NORTHEAST STATES CENTER
FOR A
CLEAN AIR FUTURE

REQUEST FOR PROPOSALS (RFP)

HEAVY-DUTY VEHICLE EMISSIONS AND FUEL CONSUMPTION IMPROVEMENT PROJECT

April, 2006

The Northeast States Center for a Clean Air Future (NESCCAF)[1] and the International Council on Clean Transportation (ICCT)[2] are requesting proposals from potential contractors for a project to assess heavy-duty vehicle emission and fuel consumption reduction technologies and to estimate the environmental benefits and costs associated with introducing those technologies into the United States' vehicle fleet.

Heavy-duty trucks are an important category to evaluate when looking for emissions reductions and fuel consumption savings in the transportation sector. In the U.S., diesel trucks emit approximately 7 percent of greenhouse gas emissions (GHGs), 20 percent of ozone forming pollutants and up to 50 percent of particulate matter in urban areas. Worldwide, diesel fuel consumption accounts for about eight percent of total energy consumption (WRI 2005). Trucks move the bulk of all freight value, and their share is increasing. Between 1973 and 1998, energy use from freight trucking increased by more than 80 percent in the group of eleven European nations monitored by the International Energy Agency, which includes the United States. This is about double the growth rate from the passenger transport fleet (IEA 2004). Trucking accounts for 60 percent of freight energy use in the United States, consuming 2.3 million barrels of oil per day in 2000.

BACKGROUND

In most developed nations, truck fuel consumption (energy used per ton-mile) has shown only very modest improvements per ton of freight moved over the last several decades. There is a relatively wide range of energy intensity in trucking sectors in various developed nations. Freight trucks in Japan and Norway use more than twice the energy to move a ton of freight compared to Finland and Italy, the two nations with the most efficient trucking industries. Most of the world's truck energy intensity remained largely flat over the

[1] NESCCAF is an association of air quality control regulators in the eight northeast states, academics, and business leaders in the region. The goals of NESCCAF are to reduce motor vehicle criteria, greenhouse gas, and toxic pollution through scientific research, policy analysis, and public education.

[2] The goal of the ICCT is to dramatically improve the environmental performance and efficiency of cars, trucks, buses and transportation systems in order to protect and improve public health and the environment. The Council is made up of regulators and experts from leading auto markets around the world, who participate as individuals based on their experience with air quality and transportation issues. The ICCT is sponsored by the William and Flora Hewlett Foundation and the Energy Foundation.

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past twenty years. With regard to criteria pollutant emissions, new stringent heavy-duty engine nitrogen oxide (NOx) and particulate (PM) emissions standards will result in substantial reductions in heavy-duty truck criteria pollutant emissions in the U.S. and in other countries.

In the United States, there are fewer than three million medium and heavy trucks (those over 10,000 pounds gross vehicle weight) on U.S. roads, and annual sales are about one percent of passenger vehicle sales. Sales of individual models number in the hundreds or thousands, in contrast to the tens or hundreds of thousands for car models. Truck production is also more modular; engines typically are manufactured by diesel engine companies, then integrated into a vehicle meeting the specifications of the customer and, in many cases, matched with a trailer. The engines must meet federal air emission standards, but neither the engine nor the vehicle is subject to fuel consumption requirements. As is the case with passenger vehicles, heavy trucks are produced by a handful of companies in the U.S., Europe and Asia.

While truck users are more affected than passenger vehicle users by the operating cost of fuel, the demand for reducing fuel consumption alone is not sufficient to bring all cost-effective efficiency technologies into the market. Manufacturer risk, low fuel prices, and lack of information on individual models all limit the introduction of better technologies.

Recent studies have shown that significant reductions in heavy-duty vehicle fuel consumption can be achieved through the introduction of new and existing technologies. In addition, recent testing has shown that technologies installed to lower fuel consumption also reduce criteria pollutant emissions. Wal-mart announced a broad fuel consumption improvement program that will include doubling the energy efficiency of its commercial truck fleet (NYT 2005). Regulations to lower greenhouse gas (GHG) emissions from heavy-duty vehicles have been proposed in Japan. Achieving reductions in heavy-duty GHG emissions could play an important role in helping countries and states meet climate action plan goals. In order to gain a better understanding of the potential emissions reduction and fuel consumption improvements possible from this sector, the ICCT and NESCCAF are undertaking a research program to assess the applicability and effectiveness of available and emerging engine and vehicle emissions and fuel consumption technologies.

