jurisdictions were Charles County, City of Baltimore, City of Gaithersburg and City of Rockville.

Total cost: \$416,997

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	0	2.1	47	143	192

EPA (MPA) International Marine Emissions Reduction Study

Using DERA funds, MDE partnered with Maryland Environmental Service and the Maryland Port Authority to develop a study with two specific tasks. Task 1 would identify candidate technologies that would reduce emissions from ocean going vessels at the Port. Task 2 would evaluate the list of technical and operational options for reducing emissions developed under Task 1 and evaluate them for applicability at the Port of Baltimore.

Total cost: \$75,000

Maryland Port Administration (MPA) Retrofits

Using State funds, 12 rubber tire gantries, six yard jockeys and two trucks were retrofitted with diesel oxidation catalysts.

Total cost: \$132,079

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	0	2.1	5.5	16.4	24.0

Prince George’s County Thermal Wraps

A year after 85 school buses were retrofitted with passive diesel particulate filters (DPF), some of the buses required filter cleaning earlier than anticipated and were right on the borderline of the required heat needed for the DPFs to regenerate and burn the soot into ash. Further investigation revealed that the engine duty cycle had changed since the initial exhaust temperatures were taken as a result of changes to assigned bus routes and due to different driving characteristics of the drivers. To resolve the issue, thermal blankets were installed on the section of exhaust pipe from the turbo to DPF to retain the temperature in the heat range for the DPFs to regenerate.

Total cost: \$50,425

Construction Equipment Retrofits

Using EPA funds from a NCDC Grant, diesel particulate filters were installed on four rubber tire loaders owned by Montgomery County and City of Baltimore.

Total cost: \$50,000

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	0	2.0	2.7	7.9	12.6

Emergency Response Vehicle Retrofits

Using EPA funds from the Sensitive Populations Grant, a total of 81 emergency response vehicles including fire trucks, ambulances and hazmat vehicles were retrofitted with diesel oxidation catalysts. Participating jurisdictions were City of Annapolis, City of Baltimore, Montgomery County and Maryland Department of the Environment.

Total cost: \$89,120

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	0	1.1	43.3	428.3	472.7

MASSACHUSETTS

MBTA Locomotive Head End Power Repower Program

MassDEP provided ARRA, DERA, and supplemental environmental project (SEP) settlement funds to the Massachusetts Bay Transportation Authority (MBTA) to repower 18 head-end power (HEP) generator sets in its commuter locomotive fleet. HEP generators supply electrical power used for heating, cooling, and lighting the passenger coaches. Although much smaller than main locomotive engines (670 horsepower versus 3,000 hp), HEP engines typically consume 40 percent or more of the diesel fuel used by a locomotive and emit a substantial amount of the total emissions.

Total cost: \$1,793,000

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	260.6	18	14.5	133.4	426.5

Waste Collection Vehicle Retrofit Program

MassDEP provided funding to retrofit 203 waste collection vehicles owned by municipal and private waste haulers with diesel oxidation catalysts (DOCs). Funding was provided by ARRA, DERA, and SEP settlement.

Total cost: \$470,000

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	N/A	2.6	12.5	49.7	64.8

Massachusetts' state-owned on-road heavy-duty diesel vehicle fleet

MassDEP provided ARRA and SEP funding to retrofit 341 heavy-duty vehicles, including dump trucks, plow trucks, rack trucks, truck/crane combination vehicles, and front end loaders with DOCs. The vehicles are owned by the Massachusetts Department of Transportation and the Department of Conservation and Recreation. These vehicles are typically used for on-highway construction projects and/or snow plowing and other uses including movement of materials and personnel.

Total cost: \$699,000

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	N/A	5.6	18.9	58.3	82.8

Northeast Hybrid Truck Consortium Hybrid Truck Purchasing Program

MassDEP used ARRA, DERA, and SEP funding to offset the incremental cost (up to 25% or \$40,000) of purchasing 11 diesel medium- and/or heavy-duty hybrid trucks for commercial fleets and utility fleets as replacements for the conventional diesel-powered trucks.

Total cost: \$440,000

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	CO ₂	Total Reduction
Emission Reduction	10.1	0.4	1.4	5.5	1,941	1,958.4

Massport Fish Pier Electrification Project

MassDEP provided funding to Massport to enable fishing vessels berthed at the Boston Fish Pier associated to switch power from diesel engines to the electrical grid system. The ARRA funding was used to add three power stations to accommodate six vessels.

