7. Materials Technologies: Propulsion Materials

Introduction

Advanced materials, including metals, polymers, composites, and intermetallic compounds, can play an important role in improving the efficiency of transportation engines and vehicles. Weight reduction is one of the most effective ways to increase the fuel economy of vehicles while reducing exhaust emissions. The development of propulsion materials and enabling technologies will help reduce costs while improving the durability, efficiency, and performance of advanced internal combustion, diesel, hybrid, and fuel-cell-powered vehicles. The advanced materials research conducted under the direction of the U.S. Department of Energy and the Vehicle Technologies Program will help ensure the nation's transportation energy and environmental future by making affordable full-function cars and trucks that use less oil and produce fewer harmful emissions.

In this merit review activity, each reviewer was asked to respond to a series of questions, involving multiple-choice responses, expository responses where text comments were requested, and numeric score responses. In the pages that follow, the reviewer responses to each question for each project will be summarized: the multiple choice and numeric score questions will be presented in graph form for each project, and the expository text responses will be summarized in paragraph form for each question. A table presenting the average numeric score for each question for each project is presented below.

Presentation Title	Principal Investigator and Organization	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
Materials Compatibility of Power Electronics	D.F. Wilson (Oak Ridge National Laboratory (ORNL))	7-4	2.80	3.00	2.20	2.80	2.83
Electrochemical NOx Sensor for Monitoring Diesel Emissions	Robert Glass (Lawrence Livermore National Laboratory (LLNL))	7-6	3.50	3.25	3.25	2.75	3.25
Fuel injector Holes (Fabrication of Micro-Orifices for Fuel Injectors)	George Fenske (Argonne National Laboratory (ANL))	7-8	2.25	2.25	2.75	2.50	2.34
Hydrogen Material Compatibility for Hydrogen ICE	Mark Smith (Pacific Northwest National Laboratory (PNNL))	7-10	3.00	2.80	3.60	2.40	2.90
Design Optimization of Piezoceramic Multilayer Actuators for Heavy Duty Diesel Engine Fuel Injectors	H.-T. Lin (Oak Ridge National Laboratory (ORNL))	7-13	3.33	2.67	3.00	3.00	2.92
Materials-Enabled High-Efficiency Diesel Engines (CRADA with Caterpillar)	Michael Kass (Oak Ridge National Laboratory (ORNL))	7-15	2.75	2.50	3.00	2.25	2.59
Fatigue Enhancements by Shock Peening	Curt Lavender (Pacific Northwest National Laboratory (PNNL))	7-17	3.33	3.00	3.33	3.67	3.21
Tailored Materials for High Efficiency CIDI Engines (Caterpillar CRADA)	Glenn Grant (Pacific Northwest National Laboratory (PNNL))	7-19	3.20	3.20	3.20	3.40	3.23
Durability of Diesel Engine Particulate Filters	Thomas Watkins (Oak Ridge National Laboratory (ORNL))	7-21	3.00	3.50	3.00	3.00	3.25
Thermoelectric Mechanical Reliability	A.A. Wereszczak (Oak Ridge National Laboratory (ORNL))	7-23	3.20	3.20	3.20	3.20	3.20
Thermoelectric Materials by Design, Computational Theory and Structure	David Singh (Oak Ridge National Laboratory (ORNL))	7-25	3.00	3.00	3.00	3.00	3.00

Presentation Title	Principal Investigator and Organization	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
Thermoelectric Nanocarbon Ensembles	D.M. Gruen (Argonne National Laboratory (ANL))	7-27	3.50	3.25	3.00	3.50	3.31
Proactive Strategies for Designing Thermoelectric Materials for Power Generation	Terry Hendricks (Pacific Northwest National Laboratory (PNNL))	7-29	2.80	3.00	3.00	2.80	2.93
Mechanisms of Oxidation-Enhanced Wear in Diesel Exhaust Valves	*Peter Blau (Oak Ridge National Laboratory (ORNL))*	*7-31*	*3.00*	*3.00*	*2.50*	*3.00*	*2.94*
Materials for High Pressure Fuel Injection Systems	*Peter Blau (Oak Ridge National Laboratory (ORNL))*	*7-33*	*3.50*	*3.00*	*3.00*	*3.00*	*3.13*
Super Hard Coating Systems	*Ali Erdemir (Argonne National Laboratory (ANL))*	*7-35*	*4.00*	*3.50*	*3.50*	*3.50*	*3.63*
Lithium-Ion Battery Recycling Issues	*Linda Gaines (Argonne National Laboratory (ANL))*	*7-36*	*3.00*	*3.00*	*2.00*	*3.00*	*2.88*
Solder Joints of Power Electronics	*Burak Ozpineci (Oak Ridge National Laboratory (ORNL))*	*7-37*	*3.00*	*3.00*	*3.00*	*3.00*	*3.00*
Materials for HCCI Engines	*Bruce Bunting (Oak Ridge National Laboratory (ORNL))*	*7-38*	*3.00*	*2.50*	*3.00*	*3.00*	*2.75*
Materials Issues Associated with EGR Systems	*Michael Lance (Oak Ridge National Laboratory (ORNL))*	*7-39*	*3.50*	*3.00*	*4.00*	*3.00*	*3.25*
Durability of ACERT Engine Components	*H.-T. Lin (Oak Ridge National Laboratory (ORNL))*	*7-41*	*3.00*	*3.00*	*3.00*	*2.00*	*2.88*
High Performance Valve Materials	*Philip Maziasz (Oak Ridge National Laboratory (ORNL))*	*7-43*	*3.00*	*3.00*	*3.00*	*3.00*	*3.00*
Materials for Advanced Turbocharger Designs	*Philip Maziasz (Oak Ridge National Laboratory (ORNL))*	*7-44*	*3.00*	*3.00*	*3.00*	*3.00*	*3.00*
Catalysts via First Principles	*C.K. Narula (Oak Ridge National Laboratory (ORNL))*	*7-45*	*3.00*	*2.00*	*2.00*	*3.00*	*2.38*
Compact Potentiometric NOx Sensor	*Dileep Singh (Argonne National Laboratory (ANL))*	*7-46*	*3.00*	*3.50*	*3.00*	*3.00*	*3.25*
Residual Stress Measurements in Thin Coatings	*Dileep Singh (Argonne National Laboratory (ANL))*	*7-48*	*3.50*	*2.50*	*3.50*	*3.00*	*2.94*
NDE Development for ACERT Engine Components	*J.G. Sun (Oak Ridge National Laboratory (ORNL))*	*7-49*	*3.00*	*3.00*	*3.00*	*3.00*	*3.00*
Catalyst Characterization	*Thomas Watkins (Oak Ridge National Laboratory (ORNL))*	*7-51*	*3.00*	*2.00*	*3.00*	*2.00*	*2.38*
Environmental Effects on Power Electronic Devices	*A.A. Wereszczak (Oak Ridge National Laboratory (ORNL))*	*7-52*	*3.00*	*3.00*	*3.00*	*3.00*	*3.00*
Erosion of Radiator Materials by Nanofluids	*Dileep Singh (Argonne National Laboratory (ANL))*	*7-53*	*2.50*	*2.50*	*2.50*	*2.00*	*2.44*
Low Cost Titanium Propulsion Applications	*Curt Lavender (Pacific Northwest National Laboratory (PNNL))*	*7-55*	*3.00*	*3.00*	*3.00*	*3.00*	*3.00*
Magnetic Material for PM Motors	*Iver Anderson (NASA Ames)*	*7-56*	*3.25*	*3.25*	*3.25*	*3.25*	*3.25*
Ultra-high Resolution Electron Microscopy for Catalyst Characterization	*L.F. Allard (Oak Ridge National Laboratory (ORNL))*	*7-58*	*3.50*	*3.00*	*3.50*	*2.50*	*3.13*
OVERALL AVERAGE FOR PROPULSION MATERIALS			**3.09**	**2.97**	**3.04**	**2.91**	**3.00**

NOTE: Italics denote poster presentations.

Overview of Propulsion Materials: Jerry Gibbs, U.S. Department of Energy

1. Was the Sub-program area adequately covered? Were important issues and challenges identified? Was progress clearly presented in comparison to the previous year?