PROJECT SCOPE OF WORK

The purpose of this study is to evaluate - through simulation modeling - the combination of vehicle platform and technologies that would result in the greatest real-world emissions and fuel consumption improvements. NESCCAF and ICCT prefer that an existing software modeling program be used for this work - the goal of the study is not to develop a new modeling tool. The primary focus of the study should be Class 8 heavy-duty trucks (33,000 lbs. GVWR and greater). Proposals should include a thorough assessment of Class 8 trucks fuel consumption and emissions improvement potential. US fleet characteristics should be assumed in developing the baseline scenario as described below. Efficiency technologies should be selected from those available in the US and throughout the world. The focus will be on evaluating the improvements that can be realized on a per truck basis, however, the contractor will be required to estimate the benefits on a fleet-wide level as well, based on the estimates developed for individual truck(s).

The real-world technical viability and the potential for fleet-wide efficiency improvements are most important to ICCT and NESCCAF. Previous studies on potential fuel consumption improvements from the heavy-duty truck sector have suggested that substantial improvements are technologically feasible and would pay for themselves within the vehicle's useful life. Market trends suggest that the freight truck industry does not altogether accept these previous findings. The ICCT and NESCAUM are aware of these tensions. We expect that the successful proposal will anticipate this challenge of developing a study that reflects the technological potential while maintaining its credibility with industry. Applicants are encouraged to partner with industry, academia, and government to enhance credibility and gain a real-world understanding of the opportunities and challenges presented by new and existing technologies.

ICCT and NESCCAF encourage applicants to build proposals that create synergies between computer modeling simulations and existing field demonstrations and track testing programs that currently are being implemented by government agencies, heavy-duty engine manufacturers, or trucking freight fleet operators. Overall, successful proposals will be those that are expected to yield results deemed credible by a range of audiences from industry to regulators.

To achieve the project's goal, four main tasks and several sub-tasks have been identified. These tasks are intended as guidelines to organize the work required. Respondents should feel free to propose a different task structure as long as the project objectives and deliverables are met. The main proposed tasks are:

1. **Identify emissions and fuel consumption improvement technologies and develop a "first cut" benefit assessment:** For the years 2012 and 2017 identify emerging emissions and fuel consumption improvement technologies. The purpose of this part of the study is to evaluate all technologies - both in production and currently under development. Once this list is complete, assess the emissions reduction and fuel consumption improvement potential of each technology in order to develop a baseline conventional pollutants and greenhouse gas emissions rate and technology packages for simulation modeling of advanced, fuel efficient heavy-duty vehicles.

2. **Develop baseline heavy-duty vehicle emissions and fuel consumption projections:** Identify emissions and fuel consumption improving technologies that are likely to be introduced into heavy-duty vehicles in model years 2012 and 2017. Project the penetration of these technologies into the vehicle fleet in those years, detailing the assumptions used to derive the penetration rate. Develop baseline vehicle(s) scenarios and simulate baseline emissions and fuel consumption, assuming the penetration rates estimated for the technologies and changes in engine design to meet new emissions standards.

3. **Develop enhanced emissions and fuel consumption heavy-duty vehicle technology packages and scenarios. Conduct computer simulation of the emissions reduction and energy efficiency benefits resulting from technology packages:** Simulate the benefits of enhanced technology vehicles in terms of criteria pollutants, fuel consumption improvements, and GHGs. Project reductions on a

per-truck basis for model years 2012 and 2017, taking into account development of new technologies over those years.

4. **Assess the costs of introducing these technologies into the vehicle fleet**: Determine the full learned-out costs of introducing enhanced technologies as well as quantify any potential operating cost changes.

