Public Abstract
The Nationwide Hybrid-Electric School Bus Program

Five school districts from across the country are joining together to evaluate hybrid-electric school buses operating on conventional diesel fuel and renewable biodiesel-fuel. The intent of this program is to allow the schools to provide children with safe, clean, and fuel-efficient transportation to and from school. After completing the two-year program, the results will be published and made available on the Internet so other school districts can take advantage of the lessons learned from this study.

The hybrid electric technology used in the buses is expected to reduce fuel consumption by at least 35 percent and reduce certain harmful emissions by over 90 percent. The additional use of a biodiesel blend may reduce those emissions by 20 percent. By lowering fuel consumption and emissions, this program will not only allow school districts to reduce fuel costs, but it will minimize students' exposure to harmful pollutants.

This multi-state program is known as "The Nationwide Hybrid-Electric School Bus Program" and has the support of environmental organizations, state agencies, school districts, biodiesel fuel suppliers, universities, energy offices and a national laboratory. The National Association of State Energy Offices (NASEO) is sponsoring the program working through state energy offices, health departments, Clean Cities coalitions and universities in Colorado, Indiana, Kentucky, Montana and Tennessee. Each state is providing matching/in-kind funding to help support this $1.6 million program with $632,625 coming through NASEO from the U.S. Department of Energy.

Starting in the first calendar quarter of 2004, each of the five school districts will order a new Class D (36 ½ foot) front engine, school bus. Each bus will be upgraded with a parallel hybrid-electric drive system from Solectria Corporation located in Massachusetts. Over the next year the buses will be used to pick up and deliver children to school, and take them on field trips and interscholastic activities. Each bus will be tested for emissions and fuel usage at the Renewable Fuels and Lubricants (ReFUEL) Research Lab operated by the National Renewable Energy Lab (NREL) in Colorado.

The final report from this program will be used by other school districts from around the country in their search for cleaner and more efficient buses. The positive impact on the health of school children and the cost of their transportation is expected to be huge. The program will be completed by late 2005.

The lead organization for this program is the Colorado Department of Public Health and Environment. Lead participating organizations include the Kentucky Division of Energy, Indiana Department of Commerce/Energy, Tennessee Economic Development/Energy Division and the University of Montana. For further information or a press package contact EnergySense, LLC at NationwideBusInfo@EnergySense.com

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Public Abstract
Research, Development, Demonstration, and Deployment of Truck Stop Electrification Infrastructure

An advanced Transportation Technologies multi-state proposal submitted by the states of California, Iowa, Maryland, Massachusetts, New York, North Carolina, and Texas; in response to the State Technologies Advancement Collaborative Solicitation (03-STAC-1) on September 24, 2003.

Long-haul truck drivers typically idle their engines while spending the night at truck stops to supply heat or cooling in their sleeper cab compartments, to keep their engines warm during cold weather, and to maintain vehicle battery charge while electrical appliances such as TVs, computers and microwaves are in use. Unnecessary idling costs truck owners/operators not only through additional diesel fuel used, but also through additional engine maintenance needs as well. The unnecessary idling of truck tractor engines also results in localized engine emissions and noise pollution, and is exacerbated in high-density truck parking locations along the Interstate Highway System. The health implications to the truck driver are obvious and, when aggregated over a sizable truck stop, impact the neighboring community as well. Additional health implications arise from the noise and low frequency vibrations emitted from the idling truck. Each are thought to degrade the quality of sleep realized by the truck driver and have both health impacts, and highway safety concerns once the ill-rested driver is back on the road.

This proposal seeks to advance the deployment of Truck Stop Electrification (TSE) infrastructure along three major, north-south transportation corridors; I-95 on the east coast, I-5 on the west coast, and I-35 in the center of the country. Specifically, this proposal seeks to advance marine-style, shorepower TSE systems that provide grid electricity to stationary, long-haul trucks for the operation of on-board HVAC units, block heaters, and in-cab convenience appliances. Availability of electricity while overnighting allows the diesel engine of a shorepower-capable truck to be shut down; thus saving energy and eliminating the associated noise and air pollution.

