

CONSENT DECREE ENVIRONMENTAL OFFSET PROJECTS

CUMMINS INC.

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CONSENT DECREE ENVIRONMENTAL OFFSET PROJECTS

CUMMINS INC.

EPA Approved Projects

On-Highway Low NOx Incentive Program

Project Description:

Cummins proposes to develop an incentive program to recalibrate engines, long before rebuild, to a lower emissions level. The program would be directed toward the owner-operator segment of the heavy-duty truck market utilizing engines built in 1996 and later. By targeting the most recently built engines, Cummins will maximize the emissions reduction potential (newer engines have fewer miles, and thus have the longest expected life before overhaul). The calibrations used for the program would use existing “Low NOx” calibrations currently submitted for the rebuild program. Cummins intends to conduct reviews of this program annually to assure the programs effectiveness. Adjustments will be implemented as required.

Planned Spending: \$4.98M

Project Status:

Project on plan.

New York Sanitation Truck PM Retrofit

Project Description:

Cummins intends to retrofit approximately 260 Cummins engine heavy-duty sanitation vehicles with Emission Control Devices (ECD) within the five boroughs of NY City. This project will include approximately 260 trucks with advanced ECDs including but not limited to diesel particulate filters (DPF) potentially from a variety of manufacturers. The program also intends to put into service four compressed natural gas (CNG) street sweepers. At predetermined intervals of operation, a representative cross-section of ECDs will be removed and evaluated in an emission test cell. A small portion of the retrofitted fleet will also be evaluated on a chassis dynamometer. Exhaust parameters (e.g. backpressure) will be monitored as an indicator of aftertreatment plugging and/or failure.

If successful during the two-year tracking period, these units will remain in service after conclusion of the project. Project goals include:

1. Reduce PM and HC emissions from in-use heavy-duty diesel engines in local urban, ozone and PM non-attainment area neighborhoods;
2. Facilitate the successful retrofit of sanitation type vehicles, as well as their long-term maintenance;
3. Assess the effectiveness of DPF technologies in reducing pollution over long periods of time; and
4. Quantify the emissions reductions achieved from the retrofit program from each emission control device;

Planned Spending: \$1.95M

Project Status:

Project completed.

Washington D.C. Mass Transit PM Retrofit

Project Description:

Cummins Inc. proposes to retrofit approximately 300 Washington Metropolitan Area Transit Authority (WMATA) buses powered by Cummins heavy-duty (HD) engines with emission control devices (ECD) as part of Cummins Inc.'s strategy to reduce PM, HC from heavy-duty engines. These advanced ECDs may include, but not be limited to Diesel Particulate Filters (DPF) potentially from a variety of manufacturers. If successful during the two-year tracking period, these units will remain in service after conclusion of the project. The goals of this project are to:

1. Reduce PM and HC emissions from in-use heavy-duty diesel engines in local urban, ozone and PM non-attainment area neighborhoods;
2. Facilitate the successful retrofit of transit buses as well as their long-term maintenance;
3. Assess the effectiveness of DPF technologies in reducing pollution over long periods of time; and
4. Quantify the emissions reductions achieved from the retrofit program and from each emission control device;

Planned Spending: \$1.95M

Project Status:

Project completed.

Metropolitan Atlanta Rapid Transit Authority CNG Buses

Project Description:

Cummins Inc. intends to fund the difference in cost to the Metropolitan Atlanta Rapid Transit Authority (MARTA) between a Cummins diesel fuel engine MARTA would select for use in new urban buses and the corresponding Cummins Compressed Natural Gas (CNG) fueled engine. MARTA is in the process of expanding their compressed natural gas (CNG) clean bus program. A significant impediment to this expansion is the high cost premium of heavy-duty (HD) CNG powered bus engines as compared to conventional diesel engines. Cummins will provide the specified discount pricing for all the Cummins CNG engines acquired under this program up to the extent of committed funding. Cummins proposed funding would provide discounts that are estimated to be sufficient for approximately 270 buses. This project will: 1) allow MARTA to procure additional clean CNG buses earlier than otherwise possible; 2) improve regional air quality, enhance utilization of CNG refueling facilities and accelerate the development of sustainable refueling infrastructure; and 3) provide high visibility and awareness of the program to the public via clear designation of CNG buses.

Planned Spending: \$1.9M

Project Status:

Project proceeding according to revised plan.

Massachusetts Bay Transit Authority CNG Buses

Project Description:

Cummins Inc. intends to fund the difference in cost to the Massachusetts Bay Transit Authority (MBTA) between a Cummins diesel fuel engine MBTA would select for use in new urban buses and the corresponding Cummins Compressed Natural Gas (CNG) fueled engine. Cummins proposed funding would provide discounts that are estimated to be sufficient for approximately 270 buses. This project will: 1) allow MBTA to procure additional clean CNG buses earlier than otherwise possible; 2) improve regional air quality, enhance utilization of CNG refueling facilities and accelerate the development of sustainable refueling infrastructure; and 3) provide high visibility and awareness of the program to the public via clear designation of CNG buses.