In performing required analyses, it is expected that the contractor will draw upon their technical expertise, knowledge of the industry, and awareness of market forces. The contractor is expected to review the technical literature, and consult with other experts in the field as appropriate. ICCT and NESCCAF encourage applicants to team with other experts. As an example, a team consisting of an engine technologies expert, a transmission technologies expert, and an organization or company that has introduced emissions reducing and fuel consumption improvement technologies into its vehicle fleet will be looked upon favorably in the evaluation of the proposals.

Task 1: Identify emissions and fuel consumption improvement technologies and develop a "first cut" benefit assessment:
Subtasks

- Develop a list of emissions and fuel consumption improvement technologies applicable to model years 2012 and 2017 vehicles. Consumer demand, OEM strategies, and new emissions standards should be taken into consideration during the development of this list.
- Determine which test cycle(s) should be used to evaluate technologies. For example - the contractor should determine whether truck idling should be taken into consideration when evaluating vehicle emissions and potential fuel savings. To add to that point, the UDDS would not evaluate idling fuel consumption and emissions whereas a real-world cycle might.
- Assess (either through simulation modeling, real-world testing, or from pre-existing simulation modeling or testing data) the fuel consumption and emissions improvement potential of the technologies identified on a per-vehicle basis.
- Assess the impacts on emissions of HC, NOx, PM, CO, GHGs, and toxics, and impacts on fuel consumption on a per-vehicle basis.

Guidelines

- In developing the technology list, the contractor will investigate all technologies which are reasonably anticipated to be available in 2012 and 2017 which have the potential to reduce fuel consumption and emissions, including (but not limited to) engine and driveline efficiency improvements, aerodynamic drag reduction, parasitic heat loss reduction, alternative fuels, hybrid electric technology, and methods for reducing or eliminating emissions from auxiliary equipment.
- Additional categories, or alternate approaches to vehicle category definition, should be included, if warranted. These categories should be proposed to and approved by ICCT and NESCCAF prior to analysis. Regardless of the number of vehicle categories selected for detailed evaluation, the contractor is expected to identify any potential limitations on application of technologies to other categories not subject to detailed evaluation
- The contractor is expected to document the methodologies used to quantify GHG

reductions and fuel savings.

- GHG reduction benefits shall be expressed in CO_2 equivalent percentage reductions for vehicles operated over the federal urban dynamometer driving schedule for heavy-duty vehicles, or an alternative schedule recommended by the contractor (and approved by ICCT/NESCCAF).

Task 2: Develop baseline heavy-duty vehicle emissions and fuel consumption projections.

Subtasks

- Develop two baseline vehicle scenarios, one for 2012 and one for 2017. These scenarios will be based on the vehicles selected (Class 8 and other) and the technology forecasts from Task 1 for each selected truck category.
- Several of the technologies that improve emissions and fuel consumption are already being incorporated on current vehicles. The contractor is expected to make reasonable judgments on the expected penetration of these technologies into the heavy-duty fleet by 2012 and 2017 absent any regulatory drivers.
- This study focuses on vehicles, engines, and transmissions - and does not take into consideration off-vehicle improvement strategies such as truck stop electrification. However, if the contractor determines that truck stop electrification (for example) in 2012 or 2017 will greatly reduce truck idling - subtracting idling fuel consumption from the baseline fuel consumption will be necessary.

Guidelines – as per "Task 1", with the addition of:

- Describe the model to be used. Both public-access and contractor-proprietary models are permitted.
- Describe assumptions that will be utilized with the models that are identified above.
- Develop vehicle scenarios incorporating combinations of the identified emissions and fuel consumption reduction technologies from Task 1 for each truck category.
- Perform computer modeling to estimate the fuel consumption and emissions improvements resulting from introduction of technologies into the vehicles between 2012 and 2017 for the baseline vehicles (e.g. the contractor will estimate fleet-wide benefits for those years).
- Emissions reductions benefits assessment should include impacts on GHG, NOx, PM, VOC, HC, CO, and toxic emissions.

Task 3: Develop enhanced emissions and fuel consumption heavy-duty vehicle technology packages and scenarios. Conduct computer simulation of the fuel consumption and emissions benefits resulting from technology packages.