A reviewer stated most of the presentations had a clear overview of the challenges. Providing last year's reports and reviewer's remark enabled a good understanding of progress made in the various projects. Another reviewer commented the subprogram area was well covered and the important issues were identified. Two reviewers answered yes with one adding the sub-program covers critical enablers to support advanced combustion, thermoelectric, and hybrid-drive systems. The sub-program fulfills the goal of improving efficiency of advanced vehicles through innovative materials solutions. Important issues and challenges in the propulsion materials areas were identified. This sub-program also collaborates with Advanced Combustion Engine, Hybrid Electric Systems, and Fuel Technologies.

2. Are plans identified for addressing issues and challenges? Are there gaps in the project portfolio?

A reviewer stated that the information on the plans was limited for remote reviewers. No GANTT charts were provided making it difficult to assess if a project was running according to plan and budget. Another reviewer mentioned the plans were well identified and there are no gaps in the project portfolio. Two reviewers both answered yes, with one commenting areas of commonality and project alignment are clearly identified. Research projects were aligned to address technical challenges in each area. The other reviewer also said gaps are not surprising in a diverse set of projects for materials that enable so many other projects.

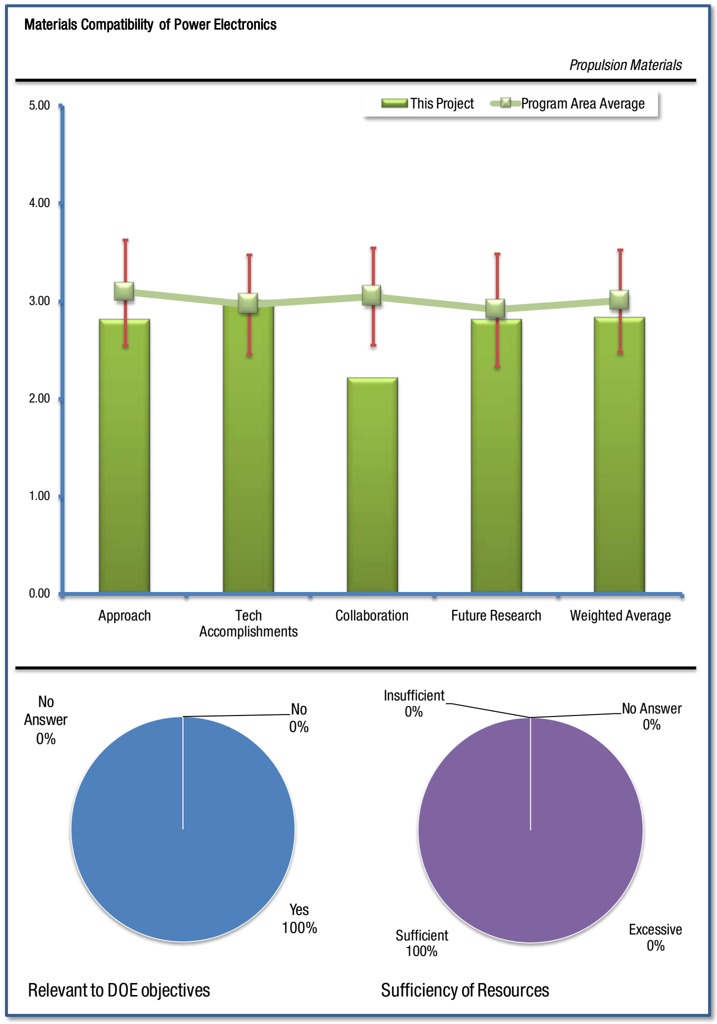
3. Does the Sub-program area appear to be focused, well-managed, and effective in addressing the DOE Vehicle Technologies Program R&D needs?

A reviewer stated the projects show a good coherence a sufficient focus is available. Three reviewers all answered yes with one adding the sub-program area is focused and well-managed. The existing activities are evaluated annually. About 12% of activities are retired each year. A well-balance of research projects are in place to address the DOE Vehicle Technologies.

4. Other comments:

A reviewer stated the materials projects within this program will provide important support to allow new energy and renewable technologies to have the reliability and low cost that is necessary to succeed in the real-world automotive marketplace. Another reviewer commented the material research program is well managed and progressing well. One other reviewer mentioned this is a well constructed and managed program.

Materials Compatibility of Power Electronics: D.F. Wilson (Oak Ridge National Laboratory (ORNL))



Reviewer Sample Size
This project had a total of 5 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?
Reviewers commented on the strength of the link between evaporative cooling and petroleum displacement. One reviewer perceived that success in this work will allow smaller, lighter-weight power electronics, and that electrical machine systems utilizing power electronics are key to petroleum displacement and reduction. A reviewer suggested developing lab methodology in evaluating power electronic components. Another reviewer noted that the importance of this problem is evident, especially when considering the strong correlation between electronic component performance and temperature. Evaporative cooling is one of a number of approaches to address this problem. A concern was that future presentations should endeavor to make the connection between electronic cooling and petroleum displacement in stronger terms. Another reviewer said that the reduction in petroleum reduction will be relatively small. The reviewer noted that in the presentation there was a claim on improved energy efficiency based on the assumption that a single system outperforms a double system. This should be backed up by an energy balance for the two possible solutions.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?
Among the positive comments was that it is a good choice to measure impacts in testing heat transfer. The investigators are to have experiments with data on the heat transfer under different experimental conditions. Bubbles left on the surfaces may reduce the heat transfer. Various regimes can be mapped out and quantitative approximations for heat transfer in each regime can provide a means to use the results in engineering applications.

Reviewers also focused on identifying the technical barriers. For instance, one reviewer felt that technical barriers are not described with clarity: while the project is crafted in somewhat broad terms, the actual plan revolves around one somewhat narrow electronic structure, namely the 'Powerex IGBT' board. How is this representative? A clearer case should be made for the configuration selected. It was unclear precisely what the test system was designed to accomplish and what specific questions it was intended to answer.

Another reviewer suggested building test systems and validating the tests, using direct side-stream cooling to decrease weight and size of PE, and mimicking in-service use. An integrated approach to compatibility issues is being developed. A reviewer noted that R-134a may ultimately be phased out in the U.S., as is happening in Europe. The reviewer asked if any provision has been made to test a back-up refrigerant/coolant. Additionally, use of an A/C side stream to cool power electronics suggests the A/C compressor must operate any time the vehicle does. Does this imply the need for a dual-capacity compressor so that the full power demand of the A/C system isn't always imposed on the main power plant? A barrier to be overcome by this project is abuse tolerance and ruggedness of HTIPE systems. One would expect to find evidence that the chosen test conditions have a correlation with the condition found in existing applications, but this is not shown in the presentation. The choice to focus on one cooling system is a good approach to reduce cost and volume of the cooling system.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.

A reviewer felt the project reached its past milestones in a timely manner, and that the milestone for 09/09 is well on its way to be reached on time. By the end of the project, there will be sufficient evidence to substantiate the start of the development of a single-circuit PE cooling system. This is especially valid in case there remains a good exchange with industry through the National Transportation Center. Another reviewer felt that it was good to see the documentation by photography of bubbles. It is also good to see temperature measurements. The suggestion is have more data (bubble images and temperatures) analyzed for estimating the thermal transport properties. A third reviewer noted that a rest system was designed and built for accelerated evaluations, no failure was observed, and that enhancements were made to the test system.

A reviewer perceived that while a test methodology was developed for the Powerex board, and the PIs have obtained some results with it, it is unclear precisely what they were going to do with their results (i.e. temperature measurements, influence of current, etc). The results seemed to raise more questions than they answered. Specifically, what is the cause of high frequency temperature oscillations (is it an artifact?) Is the configuration designed for forced nucleate boiling, and if so what direction is the flow? How do CHF measurements compare with literature values? The reviewer felt the experimental design was not clearly defined and presented.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?