Planned Spending: \$1.9M

Project Status:

Project completed.

Northeast States Hybrid Bus Consortium

Project Description:

Cummins New York City area Distributor, Cummins Metropower, Inc. has agreed to assist in the development of a consortium of Northeast properties for the purpose of developing a common purchase specification for hybrid buses optimized for the local duty cycles. Cummins Inc. will provide subsidies to help the properties offset the premium cost between a conventional transit bus and the hybrid. The project consists of the following elements:

1. Define specification parameters for diesel-electric hybrid bus;
2. Integrate consortium members' specification requirements, perform value analysis review with help of technical advisors and produce one common specification for consortium's use;
3. Issue prototype bids to bus manufacturers, select and schedule prototypes for delivery to consortium members;
4. Assist prototype manufacturer with technical reviews during prototype building phase;
5. Work with authorities during in-service prototype testing phase;
6. Review final bids and select successful bidder(s);

Planned Spending: \$1.969M

Project Status:

Project proceeding according to revised plan.

Gwinnett County Department of Transportation CNG Buses

Project Description:

Cummins Inc. intends to fund the difference in cost to the Gwinnett County Department of Transportation between a Cummins diesel fuel engine the Gwinnett County Department of Transportation would select for use in new urban buses and the corresponding Cummins Compressed Natural Gas (CNG) fueled engine. The Gwinnett County Department of Transportation is in the process of expanding their compressed natural gas (CNG) clean bus program. A significant impediment to this expansion is the high cost premium of heavy-duty (HD) CNG powered bus engines as compared to conventional diesel engines. Cummins will provide the specified discount pricing for all

the Cummins CNG engines acquired under this program up to the extent of committed funding. Cummins proposed funding would provide discounts that are estimated to be sufficient for approximately 60 buses. This project will: 1) allow the Gwinnett County Department of Transportation to procure additional clean CNG buses earlier than otherwise possible; 2) improve regional air quality, enhance utilization of CNG refueling facilities and accelerate the development of sustainable refueling infrastructure; and 3) provide high visibility and awareness of the program to the public via clear designation of CNG buses.

Planned Spending: \$418.14K

Project Status:

Project proceeding according to revised plan.

Georgia Regional Transportation Authority CNG Buses

Project Description:

Cummins Inc. intends to fund the difference in cost to the Georgia Regional Transportation Authority (GRTA) between a Cummins diesel fuel engine GRTA would select for use in new urban buses and the corresponding Cummins Compressed Natural Gas (CNG) fueled engine. GRTA is in the process of expanding their compressed natural gas (CNG) clean bus program. A significant impediment to this expansion is the high cost premium of heavy-duty (HD) CNG powered bus engines as compared to conventional diesel engines. Cummins will provide the specified discount pricing for all the Cummins CNG engines acquired under this program up to the extent of committed funding. Cummins proposed funding would provide discounts that are estimated to be sufficient for approximately 90 buses. This project will: 1) allow GRTA to procure additional clean CNG buses earlier than otherwise possible; 2) improve regional air quality, enhance utilization of CNG refueling facilities and accelerate the development of sustainable refueling infrastructure; and 3) provide high visibility and awareness of the program to the public via clear designation of CNG buses.

Planned Spending: \$627.21K

Project Status:

Project proceeding according to revised plan.

King County Metro Transit (Seattle) PM Retrofit

Project Description:

Cummins Inc. and King County Metro Transit (KCMT) intend to retrofit advanced Diesel Particulate Filters (DPF) onto approximately thirty-nine 1998 New Flyer Model D60HF sixty-foot articulated buses powered by Cummins M11E+330HP heavy-duty engines. In addition, Cummins intends to provide funds for the storage of the Ultra-Low Sulfur Fuel (ULSF) that will be required for the vehicles retrofitted by this project. Verification testing will not be funded by this project since both the Johnson Matthey and Engelhard filters have been certified under the Voluntary Retrofit Program.

Planned Spending: \$400K

Environmental Benefit: 10 tons PM

Project Status:

Project completed.

Exhaust Aftertreatment Research and Demonstration

Project Description:

Cummins proposes to develop and demonstrate the capability of advanced diesel engine aftertreatment technologies required to meet future NO_x and particulate (PM) emissions requirements. This will include definition of the individual NO_x or PM system requirements as well as the combined NO_x/PM system.