Subtasks

- Develop vehicle scenarios incorporating combinations of the identified fuel consumption and emissions improvement technologies from Task 1 for each truck category.
- Perform computer modeling and/or real-world vehicle testing to estimate emissions and fuel consumption improvements on a per vehicle and fleet-wide basis.
- Emissions reductions benefits assessment should include impacts on GHG, NOx, PM, VOC, HC, CO, and toxic emissions.
- Quantify the impact of technology packages on vehicle performance, assuming as a baseline no-change from 2010 levels for each selected vehicle type.

- Evaluate any implications of the technology packages in regard to the ability of vehicle manufacturers to comply with existing emissions standards.

Guidelines – as per "Task 1", with the addition of:

- The technology packages must be realistic for the analysis timeframe. The package selection criteria should include technical feasibility by 2012 and 2017.
- In developing vehicle scenarios, assume mild, moderate and aggressive combinations of technologies for the same vehicle types determined in Task 1. This will require at a minimum 9 scenarios will be evaluated (1 mild, 1 moderate, and 1 aggressive scenario for each of the two evaluation years: 2012 and 2017) but most likely more than that will be required.
- Several technologies can reduce vehicle emissions and enhance vehicle power and performance. Incorporating these technologies on heavy-duty vehicles could involve trade-offs between fuel consumption improvements, criteria pollutant reduction, and vehicle performance. Therefore, in developing the scenarios for this task the contractor shall assume performance typical of the respective vehicle types for model year 2007.
- The emissions and fuel consumption benefits of combining technologies on a vehicle may not be additive, depending on the impact of specific technologies on vehicle/engine operation and performance. Therefore, the contractor should conduct a systems analysis of the efficiency potentials of specific technology combinations used in each of the scenarios. Improvements shall also be determined for the driving cycle utilized for the Task 1 evaluation and for vehicles operating under real-world conditions.
- Vehicle performance is defined by horsepower and torque performance across the range of typical engine speeds, rated horsepower and rated torque-to-weight ratios, engine and drivetrain smoothness, and compliance with emission standards. The contractor shall determine the likely impact of the technologies in each of the scenarios developed on each of these vehicles' attributes and provide a quantitative assessment of performance improvement or degradation.

Task 4: Conduct Cost Effectiveness Assessment.

Subtasks

- Develop cost estimates for individual technologies based on data in the existing literature and/or input from suppliers and OEMs.
- Develop costs for technology "packages" simulated during the study.
- Develop a cost effectiveness assessment for technology "packages" and for individual technologies taking into account the value of fuel savings realized, increased vehicle incremental cost, an assumed discount rate, an assumed fuel cost per gallon, and other factors.
- Clearly identify the assumptions used in the cost effectiveness calculation.
- Estimate the total emissions impact and fuel savings from introducing new technologies into the vehicle fleet. This will require the contractor to make assumptions about which technology packages will be introduced into the vehicle fleet.

Deliverable Summary

- Draft and Final Reports: These reports will include a description of the study's methodology and assumptions as well as a summary and discussion of the results. The draft report should be submitted for review no later than 10 months after the start of the project and final report will be submitted no later than one month after the receipt of ICCT/NESCCAF comments.
- Model run outputs (spreadsheets or other format) and cost spreadsheets
- Quarterly Progress Reports: Submitted to NESCCAF

III. RESPONSES TO THE REQUEST FOR PROPOSAL

Respondents to this RFP may submit proposals on all four tasks defined above or for individual elements described in the proposal. However, due to their technical interrelationship, separate bids for Task 1 and Task 2 will not be accepted. All responses should include the following elements: summary of qualifications, proposed work plan, proposed tasks, staff, and timeline, and costs.

1. Summary of Qualifications

In this section respondents should provide a summary of prior completed studies and staff experience relevant to this project. The respondents shall indicate for each relevant study their role in the studies, and shall electronically submit copies of such studies. Relevant experience to be described includes but is not limited to:

- Developing and/or evaluating vehicle technologies and emission control systems and their impact on vehicle performance and emissions
- Modeling the impact of fuel consumption and/or vehicle technologies on vehicle emissions and vehicle performance and analyzing the model outputs
- Determining the impact on vehicle cost of incorporating new technologies and similar cost analyses

2. Proposed Work Plan

Respondents shall outline how they intend to address each of the tasks listed above. For Task 1, respondents should indicate what sources of information are available, how they intend to conduct the investigation of proven and emerging fuel consumption and emissions improvement technologies, and any other relevant information demonstrating their expertise in vehicle technologies.