A reviewer cited coordination with DOE teams, but not with the industries yet. Another noted that the limited extent of integration (as cited in the question period) is only through an institute arrangement. A reviewer felt that there was no evidence of more partners found in the provided slides. Only cooperation with the National Transportation Center was mentioned. Another reviewer felt the collaborator element of the project might have been strengthened with a clearer statement of the partnership. The presentation materials did not appear to include any outside partners (though the reviewer apologizes if the PIs do have an extensive team of outside advisors; it is just that these were not evident from the presentation).

Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

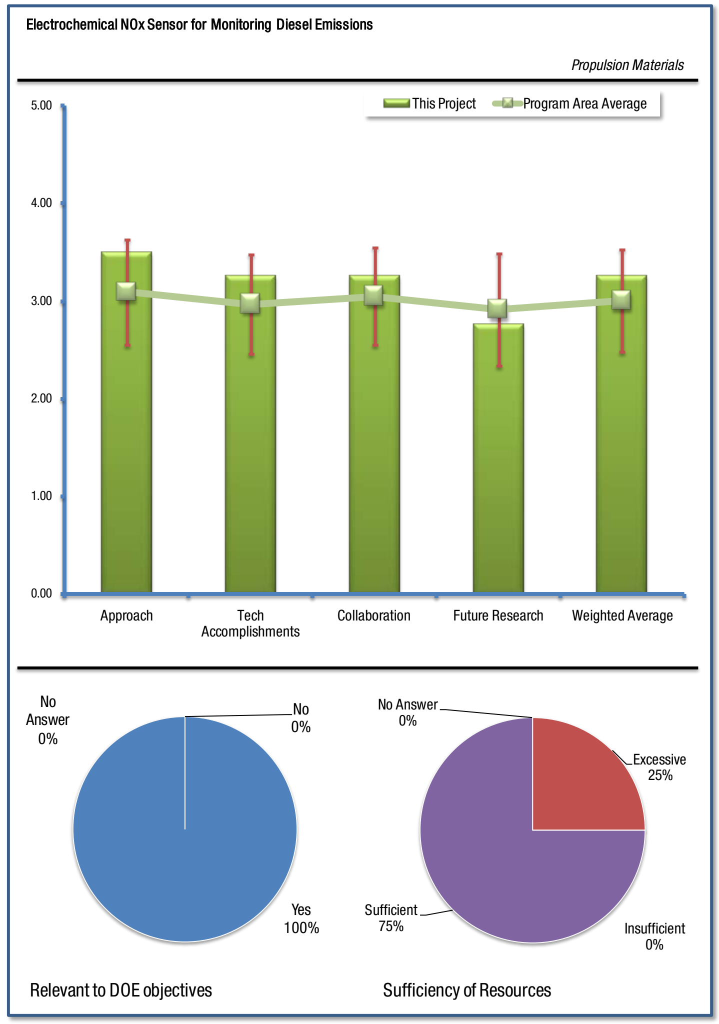
One reviewer thought the task to validate the test methodology seems good, though a clearer set of rules for establishing go/no go points would have been appreciated. Another reviewer found that the investigators are making process, and would like to see more quantitatively analyzed results in the future. A reviewer felt that the proposed steps are in line with the proposed approach. The reviewer also felt that it might be expected that the project will lead to sufficient proof of the feasibility of direct cooling with R134a refrigerant. What is missing is an indication on the use of the given methodology in case of a new/alternative refrigerant. It is likely that R134a is replaced in the near future.

Another reviewer also suggests developing a "go-no-go" criteria of failure, along with using more prototype board, and confirming the feasibility of cooling approach.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer comments were that good progress made in the research project, and that the reviewer is looking forward to seeing more cooperation with industries. Another reviewer felt that no information is provided on the spend budget. Indication is that 40% of the project is completed; this would indicate that the project is more or less running according to budget.

Electrochemical NOx Sensor for Monitoring Diesel Emissions: Robert Glass (Lawrence Livermore National Laboratory (LLNL))



Reviewer Sample Size

This project had a total of 4 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?

A reviewer thought that this project supports the overall DOE goals of petroleum replacement. However, de facto, development of new sensors would achieve this end as an ability to sense NOx is an important capability for improving energy efficiency. The quantitative linkage between results of this project and petroleum replacement was not stated. Another reviewer felt that the project assists diesels in meeting NOx emissions, noting that diesels are some of the most fuel efficient systems. A reviewer noted that the project enabled technology for diesel engine NOx sensor and work with Ford, and it develops low-cost, durable sensors for NOx.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?

A reviewer noted that only one type of NOx sensor is commercially available, but does not meet present or future diesel emission requirements. The reviewer also suggested refining criteria for sensor materials and configurations and improve sensor platform to consider design constraints in 2008, and noted that LLNL developed a unique design and measurements strategy.

Another reviewer responded that in casting their effort in the context of the state of the art, the PIs should more clearly articulate existing sensor technologies. The reviewer questioned why the design is better than the one currently commercialized: what are the issues and challenges with their sensor and with the commercial one? This will help make the case for more funding and to the industry at large.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.

A reviewer saw significant barriers remain after many years of working on this concept. The PIs have tried to resolve some of the barriers, but there are still issues, and it is no fault of them. However, there should be a clear go/no go point. Another reviewer noted that promising results for a lab prototype using alumina substrate that focuses on a more commercial design was presented, longer-term stability at operating temp of 650ºC was demonstrated, a more advanced prototype was developed, an engine successfully tested the sensor using a urea-SCR system, the projected completed initial long-term stability testing, and that there was improved electronically conducted oxide substrate.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?

The reviewers focused on the collaboration with Ford. One felt that the collaboration with Ford is good, if not essential. However, the apparent failure to attract other partners for this technology could be a sign that its promise may not in the end be realized. Another noted the work with Ford from the beginning, built on the patent issued by

Ford, and the project made significant improvements in the sensor design. Moreover, Ford will be working with suppliers to commercialize the sensors.

Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

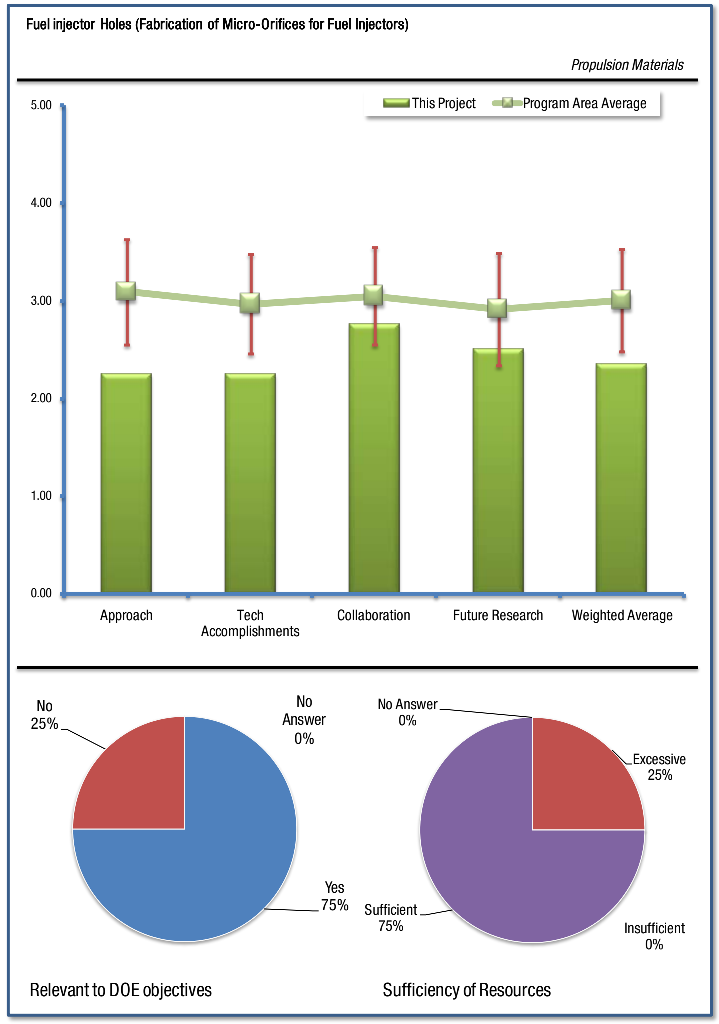
One reviewer would like to see ammonia cross sensitivity earlier. Perhaps it has been done, but this is difficult to determine from the slides. Another reviewer is uncertain precisely where this project goes from here. With seven years of funding thus far, one might have hoped for a stronger plan to commercialization. Mentioned was some potential from Ford in this regard, but it is somewhat unclear if this will materialize. There still seem to be some issues with long-term stability to resolve.