By it's very nature, long-haul trucking is regional and/or national in extent. TSE infrastructure cannot be commercially viable if installed in only one state, or if installed in a variety of conflicting designs in a multitude of states. For maximum efficiency and coordination, it is desirable that all participating states collaborate on one joint proposal. For minimum redundancy and overhead, it is desirable that a single, state-of-the-art, infrastructure design be installed and replicated at multiple locations. These initial TSE deployments are then to serve as focus points for outreach/educational efforts into adjacent states along the corridor.

The project is structured into two phases, each nominally requiring one year to complete. In Phase I, budgeted at $538,772 all of the Team States shall participate in an Interoperability Standards Workshop and shall conduct State-Specific Planning Studies. In Phase II, budgeted at $1,084,089 a subset of the Team States shall progress to State-Specific Deployments and Corridor Outreach Workshops.

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Public Abstract
Plug-In Hybrid Electric School Buses: Energy Savings, Air Quality Improvements and Students

The proposal team offers to NASEO the opportunity to participate in the development of hybrid electric school buses. Each year 440,000 school buses roll along American roads logging 4.9 billion miles, consuming 607 million gallons of diesel fuel and gasoline, and producing millions of tons of emissions that affect the atmosphere and the health of the children who ride them[1]. Advanced Energy and the Hybrid Electric School Bus Advisory Group propose to establish a process encouraging the design, production, and deployment of plug-in hybrid electric school buses.

Each year, school systems purchase 31,000 buses to either grow their fleet or replace aging buses. During the average 15-year lifetime, each school bus will consume 20,700 gallons of fuel and emit six tons of nitrogen oxides (NO_x) and 479 tons of carbon dioxide (CO_2) gases, as well as 440 pounds of ultra-fine particulate matter ($PM_{2.5}$). Hybrid electric school buses can reduce annual fuel consumption by 437 million gallons, as well as NO_x emissions by 82%, CO_2 by 25%, and $PM_{2.5}$ by 93%. Moreover, hybrid electric school buses electric platform makes it an ideal transitional technology to fuel cells.

By 2007, this project aims to have a fleet of plug-in hybrid electric school buses operating in normal service, a major school bus manufacturer supplying these buses to any group willing to buy them, and relevant and meaningful information available to any agency interested in purchasing hybrid electric school buses. Hence, during the next four years this hybrid electric school bus study will:

1. Create a focus group to identify obstacles to the manufacture and use of hybrid electric school buses and conduct a feasibility study
2. Develop a business plan in conjunction with a school bus manufacturer
3. Construct and operate four prototype buses to verify parameters used in the feasibility study
4. Revise business plan with the results from the prototype tests
5. Manufacture and operate pilot fleet(s) to gain experience and data on fleet operations in real-world use
6. Disseminate information on hybrid electric school buses to promote the widespread use of this efficient and sustainable technology.

Advanced Energy solicits the aid of the NASEO for this project to promote widespread use of an efficient and sustainable advanced vehicle technology. The $600,000 requested of STAC to support this $1,965,000 endeavor would fund the development and production of the four prototype buses and training of all personnel involved with these four buses as well as monitoring, evaluation and reporting.

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Public Abstract
I-75 Corridor Truck Stop Electrification, A Regional Partnership Approach

Recognizing the air quality and energy impacts of engine idling from the long-haul trucking industry, several southern states have partnered to use an innovative technology to reduce emissions in the states and region. This project is a multi-state proposal to install truckstop electrification technology at two truckstops located in the Southern United States on the I-75 corridor. The locations include a site in Florence, Kentucky and a site in Atlanta, Georgia. The Georgia Environmental Facilities Authority, Energy Division is requesting $1,000,000 under this proposal for technology installation to be matched with over $1,300,000 in funding from Idle-Aire technologies, the manufacturer of the truckstop electrification technology.

GEFA has partnered with the Kentucky Division of Energy to implement this project. If funded, this project will bring environmental, energy and economic benefits to the southern partners and the region.