Total cost: \$100,000

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	CO ₂	Total Reduction
Emission Reduction	149.7	10.6	12.1	32.3	5,552.6	5,757.3

MassCleanDiesel 'Clean Air for Kids' Diesel School Bus Retrofit Program

Using \$3.7 million in state and federal funding provided by the Massachusetts Department of Transportation (MassDOT), the MassCleanDiesel program installed pollution controls, DOCs and crankcase ventilation (CCV) systems, on 2,114 diesel-powered school buses that served nearly 310,000 students in 300 local communities.

Total cost: \$3,700,000

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	Total Reduction
Emission Reduction	N/A	10.8	41.4	184.2	236.4

MassCleanDiesel: Clean Market Program

MassDEP is using DERA and SEP funds to provide retrofit technologies, idle reduction technologies and replacement of diesel transportation refrigeration unit (TRU) with electric units at markets, distribution facilities, and warehousing centers. The target fleets include 74 publicly or privately owned on-road and non-road vehicles, and stationary equipment.

Total cost: \$940,000

Providence and Worcester Railroad Idle Reduction Program

Installed idling reduction technologies on 22 locomotives with SEP funds.

Total cost: \$475,000

NESCAUM

Providence & Worcester Railroad Idle Reduction Program

Under a DERA Grant, auxiliary power units (APUs) were installed on 17 locomotives, operating in Massachusetts, Rhode Island, Connecticut, and New York. The project is expected to reduce annual idling by 25,500 hours and fuel consumption by 51,000 gallons.

Total cost: \$535,250

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	CO ₂	Total Reduction
Emission Reduction	212	6.8	5779	5997.8

CSX Locomotive Genset Repower & Retrofit Project

Using supplemental environmental project (SEP) funds provided by PSEG Fossil LLC and directed to this project by New Jersey DEP, each of three switcher locomotives was repowered with two generator sets meeting Tier 3 emission standards. Each generator set was retrofitted with a diesel particulate filter (DPF) to achieve emissions equivalent to a Tier 4 standard. These locomotives are operating in switch yards in Northern New Jersey.

Total cost: \$4,742,374

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	Total Reduction
Emission Reduction	475	28	503

CSX Locomotive Genset Repower Project

Under a DERA-ARRA grant, a switcher locomotive operating in New Haven, CT was repowered with three generator sets meeting Tier 3 emission standards. In addition to the emissions benefits, there is an annual fuel savings of 15,000 gallons.

Total Cost: \$1,400,000

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	Total Reduction
Emission Reduction	166	5	171

Construction Equipment Retrofit Projects

Under two separate DERA-funded projects, construction equipment (loaders, excavators) were retrofitted with diesel particulate filters (DPFs). One project involved five pieces of equipment based on construction sites in Massachusetts and New Hampshire. The other project involved 17 pieces of equipment, owned by rental companies and operating throughout Regions 1 and 2.

Total cost: \$521,682

Lifetime Emission Reductions (tons)

Pollutant	HC	PM	CO	Total Reduction
Emission Reduction	11.36	3.25	44.70	59.31

Marine Vessel Engine Repower/Upgrade Projects

Under two separate DERA-ARRA grants, a combination of 29 propulsion and auxiliary engines were repowered in 10 marine vessels. Two engines in another vessel were upgraded with certified NO_x rebuild kits. The vessels operate in Maine, New Hampshire, New York, Vermont, and Puerto Rico.

Total cost: \$6,771,024

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	CO ₂	Total Reduction
Emission Reduction	1096	81.5	6030	7207.5

Northeast Hybrid Truck Consortium Hybrid Truck Purchasing Program

Under a subcontract with the Environmental Defense Fund, NESCAUM managed this project to provide 25 percent subsidies to various fleets in Connecticut, Maine, New Hampshire, and Rhode Island towards the purchase of 11 new heavy-duty hybrid trucks. The subsidies were made available through a DERA grant. In exchange, fleet owners retired an older conventional diesel truck for each hybrid purchased.

Total cost: \$1,464,915

Annual Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO ₂	Total Reduction
Emission Reduction	2.28	0.08	0.13	84.20	86.69

New Jersey Vehicle Idle Reduction Project

Using supplemental environmental project (SEP) funds provided by Valero Energy Corporation and directed to this project by New Jersey DEP, an ambulance plug-in station was established at Underwood Memorial Hospital in Woodbury, NJ. In addition, a locomotive block heater plug-in station was built at the Valero Refinery, in Paulsboro, NJ. As a result, idling was reduced by 9200 hours per year.