Another reviewer suggested improving mechanical stability, evaluating cross-sensitivities, continuing characterization, and developing strategies to reduce cross-sensitivity and increase accuracy.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Most reviewers felt that resources are sufficient, with one noting good progress and good collaboration with industries. One reviewer believed that resources have been excessive, commenting that the resources invested in this project, being in excess of $2 million for the life of the project to date, seems a bit high for the results obtained to date.

Fuel Injector Holes (Fabrication of Micro-Orifices for Fuel Injectors): George Fenske (Argonne National Laboratory (ANL))



Reviewer Sample Size
This project had a total of 4 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?
Among positive evaluations, a reviewer felt that very significant progress has been made over the past 5 to 10 years in in-cylinder emissions control. The reviewer questioned, Does this approach offer sufficient remaining potential (vs. aftertreatment) to justify this work toward ever-smaller injector orifice diameter? Another reviewer noted that enabling smaller orifices in fuel injector nozzles lead to lower emissions. This increases the operating window for combustion control. This will lead to lower fuel consumption. The somewhat disappointing improvement in fuel efficiency over the recent years is partly caused by the need to improve emissions.

One reviewer felt it was unclear whether fuel economy will actually improve. It is also unclear if smaller hole will actually reduce emissions significantly to reduce the need for aftertreatment. Another reviewer noted that the development of new injector designs can improve fuel efficiency and reduce particulate emissions. Therefore, de facto, an effort in this area would impact petroleum displacement. Precisely how much, however, for this particular project is unclear.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?
Reviewers latched on to the concept of varied injector orifice diameters. A reviewer felt that the technical barrier addressed is clear. The approach has a trial and error character. There is no evidence provided that a third production run will be successful. In the provided material, no characterization of the EN baths was shown. This will be a critical parameter to bring this process to an industrial level in future. Surface cleanliness is clearly important in this process. The improvement of cleanliness in general not only achieved by more aggressive cleaning, but by a full control of all steps in the production process. Another reviewer saw that engine dyno evaluation of the effect(s) of very small injector orifice diameters could be brought forward in time to validate the potential of this approach to PM reduction.

A reviewer felt that the approach taken is to design a multi-hole injector, with hole sizes to vary over a prescribed range. The basis for the idea seems to be a study dating to 2005 which showed that smaller hole diameters reduce emissions. For the present study, it was not clear precisely how the present study fit into this prior work, nor why having holes drilled in the side of the injector in the manner described in the presentation is the right approach. Presumably, droplet trajectory will exert an influence as well but this was not discussed.

Another reviewer saw that the approach seems to be flawed because commercial nozzles were used that had unknown materials and heat treatments. A better approach might be to utilize experience from a knowledgeable specialty steel manufacturer and list the conditions the investigators are attempting to achieve: how to achieve small holes sizes in a nozzle, what is the best material(s) that should be investigated, and how to approach the problem.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.

One reviewer felt that the accomplishments over the past year seemed to involve developing processes for drilling holes. With such an effort in this area, it would be assumed that the end result will be a significant reduction in PM and increase in fuel efficiency. With so much invested (last year) in fabrication, it was unclear if the payoff would be worth it. Concerns were expressed, namely one reviewer commenting that this item is difficult to assess. No evidence is provided to prove that bath conditions are under control to produce flawless specimens. The nature of the studied processes results often in an exploratory phase in a project. It is indicated that the penetration rate of 50 micron orifices was small. No indication is given of the used injection pressure. At least injection pressure influence could have been studied.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?

Among the positive comments, one reviewer stated that a good cooperation with EPA was shown, as was cooperation with industry partners. Another noted that industry collaboration was good.

Another reviewer felt that collaborations with industry should have been more clearly stated. Rather broad references to "OEMs", "Engine OEMs" and "Small Business" are mentioned, but no specifics are given. Nor were the industry roles discussed, or interaction with industry partners. A reviewer stated that it did not appear that the right industries or partners were involved based on the slides.

Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

One reviewer felt that the transition from the present results to future work in the next year seems somewhat uninspired. The reviewer hoped for more than refine coating protocols, EPA flow studies, and return nozzles to shop in a plan for future work. Perhaps the most important question to address, since the project seems in part to be based on it, is the mechanism for an orifice size reduction on particulate emissions. This does not seem to be established, yet it apparently forms the basis of the project. A reviewer felt that the coating process may not work, and that no alternative plan seems to exist. It is important to ask the question, ‘What steel or stainless steel microstructure would help us achieve the goals?’ It seems that the investigators continued down the plating path and perhaps there are better approaches.

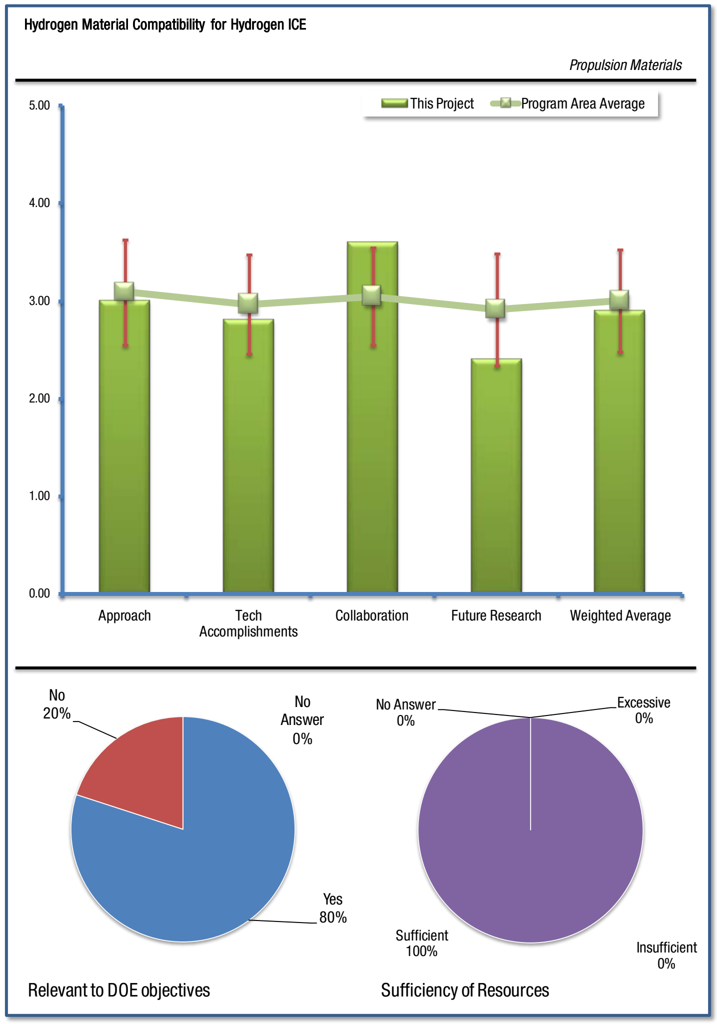
Another reviewer saw the value in investigating in the future the effect of smaller orifices on emissions. Also, the study on durability of the coatings is a necessary step for future implementation of the process.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Of the reviewers who felt that the resources were sufficient, one commented that while resources are sufficient, somewhat more results should be possible for the $350k annual budget. Another felt that this project may be deemed to be funded at an excessive level, depending on answer to question posed in Question 1.

A reviewer saw the program resources as being excessive, and commented that with $1.5 million invested to date, it seems that more might have been expected, especially given the somewhat tenuous linkage between orifice size and particulate emissions.