Project goals include:

1. Develop a particulate aftertreatment sub-system, and related control systems, sensors and service procedures to maximize the useful life of the system and minimize impact on the customer;
2. Develop a NO_x aftertreatment sub-system, and related control systems, sensors and service procedures to maximize the useful life of the system and minimize impact on the customer;
3. Integrate the combined system of particulate aftertreatment, NO_x aftertreatment, sensors and control systems with the base engine; and
4. Provide recommendations of the production viability of the aftertreatment concepts.

Planned Spending: \$8.794M

Project Status:

Project on plan.

Alternative Fuel Technology and Engine Program

Project Description:

In this project, Cummins intends to team with Allison Transmission and develop an optimum natural gas power plant and integrate it with a hybrid drive train so as to maintain or significantly lower the emissions signature as well as enhance energy efficiency. Project goals are to develop an electronic engine (drive by wire), robust controls, in-cylinder combustion optimizations; and integrate with an electric drive system.

The project emissions deliverables include 1.5 g NOx/bhp-hr, and 0.02 PM g/bhp-hr, 0.6 NMHC g/bhp-hr, and 5.0 CO g/bhp-hr.

Planned Spending: \$2.361M

Project Status:

Project currently being re-planned.

Chassis Dynamometer Vehicle Test

Project Description:

EPA, ARB and other emissions regulatory agencies have expressed interest in developing a broader understanding of in-use emissions from heavy-duty engines. This program will investigate the effect of engine use on emissions over time, and will begin to establish a database to correlate in-use, chassis-dynamometer-test, and engine-dynamometer-test emissions. The test program will establish baseline engine and vehicle emissions, track the engine through service, and test emissions periodically through the useful life period. The proposed test sequence for each engine is as follows:

1. Engine dyno emissions baseline;
2. Vehicle emissions baseline;
3. Vehicle emissions at 1/3, 2/3 and 3/3 Useful life;
4. Engine dyno emissions at Useful Life.

Planned Spending: \$2.196M

Project Status:

Project currently being re-planned.

ARB Approved Projects

On-Highway Low NOx Incentive Program

Project Description:

Cummins intends to develop an incentive program to recalibrate engines to a lower emissions level. The program would be directed toward the owner-operator segment of the heavy-duty truck market utilizing engines built in 1996 and later. By targeting the most recently built engines, Cummins will maximize the emissions reduction potential (newer engines have fewer miles, and thus have the longest expected life before overhaul). The calibrations used for the program would use existing "Low NOx" calibrations currently submitted for the rebuild program.

Planned Spending: \$1.679M

Project Status:

Project proceeding according to revised plan.

Los Angeles School Bus Repower and PM Treatment

Project Description:

Cummins Inc. intends to repower 30 school buses in the Los Angeles Unified School District with ISB engines and catalyzed particulate filters (CPF) at the rate of one bus/week commencing 120 days after approval to proceed. These buses are configured for special education needs.

Planned Spending: \$1.2M

Project Status:

Project completed.

San Juan and Elk Grove Bus Repower and PM Treatment

Project Description:

Cummins Inc. intends to repower additional school buses in the Elk Grove school district in Sacramento County with ISB engines and install the CARB verified Cleaire Longview PM and NOx emission reduction systems on AC Transit buses in Alameda County. AC

(Alameda County) Transit is the public transit agency serving the East Bay area of the San Francisco Bay Area.
Planned Spending: \$1.872M

Project Status:
Project completed.

High Pressure Direct Injection (HPDI) LNG On-Highway

Project Description:

Cummins has executed a Memorandum Of Understanding with Westport Innovation to evaluate HPDI technology. Cummins intends to demonstrate high pressure direct injection (HPDI), of natural gas in Cummins ISX engine for use in an on-highway truck. The key objectives are to maintain diesel-like power and engine efficiency similar to diesel but with lower NOx and PM emissions. The engine is to use an oxidation catalyst to reduce unburned hydrocarbons and CO. It is planned to validate the engine performance, response, etc. by field test in two trucks in the Sacramento area of California and in Canada.

The project deliverables include 400 hp, 1450 ft-lbs torque, 2 g NOx/bhp-hr, and 0.02 PM g/bhp-hr.

Planned Spending: \$300K

Project Status:
Project completed.

High Pressure Direct Injection (HPDI) Ultra Low Emission Technology Development

Project Description:

This program is a follow on to High Pressure Direct Injection LNG in On-highway Truck Program. In this program, the HPDI natural gas engine concept will be evaluated for lower NOx emissions. Exhaust Gas Recirculation (EGR) technologies will be in production in 2002 in diesel platforms. This project intends to bring together cooled EGR technologies and HPDI concept on a Cummins model ISX engine. The engine concept is likely to require the use of oxidation catalyst to reduce unburned hydrocarbons and carbon monoxide. This is a cost shared program. The funding consortium includes

SCAQMD, DOE/NREL and CEC. The program has been approved for funding by the SCAQMD board. The project is made up of Cummins Inc. and Westport Innovations.