For Task 2, the respondents shall identify the computer model(s) that are available for such analyses as well as the capabilities and limitations of the computer model(s) to generate the required output. The respondents should also describe how they intend to use the computer model(s) in the context of this study including the methodology they will employ to estimate benefits.

After the submission of proposals, NESCCAF and ICCT may schedule meetings with potential contractors to discuss elements of the proposals. During such meetings, potential contractors should be prepared to discuss for Tasks 1, 2, and 3:

1) The source of engine maps to be used for the simulation modeling and how have they been validated. In addition, if the engine map data is taken from dynamometer testing, how will that information be translated to road behavior for the vehicle?

2) How are emissions and fuel consumption estimated during transient operating conditions?

3) What duty cycle would be used for the modeling exercise? How does this cycle account for the range of duty cycles for class 8 trucks?

4) How would the impact of terrain on emissions and fuel consumption be assessed?

5) How would the fuel consumption and emissions impact of technologies (including the following) be assessed:

- hybridization
- idle reduction
- electric accessories
- lower tire rolling resistance
- aerodynamics drag improvements
- changes in weight

6) Describe the baseline class 8 vehicle that would be modeled. What are the performance and emissions characteristics of that vehicle?

For Task 4, the respondents shall provide anticipated sources of information, and the proposed methodology for determining the cost impact of efficiency technologies on vehicle prices shall be included.

3. Proposed Tasks, Staff and Project Timeline

The respondents should provide a table summarizing the proposed task and subtasks identifying the assigned staff. Resumes and bibliographies for each proposed project staff member should be included in the proposal. Respondents should also submit a timeline for the completion of each task and the submittal of the deliverables identified above. ICCT and NESCCAF anticipate that the work in Tasks 1 to 4 will be started in July of 2006 and completed by April of 2007.

4. Proposed Cost

Respondents shall include a cost for each task of the project they are bidding on as well as the rates for each of the staff members anticipated to participate in the project. Travel and material costs for each should be identified separately. ICCT and NESCCAF expect the cost for this research program to be commensurate with a specified set of tasks meeting the requirements set forth in the Scope of Work. We anticipate that the cost of the proposed work will be in the range of $200,000. If the actual tasks are less comprehensive or more comprehensive than envisioned by ICCT/NESCCAF, the prospective contractor shall have the option to re-specify the Scope of Work and cost.

IV. PROPOSAL SUBMISSION AND CONTRACTOR EVALUATION CRITERIA

The deadline for submission of proposals to the RFP is 5 p.m. EST, June 9, 2006. Proposals may be sent via e-mail, fax, or mail to the attention of Coralie Cooper: ccooper@nescaum.org, fax: (617)742-9162, mail: NESCAUM, 101 Merrimac Street, Boston, MA 02114. No proposals will be accepted after the deadline. Electronic submission of proposals is preferred. Prior to submission of final proposals, ICCT and NESCCAF staff will schedule individual conference calls with candidate contractors to underscore key facets of the RFP, and clarify issues, if required.

Contractors will be selected based upon the demonstrated understanding of all aspects of the subject matter (technical, policy, economic, etc.), the demonstrated experience of key personnel, the likelihood of successfully meeting project goals and specifications, administrative support capabilities, total cost, and the ability to meet the time schedule set by the project management team. Cost will be an important consideration, but the choice of contractor(s) will not depend on cost alone.

References:

International Energy Agency (IEA). 2004. Oil Crises & Climate Challenges- 30 Years of Energy Use in IEA Countries. OECD, Paris, France
New York Times. October 25 2005. Wal-mart to Seek Savings in Energy.
World Resources Institute. 2005. Earthtrends. http://earthtrends.org/, Accessed 11/2005.