Hydrogen Material Compatibility for Hydrogen ICE: Mark Smith (Pacific Northwest National Laboratory (PNNL))



Reviewer Sample Size
This project had a total of 5 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?
Of reviewers who saw that the project supported the objective of petroleum displacement, one posited that the use of hydrogen-fueled engines would certainly impact petroleum displacement. Another saw that the goal of the project is to solve one of the barriers for introducing hydrogen as an alternative fuel in internal combustion engines. As such it supports the overall DOE objectives. A third reviewer noted that the project supports technology advancement in direct injection of H_2 for ICE, studies impact friction at injector nozzle, improves injector durability and performance, and measures wear and friction of injector materials and coating system. Another reviewer is of the opinion that success of this project will aid the adoption of hydrogen fuel technologies. If the hydrogen is made from a non-fossil-fuel source, the combustion will eliminate decrease the amount of petroleum that is needed. For example, if hydrogen comes from nuclear-electric, there will be an advantage. The non-fossil-fuel generation of hydrogen may require many years.

A reviewer had the opinion that H_2-fueled ICEs suffer, in addition to the unique problems outlined in this presentation, from the overarching problems attending all hydrogen-as-mobility-fuel schemes, namely, where does the hydrogen come from, at what cost and what's the fate of the CO_2 co-produced in the most straightforward H_2 generation processes? As a "bridge" to H_2 fuel cell vehicles, H_2-fueled ICEs seem even more questionable.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?
Several reviewers noted that the project had a reasonable approach. Specifically, one reviewer saw that the concept of direct injection is reasonable. The focus on injector design seems to be one of a number of aspects that have to be solved to develop a commercial hydrogen-fueled engine. Another reviewer felt that the approach is reasonable, but the barriers are numerous, daunting and the practical means to overcome them suggest production costs of hydrogen injectors will be excessive, which will inhibit (or prohibit) their commercialization.

Another reviewer focused on feasibility. The reviewer stated, while the approach for improving scuffing resistance by applying hard coatings is straight forward, a better description should be provided on the approach to improve the hydrogen uptake behavior, this to define piezoelectric materials suited for a hydrogen environment. This goes beyond measuring and model developing and is more related to material property engineering. Perhaps it is possible to describe the advanced analytical techniques used to characterize the coatings. An important one would be the internal stresses. And in case of multi layer systems the correct matching of stiffness of the layers to reduce hertzian stresses.

Integration was the focus of another reviewer. The reviewer thought that the work is bits and pieces of trouble-shooting. It is good that the work is integrated with the OEM and the fuel injector manufacturer. The reviewer does not hear a physical understanding of why hydrogen causes such friction and wear problems. So the approach appears to be one based on trial-and-error. A reviewer noted that the project addressed potential failure sites at needle and nozzle, conducted hydrogen in-situ friction wear tests, looked at DLC coating, nanolaminate coatings, and tailored properties, and looked at Actuator as another potential failure sites.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.

Several of the reviewers generally thought that the project showed good progress. Among these reviewers, one said that the PIs have made good progress in their study of a hydrogen injector and an evaluation of failure mechanisms. Another noted that with an empirical approach, solid data need to be present. The degree of success with the nano-coatings is reported only at 15,000 cycles. For a fuel injector, this number of cycles is far short of a prototype-test level need. The combination of a non-physically-motivated approach with a limited number of test cycles is a little unsatisfying. It is recognized that there are multiple sub-parts of this work. Even without physical interpretation, the solid experimental work is valuable. A reviewer focused on the coating development, commenting that the progress reported on the coating development is very good; it's very likely that the addressed barriers are overcome. This is less clear for the progress made in characterizing different piezoelectric materials with respect to hydrogen uptake. Another reviewer noted that the project measured and modeled H2 take-up, and conducted sliding impact wear tests, which showed good performance in coating.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?

Reviewers saw close cooperation. One said that The PIs have a good collaboration with Ford, ANL and Westport. Another reviewer saw excellent collaboration among many entities and national labs, including Ford, Westport, PNNL, ORNL, and ANL. A third reviewer concurred. The reviewer saw exceptionally close cooperation in responding to OEM test concerns. Hopefully, there will be opportunities for physical understanding over time. Another reviewer commented that in this project there is an excellent mix of industry and institutes. The report showed that there is a close collaboration between them. Also, the involvement of international parties strengthens the consortium.

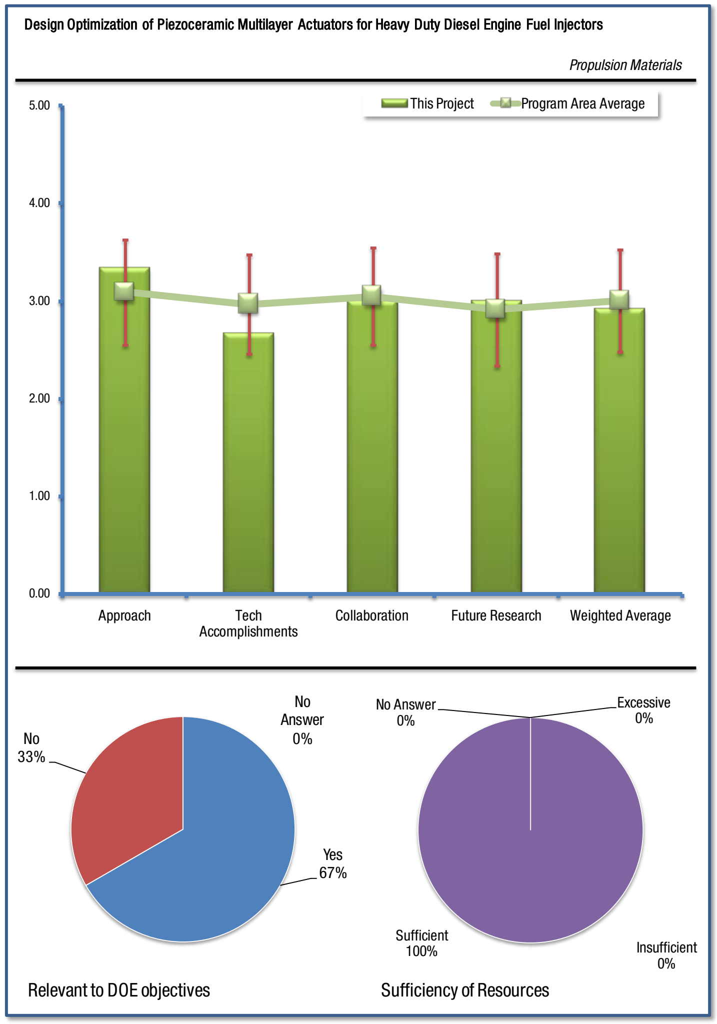
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

Reviewers commented on the time horizon of the project. For instance, one reviewer saw that the work is short-term, and would like to see more opportunity for physical understanding in the longer term. Other situations like natural-gas-driven stationary engines have special valve materials for similar exceedingly low-humidity wear situations. Another reviewer felt that the future plans seem reasonable. However, the PIs may be treading uphill because of the well-known issues with hydrogen. If the infrastructure and storage issues cannot be solved (and the prospects for such seem unlikely at least in the short term), this project will not have much of an impact when considered in light of competing energy technologies. This is no fault of the PIs but the unfortunate consequence of the proliferation of other energy sources. A third reviewer saw that the indicated activities are a logical continuation based on the results so far. The description however is not sufficient to have a clear picture on the change of overcoming barriers; this is especially the case for the PZT research. Another reviewer noted further development with ORNL in sliding impact tests, use analytical technique to support a model for hydrogen diffusion, and continue to test DLC and nanolaminate coatings

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

One reviewer felt that funding seems adequate for the tasks carried out. A second was of the opinion that it is very difficult to give a good opinion on this question. No Gantt chart is provided in which the progress against the original timing and budget are made visible. The progress reported is well in line for the mentioned budget of $300k. A final reviewer noted that the project will be ending in FY2009.

Design Optimization of Piezoceramic Multilayer Actuators for Heavy Duty Diesel Engine Fuel Injectors: H.-T. Lin (Oak Ridge National Laboratory (ORNL))



Reviewer Sample Size

This project had a total of 3 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?