Total cost: \$230,000

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	Total Reduction
Emission Reduction	27.3	0.9	28.2

Tower Gantry Crane Repower Project

Under a DERA grant, 17 crane power modules are being repowered with new engines meeting Tier 3 emission standards. These modules are principally used in cranes on construction sites in New York and New Jersey.

Total cost: \$1,822,223

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	Total Reduction
Emission Reduction	416	32	448

New England Locomotive Idle Reduction Project

Under a DERA grant, 29 locomotives, owned and operated by 8 regional railroads in Connecticut, Massachusetts, New Hampshire, and Vermont are being equipped with auxiliary power units (APUs). As a result idling will be reduced by 44,200 hours annually.

Total cost: \$1,110,722

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	CO ₂	Total Reduction
Emission Reduction	370	11	23,000	23,381

South Jersey Port Cargo Equipment Repower/Retrofit Project I

Under a CARE grant provided by EPA, supplemented by SEP funds directed to the project by New Jersey DEP, 6 units of cargo handling equipment were repowered with new engines and an additional 4 units were retrofitted with diesel oxidation catalysts (DOCs).

Total cost: \$750,000

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	Total Reduction
Emission Reduction	342	56	398

South Jersey Port Cargo Equipment Repower Project II

Under a DERA grant, approximately 30 units of cargo handling equipment at the port in Camden, NJ are being repowered with new engines meeting Tier 2 and Tier 3 emission standards.

Total cost: \$1,463,000

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	CO ₂	Total Reduction
Emission Reduction	352	34	720	1106

Camden (NJ) Retrofit Project

Using supplement environmental project (SEP) funds, 54 vehicles and equipment were retrofitted with diesel oxidation catalysts (DOCs) and diesel particulate filters (DPFs). The vehicles and equipment are from various publicly owned fleets in Camden County, NJ.

Total cost: \$381,167

Lifetime Emission Reductions (tons)

Pollutant	HC	PM	CO	Total Reduction
Emission Reduction	2.29	5.2	4.71	12.20

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 NO_x 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 NO_x.

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
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 NO_x and 4.7 tons of PM_{2.5}. A similar project was also completed involving 3 switcher locomotives operating at Port Newark and Elizabeth.

South Jersey Port Retrofits

NESCAUM, in collaboration with NJDEP, repowered a wharf crane, two front end Loaders and two large lift trucks at the South Jersey Port Corporation in Camden, NJ. An additional four vehicles (3 lift trucks and a water truck) were retrofitted with Diesel Oxidation Catalysts. Emissions benefits each year are estimated to include 2.78 tons of PM and 17.1 tons of NO_x.

New Jersey Clean Construction

Using several sources of funding, NJDEP is retrofitting diesel vehicles used on state construction projects in urban, high population areas. To date, 158 diesel particulate filters have been installed on 118 pieces of construction equipment. Emissions benefits each year are estimated to include 5.0 tons per year, with additional retrofits ongoing.

New Jersey Transit Idle Reduction

New Jersey Transit (NJT), working with NJDEP and NESCAUM, has instituted a two-pronged approach to idle reduction in their locomotives, encompassing both policy changes and technological updates. NJT has installed automatic shutdown devices on 33 NJ Transit PL-42 locomotives. They have revised their policy for trains entering or leaving their train yard, limiting idling to no more than 1 hour per day per locomotive. The installations reduced emissions of PM by 1.86 tons per year and NOx by 74.95 tons per year, while the policy change dropped PM by 14.8 tons per year and NOx by 592 tons per year.

Ambulance bay electrification

Through two Supplemental Environmental Projects, the ambulance bays at Underwood Memorial hospital in Camden, NJ were outfitted with electrification technology, and electric plug-ins were installed for nearby short line locomotives. The ambulance bay electrification reduced PM by 0.12 tons per year, and NOx by 0.338 tons per year, while the locomotive plug-ins achieved a PM reduction of 0.078 tons per year of PM and 2.392 tons per year of NOx.

Mandatory Diesel Retrofit Program

Pursuant to a law passed in 2005, retrofits have been installed on 10,000 school buses, garbage trucks, transit buses and “public works” type vehicles, with an additional 6,000 expected before the program ends in 2016. When completed, these retrofits will result in about 130 tons per year of PM benefits.

Other Projects

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

Total cost: \$28,000

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.