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Public Abstract
Truck Idling Energy, Emission and In-Cab Driver Occupational Safety Impacts Characterization
For California, Oregon and Washington States

The states of California, Oregon and Washington propose a study to characterize the energy, air quality and driver health impacts resulting from extended idling of long-haul diesel trucks at rest stops. Extended idling occurs when drivers use their engines to provide power for accessories including climate control units, televisions, refrigerators, and other appliances during legally required rest periods. The adverse impacts of this practice are substantial. Idling diesel engines operate at efficiencies of only 3-11% and use approximately one-half to two gallons of fuel per hour. Estimates of annual diesel fuel consumption resulting from all types of idling activities are between 838 million to 2 billion gallons. In addition to wasting energy, idling diesel trucks emit a mixture of air pollutants which may present a health hazard to truck drivers and to nearby communities, and are known to contribute to regional air pollution problems and climate change.

New technologies offer the possibility of greatly reducing truck idling for accessory power. One such option, advanced truck stop electrification (TSE), is being implemented at select locations throughout the country supported by public-private funding partnerships. Advanced TSE provides drivers access to climate-controlled air supply and other amenities without truck modifications; the power for these systems is supplied through the electricity grid, and thus eliminates on-site vehicle idling. Unfortunately, the current lack of reliable quantitative estimates of the adverse impacts associated with truck idling highlight the need to evaluate the urgency and justify the capital costs of implementing TSE and other truck idling mitigation technologies.

The proposed study addresses key data needs for assessing energy, environmental, and driver exposure impacts of extended idling at truck stops. The study will be conducted primarily on site at truck stops in California, Oregon and Washington and include several major measurement and analysis tasks. These include on-site surveys of truck populations and activity patterns, including accessory use rates at 10-15 truck stops along east-west and north-south corridors in each state, measurements of in-cab and ambient pollutant concentrations at 3-5 locations, and a field sampling program to quantify integrated pollutant emission rates from groups of hundreds of vehicles per night at 1-2 sites. Results from these activities will be used to estimate the potential benefits of widespread implementation of TSE.

The proposal is being submitted by the California Energy Commission as lead manager, in cooperation with state agencies of Oregon (Departments of Energy and Environmental Quality) and Washington (Department of Ecology). The scientific tasks will be completed cooperatively by research teams from Lawrence Berkeley National Laboratory (LBNL) and the University of California, Davis (UCD) in consultation with the state agencies.

The proposed research will cost $800,000 over twenty four months. The planned project performance period is January 2004 to December 2005.

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Public Abstract
Fuel Economy and Emission Measurements on an Optimized Hybride-Electric School Bus Design

This project examines the environmental impact and fuel use for a potential hybridelectric school bus (HESB). The work is a combination of analytical modeling and prototype hardware testing. In the end, a real test of an internal combustion (IC) engine from the HESB design will be performed to quantify the fuel economy and characteristics that can be expected from an HESB. The project consists of three deliverables.

First will be the characterization of an actual school bus drive cycle. A Tuscaloosa City School System bus will be instrumented to measure relevant performance and operating condition parameters while in operation. This will allow definition of operating requirements for the HESB design. An engine identical to the one in the school bus will be acquired and laboratory tested using the recorded drive cycle, to establish a baseline measurement of fuel economy and emissions.

The second deliverable will be a number of rough HESB designs. These will be developed using existing vehicle modeling and simulation capabilities at Mississippi State University. Exercising these models will allow approximation of the IC engine load requirements and specification of components for a final design. More refined models for the specified components will be created that will allow more accurate modeling of a final HESB design. These models will be verified through testing in an electromechanical laboratory at the University of Alabama.

The last deliverable will be a final HESB system design. The design will be verified with an electromechanical scaled prototype and will be used to determine accurate anticipated IC engine loads for the drive cycle determined in deliverable 1. An actual example of the IC engine selected for the final design will then be laboratory tested to project fuel usage and emissions for the HESB. Comparison of those projections to the baseline testing results will provide insight into the fuel economy and emissions improvements that may be realized with an HESB.

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