A reviewer felt that with the prospect of HD engine/vehicle fuel economy standards, the additional degree of fuel injection control potentially available from this technology becomes significant. A second reviewer felt that this technology provides improvements to diesel combustion. So, this work will be able to provide further improvements beyond the gains from the category change of going to diesel fuel. Another reviewer commented that the PIs did not clearly link their efforts with injector design to petroleum displacement. According to this reviewer, presumably, there is a link- their design would create smaller droplets, larger fuel surface area, greater evaporation, lower emissions , etc. But these were not outlined for the audience.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?

One of the reviewers saw that the work gives an analytical basis for mechanical reliability of PZT actuated fuel injectors. Another reviewer saw a mixed bag, commenting that the approach to measure mechanical properties of PZT piezoceramics, develop test methods for reliable qualification of piezoactuators, and adapt their design to heavy-duty diesel engines seems reasonable. However, this reviewer is unclear if the piezoactuation concept for injector design is the way to go. It has some attributes, but how it fares in comparison with existing designs should be strengthened.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.

For one reviewer, considering the investment, the pursuit of mechanical strength testing of piezoceramics seems reasonable, though a bit modest. Another noted that complex mechanical property measurements were made with electric field applied. However, this reviewer was concerned that the cracks in the stack example (shown later in the presentation) are in a different orientation than the cracks in the ball on ring geometry tests. If there is a way to measure the strength with the cracks in the orientation of the stack failure mode, it may be possible to correlate the strength values to the life prediction task. If the metal in the metal ceramic bond melts, then the failure mechanism may be complex.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?

Several reviewers recognized the collaboration with Cummins. One reviewer saw only one industry partner, but that the partner was an excellent choice. There were other comments about the CRADA. One reviewer noted the collaboration with Cummins, but commented that though a three-year Cummins-ORNL CRADA was approved last year, Cummins' role was unclear. Another reviewer also noted the CRADA with Cummins, and commented that regarding the confidentiality of the work, it should be noted that similar piezo-injectors are already in mass production for diesel applications.

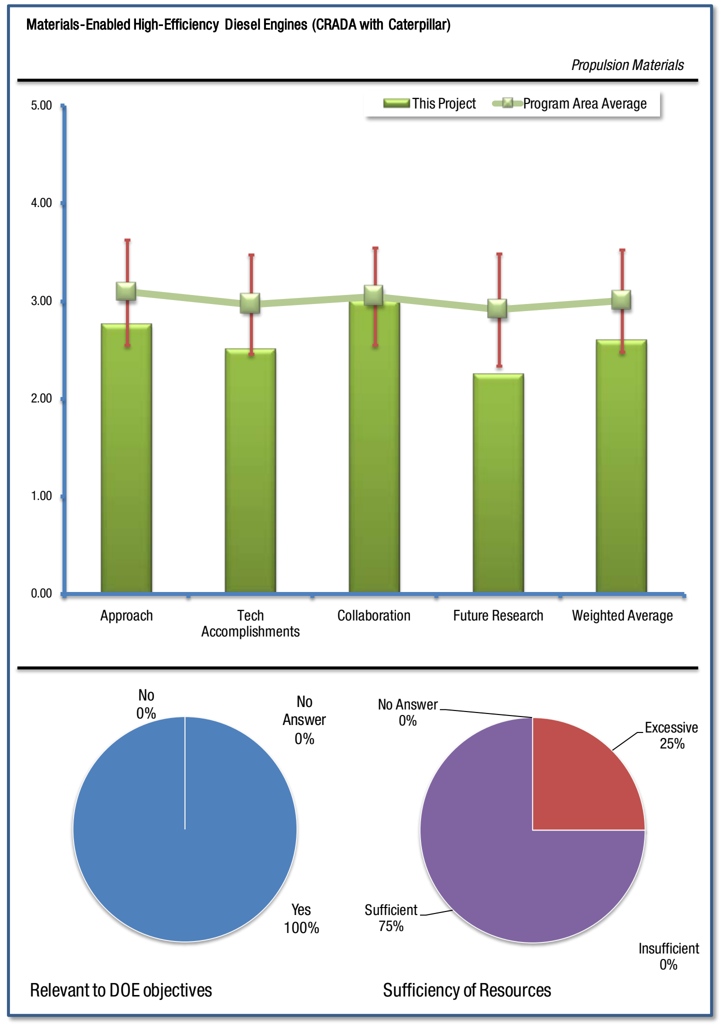
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

Among positive reviews, a reviewer was looking forward to seeing how the materials information will help design optimization for future iterations. Another reviewer felt that the proposal for accelerated tests is reasonable, but it was unclear how the approach for future work will translate to an improved design.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

There were no comments on the resources.

Materials-Enabled High-Efficiency Diesel Engines (CRADA with Caterpillar): Michael Kass (Oak Ridge National Laboratory (ORNL))



Reviewer Sample Size

This project had a total of 4 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?

One reviewer commented that the project aims at developing new material application to enable 55% engine efficiency. Important is the addition of the demand for a one million mile endurance of the material solution. Another reviewer saw that, generally, high strength, high thermal conductivity and lightweight materials will lead to improved efficiency and thereby assist in petroleum displacement. It was unclear to this reviewer that the engine test facility development that seemed to have been the focus of the effort over the past year could accomplish a 55% efficiency target.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?

Among positive reviews, one commented that the planned approach is reasonable. Another reviewer felt that the behavior of materials under real engine conditions has always been difficult to translate to laboratory conditions. This project will avoid this problem by going directly into an experimental engine.

A third reviewer felt that assessment was too early to determine. Another reviewer did not feel a rationale was provided for the particular engine selected for study - the C15 ACERT engine- except that it seemed to have been donated by Caterpillar. It was unclear to this reviewer how results from this engine could be generalized to the wider range of designs in current use nationally. No mention of generalizing the results was included in the effort. Further, the PIs mention "inadequate design and performance data" but do not tell us what these "data" are, nor why their approach of carrying out tests on this particular engine will be relevant. They also mention "advances in thermal management and advanced combustion" but again do not elaborate. The motivation and approach are crafted in only the most general of terms. For this reviewer, perhaps the most curious aspect about this effort was that while it concerned "materials", no specifics of precisely what materials, or how they would be fabricated, was included in the presentation.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.

Most reviewers felt the project was in its early stages. Specifically, one reviewer commented that it is too early in project to evaluate progress. Another reviewer noted that the project is mostly infrastructure building. A third reviewer commented that the project is still in its preparatory phase. Therefore, no results with respect to the main goal are available, though the engine test-cell is operational. Another reviewer commented that the PI has developed an engine test facility for the Caterpillar engine with significant effort and has "instrumented" the engine for temperature, pressure, flow rate and "chemistry" (the meaning of the latter was unclear). Precisely what they would do with the data they would obtain was not certain, which was somewhat the problem with this study. Further, a logical rationale for engine testing, materials development and generalization of the results to beyond the particular engine of interest to this study was not provided.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?

Several reviewers commented on the collaboration with Caterpillar. For instance, a reviewer noted the cooperation between ORNL and Caterpillar, making it a small consortium. This reviewer also noted the cooperation with Caterpillar WFO on modeling, but was unclear how this is included in the program; it should be stated more clearly. Another reviewer felt that CRADA involved only one partner, but a highly credible one. However, this reviewer expressed a concern, commenting that Cat has announced its intention to exit the highway diesel engine market within a year. Will proprietary considerations inhibit the commercialization in the highway sector (by others) of any technologies arising from this project?

A third reviewer felt that the CRADA with Caterpillar was good, especially the donation of the C15 ACERT engine. However, it was not clear precisely what Caterpillar's interest was in this study except to provide the engine and have ORNL do tests on it. The PI mentions a "materials-by-design approach to high temperature, high pressure engine operation." but it is not clear what this means, in quantitative terms. It seems more like a buzz phrase. The PIs should be more specific and elaborate in their presentation.