It is anticipated that this technology will be further evaluated in the field in a follow-up program. The prototype testing of the technology will likely be performed in the Sacramento area.

The project deliverables include 400 hp, 1450 ft-lbs torque, 0.5 g NOx/bhp-hr, and 0.02 PM g/bhp-hr.

Planned Spending: \$499K

Project Status:

Project completed.

**High Pressure Direct Injection (HPDI) Ultra Low Emissions Technology
Development: Phase II - Field Testing**

Project Description:

This program is a follow-up to the preceding High Pressure Direct Injection (HPDI) Ultra Low Emissions Technology Development program. The objective of this work scope is to field test the engine concept developed under that program. The technologies developed under the High Pressure Direct Injection (HPDI) Ultra Low Emissions Technology Development program are ideally suited for the New Generation of Natural Gas Vehicle (NGNGV) class 8 vehicle project currently under discussion. The vehicle field test is planned for 2003 - 2004, with the objectives of demonstrating vehicle performance, reliability/ durability evaluations, discovering problems early and implementing design changes. An oxidation catalyst may be required to reduce unburned hydrocarbon and carbon monoxide in the exhaust. The limited production engine system is most likely to be tested in California, replacing the HPDI natural gas engine (without EGR) planned for tests in 2001-2002. The overall project is contingent upon availability of external funds and teaming arrangements.

The project deliverables include 400 hp, 1450 ft-lbs torque, 0.5 g NOx/bhp-hr, and 0.02 PM g/bhp-hr.

Planned Spending: \$400K

Project Status:

Project proceeding according to revised plan.

ISL-G Natural Gas Engine Integration

Project Description:

Current production spark ignition (S.I) engines exhibit approximately 0.2 g/bhp-hr NO_x. Spark ignition engines are less efficient (30-50 %) than the diesel engines in similar applications. This project is proposed to integrate lower emissions and high efficiency concepts on a new ISL platform. This technology integration work includes converting an ISL diesel engine into SI natural gas, turbomachinery matching and combustion design to enhance engine efficiency as well as lower emissions. The results from this project will guide the product development of a natural gas ISL engine. The engine may require an oxidation catalyst to reduce unburned hydrocarbons and carbon monoxide. The project deliverables include 330 hp, 950 ft-lbs torque, 1.0 g NO_x/bhp-hr, 0.5 g/bhp-hr NMHC and 0.02 PM g/bhp-hr. The controls will have humidity and knock sensing capabilities.

Planned Spending: \$450K

Project Status:

Project proceeding according to revised plan.

Ultra Low NO_x Spark Ignited Natural Gas Engine

Project Description:

The 2002 Update of the Technology Advancement Plan for the Clean Fuels Program includes Proposed Project 2002CFM2-5 – Next Generation Natural Gas Vehicle (NGNGV) Development and Demonstration, which calls for significant emission reductions through the commercialization of natural gas engines certified for NO_x at 0.2 g/bhp.hr, as compared to 4.0 g/bhp.hr for current heavy-duty engines, to meet the forthcoming emission standards for heavy-duty engines. The objective of the NGNGV II project is to develop and implement a variety of technologies to further lower the emissions from natural gas engines. For this project, Cummins plans to integrate spark ignited, exhaust gas re-circulation engines and three way catalysts to achieve the desired emission levels, power density, and efficiency in a stoichiometric natural gas engine. The goal is to demonstrate emission control technologies that deliver emission of 0.2 g/bhp.hr NO_x, 0.01 g/bhp.hr PM, 0.14 g/bhp.hr NMHC, and 0.01 g/bhp.hr formaldehydes. The demonstration will be done over the U.S. EPA Heavy Duty Transient test cycle.

Planned Spending: \$1M

Project Status:

Project on plan.

Advanced Emission Measurement Support

Project Description:

Cummins intends to provide funding of \$200,000 per year for three years beginning in 2001, to support the College of Engineering - Center for Environmental Research and Engineering (CE-CERT) development of a comprehensive new database of emissions in the South Coast area using the latest measuring technology which has been installed in the mobile emissions laboratory. The CE-CERT laboratory will be able to characterize the constituent elements in the South Coast area to a greater precision than previously possible, which should be of great benefit to equipment manufacturers and regulators alike. A better understanding of the detailed chemistry that make-up the pollutants in the air should enable a more precisely targeted approach to eliminating or reducing those pollutants and in less time than would otherwise be the case.

These funds are supplementary to those provided from Federal, State or other private sources.

Planned Spending: \$600K

Project Status:

Project completed.