Total cost: \$232,000

Lifetime Emission Reductions (tons)

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

New Hampshire is also funding schools bus additional idle reduction projects 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	Total Reduction
Emission Reduction	4,027	2334	6,307	374	13,042

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 (tons)

Pollutant	NO _x	PM	VOC	Total Reduction
Emission Reduction	1,890	44	99	2,033

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 (tons)

Pollutant	NO _x	PM	CO	Total Reduction
Emission Reduction	13	0.5	1,110	1,123.50

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 exceeded EPA requirements.

Lifetime emission reductions (tons)

Pollutant	NO _x	PM	CO	VOC	Total Reductions
Emission Reduction	650	16	90	9	765

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 near PHL. The lifetime of the individual airport projects vary from 10 to 40 years.

Emissions reductions over the projects' lifetime (tons)

Pollutant	NO _x	PM	CO	VOC	SO ₂	Total Reduction
Emission Reduction	1,179	104	4,532	2,214	174	8,203

VERMONT

School Bus Retrofits

Using Clean School Bus USA grant funds in conjunction with State funds and in-kind staff resources and expertise to facilitate the program, the Vermont Department of Environmental Conservation (DEC) retrofitted 15 school buses with Diesel Oxidation Catalysts (DOCs) and Closed Crankcase Ventilation (CCV) systems and equipped 25 buses with programmable diesel-fired coolant heater technology. Through this project, emissions from buses equipped with emissions control retrofit devices and idle-reduction technology were significantly reduced, childhood exposure to unhealthful contaminants was reduced, and the effectiveness of these technologies was demonstrated to a broad audience of school bus administrators and interested parties throughout the state. The idle reduction technology will also result in an estimated savings of 59,762 gallons of diesel fuel over the remaining life of the buses.

Total cost: \$200,904

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	CO ₂	Total reduction
Emission Reduction	20.0	0.7	0.5	1.2	663.4	685.8

School Bus Replacement

Using ARRA-DEFA funds, DEC provided technical assistance and cost-matching grants to Vermont school districts to improve air quality and help protect public health through the early replacement of 43 older, more heavily polluting school buses with new buses equipped with state-of-the-art emissions control systems and idle reduction technology. Programmable diesel-fired coolant heaters are projected to save an estimated 129,568 gallons of diesel fuel over the remaining life of the buses.

Total cost: \$3,410,000 (\$1,730,000 grant funding)

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	CO ₂	Total reduction
Emission Reduction	130.6	3.0	3.4	14.4	1,438.2	1,589.6

Sawmill Repower

Through this demonstration project, DEC provided financial and technical assistance to Vermont sawmills to repower generator equipment with lower-emitting stationary diesel engines and helped to evaluate this sector as a potential target for future efforts to reduce diesel emissions. Each of the four sawmills approved for engine replacement received a 50 percent cost-matching grant and technical assistance in repowering the equipment with lower-emitting diesel engines that resulted in emissions reductions of up to 80%.

Total cost: \$200,000

School Bus Replacement

Using DERA funds, DEC provided technical assistance and cost-matching grants to Vermont school districts to improve air quality and help protect public health through the early replacement of 17 older,

more heavily polluting school buses with new buses equipped with state-of-the-art emissions control systems and idle reduction technology. Programmable diesel-fired coolant heaters are projected to save an estimated 56,916 gallons of diesel fuel over the remaining life of the buses.

Total cost: \$1,316,000 (\$701,000 grant funding)

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	CO ₂	Total reduction
Emission Reduction	50.1	2.1	1.8	6.7	631.8	692.5

Idle Reduction Technology for Emergency Response Vehicles

DEC used DERA funds to develop and implement a project for the installation of 4 shore power-type electrification “kiosks” at two Vermont hospitals to power onboard equipment and provide cabin climate control for emergency-response vehicles and help reduce exposure of sensitive populations to harmful diesel exhaust. As a first deployment of this idle reduction technology, the project serves as a demonstration for other hospitals in improving local air quality, reducing potential exhaust infiltration of hospital buildings, reducing greenhouse gas emissions, and increasing the energy efficiency of emergency services. Through the deployment of this technology at two hospital campuses, an estimated 83,950 gallon reduction in diesel fuel consumption will also be achieved.

Total cost: \$123,000

Lifetime Emission Reductions (tons)

Pollutant	NO _x	PM	HC	CO	CO ₂	Total reduction
Emission Reduction	25.3	0.7	0	0	931.8	957.9