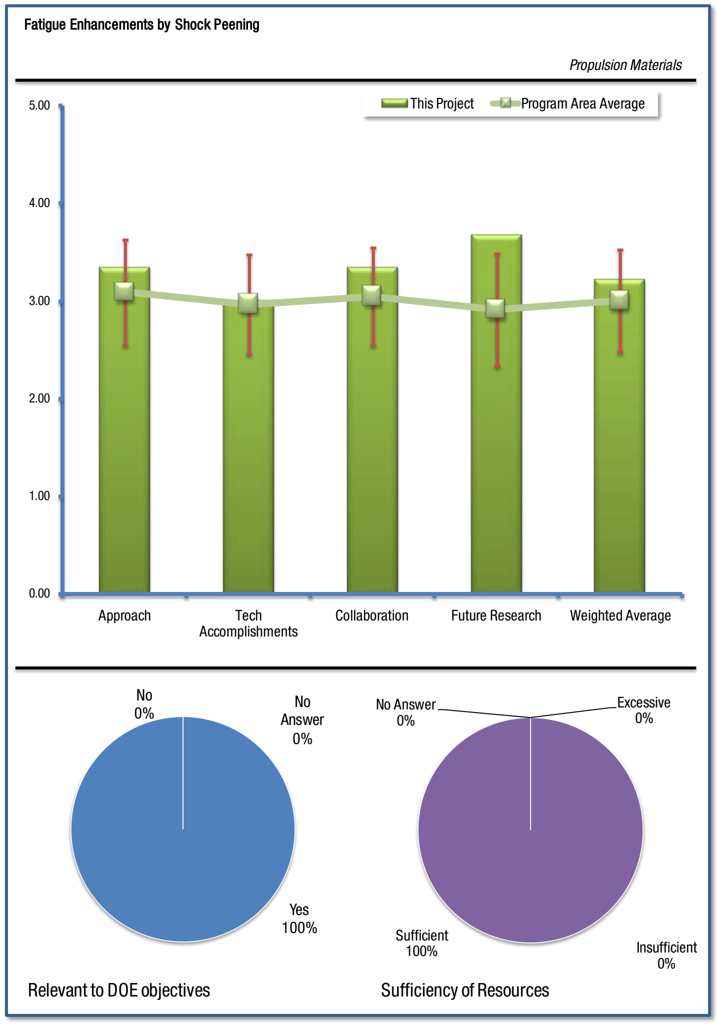
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

One reviewer commented that this was difficult to determine, and that economic conditions may alter industry participation. Another reviewer noted that although the general approach of using an engine as a test bed is good, there is only very limited information on what type of testing is done with this engine. A third reviewer commented that with the various measurements proposed in their new facility and engine, the PIs did not clearly state precisely what they would do with the data they would obtain, what range of conditions they would examine, how they could generalize the results beyond the particular engine selected for study, what efficiency gains they would expect and (most curiously) what materials they would examine. Presumably they have this information and presented it in their original proposal but it was impossible to judge the efficacy of the approach to achieve results that could have a real impact on improving engine efficiency.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

One reviewer commented that, looking at the achievements of 2008, the budget is in line with the results, but that no Gantt chart was provided showing accomplishments in relation to the original planning. Another reviewer was unclear how infrastructure development of a new engine test facility at ORNL will contribute to the 55% efficiency target (one would have thought that ORNL already had the requisite test facilities). The funding seemed only to provide funding to supplement ORNL's internal support of developing this test cell.

Fatigue Enhancements by Shock Peening: Curt Lavender (Pacific Northwest National Laboratory (PNNL))



Reviewer Sample Size

This project had a total of 3 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?

Among positive reviews, one commented that improvement of fatigue performance of materials will open the road for further fuel efficiency improvements. Another reviewer felt that the project could be important enabler for advanced combustion system and conventional engines, particularly from economic standpoint. However, another reviewer felt that the presentation did not clearly make the case for how this project would actually lead to petroleum displacement. In future presentations, the PIs should be encouraged to do so.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?

One reviewer recognized that the overall concept studied is to incorporate higher injection pressures to derive improved efficiency (a somewhat well-known approach). Higher pressures place greater strains on materials. Surface modifications can enhance material strength and fatigue. The PIs use cast-iron as their base material. The Laser Shock Peening/water jet peening approaches are interesting, though somewhat well known. For the LSP method it was unclear how the shock was generated through the water curtain; more discussion on this point should be included in future presentations. It was also unclear how uniform surface modifications were obtained by the method for curved materials as the schematic seemed to indicate a planar treatment. The reviewer questioned, was the material somehow rotated through the beam?

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.

The reviewers recognized the project's progress. One reviewer felt that the PIs have obtained a lot of data in the past year which show effects of surface treatment. Another commented that clear progress is made in the area of LSP and water jet peening, resulting in a technological deployment activity by Cummins. The friction stir welding activities on cast iron do not seem do have made much progress towards the objectives.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?

The reviewers noted that collaboration with Cummins. One reviewer commented that the collaboration is good, and that the CRADA seems to indicate a strong interest on their part to use the results of the surface treatment approach to improve material fatigue. Another reviewer noted how the CRADA is a cooperation between Cummins and PNNL, and that cooperation is well coordinated. The project is linked to a cooperation between South Dakota School of Mines and Cummins.

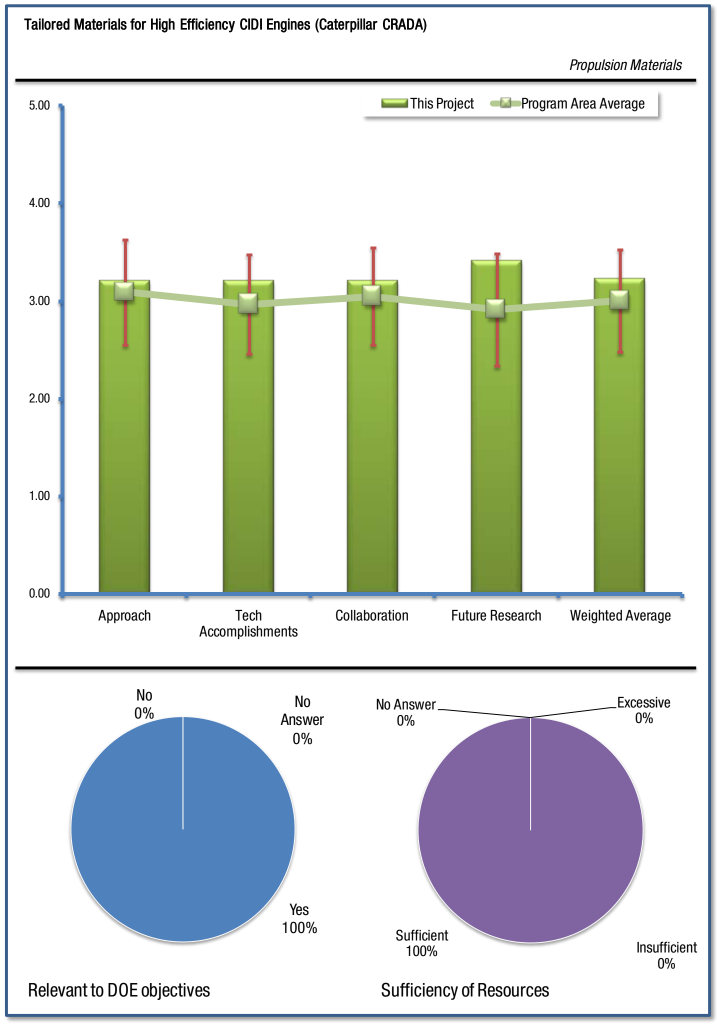
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

A positive review was that the proposed future work is well in line with the results so far. To start with screening trials for friction stir welding is a good approach. In case of study of the combination LSP finer surface finish, the same surface finish process as in previous tests must be used. Another reviewer stressed that there is a lot of testing to be accomplished. At some point, the PIs should stop and ask themselves how they can generalize their results and transition them to commercializing a process. For example, will their surface treatment approach be applicable to mass-produced items?

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

One reviewer felt that the future plans and mentioned budget are in line. Another felt that the funding of $350k seems a bit high for what seems like a testing project.

Tailored Materials for High Efficiency CIDI Engines (Caterpillar CRADA): Glenn Grant (Pacific Northwest National Laboratory (PNNL))



Reviewer Sample Size

This project had a total of 5 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?

Several reviewers noted the potential for improved efficiency. One reviewer commented that success in this work will provide improvements in reliability of large diesel engines. As such, the carbon-measured fuel efficiency of diesel over other hydrocarbon fuels can be more broadly implemented to reduce petroleum consumption in these transportation applications. Another reviewer commented on FSP, which could be an important economic enabling technology for both conventional and advanced combustion engines. For another reviewer, the project poses an interesting proposition to locally improve material properties that may allow higher pressures and temperatures in combustion chamber. A mixed review recognized that high strength materials will impact petroleum displacement through improved engine efficiency, but the PIs in the future should endeavor to show a more quantitative connection of their efforts with petroleum displacement. One wonders if the hope for enabling "new combustion processes" like HCCI by the materials development effort that this project concerns can actually be realized. Another reviewer noted improved fuel efficiency, thermal management, and develop lower cost materials by using friction stir processing.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?

Some reviewers felt the approach was interesting. Specifically, a reviewer felt the friction stir processing method (to convert a cast material to wrought) for creating an engineered surface is interesting. Improvements in strength, ductility, fatigue and wear resistance are anticipated. The incorporation of carbon nanotube composites is interesting. Another reviewer commented that the project was an interest approach. A third reviewer mentions the surface engineering approach has a long history of benefits in materials technologies for engines. The past gains with fatigue property improvements with the specific process of friction stir processing make this topic a promising area for further development. Another reviewer notes work on aluminum alloys in FY08/09 and develop tool screening studies for steel FSP, and thermal fatigue of bowl rim of aluminum pistons as potential applications.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.

One reviewer addressed how the investment to date in developing machine with post-stir heat treatment has good potential for future accomplishments. At this point (25%), there are not many accomplishments in hand. From his knowledge of other work with friction stir, the presenter seems to know the direction headed. Time will tell. Separately, the particle size narrowing information of the presentation (with distribution expressed as "percent greater than the average [mean]" would be better expressed as a distribution width parameter, such as standard deviation of a log normal fit. Another reviewer mentioned good work in a novel "cladding" process, but it's difficult to determine from the slides if the carbon nanotubes were successful at accomplishing the objectives. Another reviewer mentioned the PI's have demonstrated that the FSP method is possible for flat aluminum alloys. They investigated this process for carbon nanotube and nanofiber composites. They found significant improvements in fatigue performance. This reviewer feels the PIs should think about comparing composites made from single walled and multi-walled carbon nanotubes. Some discussion on cost and availability of SWNTs and MWNTs would be useful to have in future presentations.

A reviewer noted how the project completed of FSP of cast hypo-eutectic aluminum alloys for cylinder head applications, and showed improved fatigue strength after FSP; successfully stir in new components into piston alloys for improved bowl rim thermal fatigue; developed tool for FSP and processing parameters; and work started on FSP of steel.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?

Reviewers responded positively to collaboration with Caterpillar. One reviewer posited the CRADA with Caterpillar is good. Another commented the project has worked with Cat on this project from beginning and have potential engine testing of engine components. A reviewer agreed, noting good collaboration with the CRADA partner is evident.

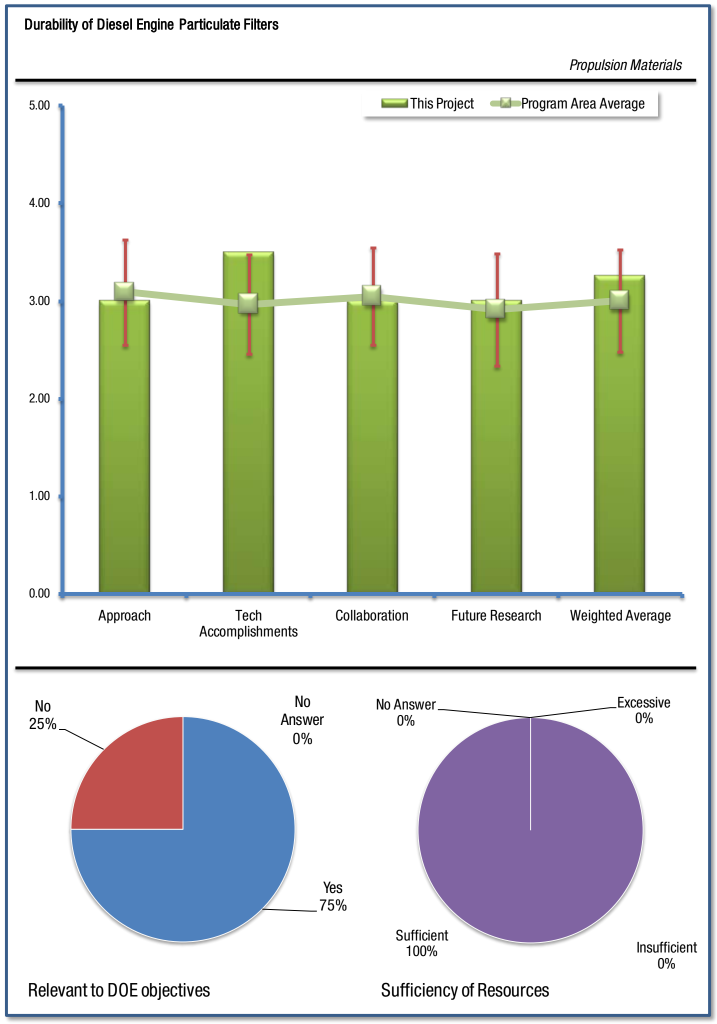
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

Reviewers made suggestions about what kind of work to perform in the future. For instance, a reviewer commented that the project is doing good work, and added that investigators may want to think about residual stress control in addition to the carbon nanotube for thermal conductivity improvement. Another reviewer feels the plan for future work appears on the same trajectory of the past year's effort. It will include a similar program of testing and evaluation. In spots the plan was vague (i.e., what does "develop strategies..." mean?). In others it was unclear what would be done with the information or why the particular material choices were made. A third reviewer noted thermal and mechanical testing of carbon nanotube mixed pistons, begin working on steel components, and to consider "Constrained thermal fatigue tests" developed by Climax Research Inc.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

One reviewer noted the 50% cost share with Caterpillar.

Durability of Diesel Engine Particulate Filters: Thomas Watkins (Oak Ridge National Laboratory (ORNL))



Reviewer Sample Size
This project had a total of 4 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?
Many of the reviewers commented on the link between the project and petroleum displacement. For instance, one reviewer recognized that work is very important from CI engine emissions and costs perspectives, but does not seem directly or strongly to impact petroleum displacement. Another remarked that part of the performance of combustion devices is to burn fuels cleanly. This effort contributes to that, though the connection to "petroleum displacement" was unclear. Future presentations should endeavor to make the link to "petroleum displacement" more clearly. For another reviewer, improved understanding of the durability of DPF's can lead to improved regeneration strategies reducing fuel consumption. Remark has to be made that this will be a relative small improvement. For a reviewer, the success of this work is important to clean diesel engine acceptance. Larger acceptance results in larger percentages of conversion to diesel, with the resulting reduction in use of petroleum.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?
Among positive reviews, one commented the approach appears well designed to facilitate engineering optimization of an indispensable CI engine emissions control technology. A reviewer stated this work is helping to put into public domain information that gives a rationale for the commercial introduction of these materials -- which has already occurred. It is good to have the materials data available to serve as underpinning of the existing commercial successes. Another reviewer felt with respect to the improvement of durability of the DPF material the approach chosen is focused on the correct topics. Also integrating analysis of DPF's coming from the field will lead to an improved applicability of the results. On the NDE activities the approach is less clear. This is based on the goals of having this type of measurement available during truck service operations.

To a fourth reviewer, it was a bit unclear precisely how the data to be obtained on porosity measurements, fracture toughness, etc. are to be used to develop new DPFs. The data are important and relevant but the design process for using the results to develop improved filters was not clearly articulated.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.
Reviewers mentioned the amount of data collected. For instance, one reviewer felt a lot of data were obtained over the past year (e.g., CTE, elastic moduli, porosity), but the PIs now need to tell us what they are going to do with these data and how their efforts to obtain them will produce improved DPFs. Another reviewer commented the mechanical

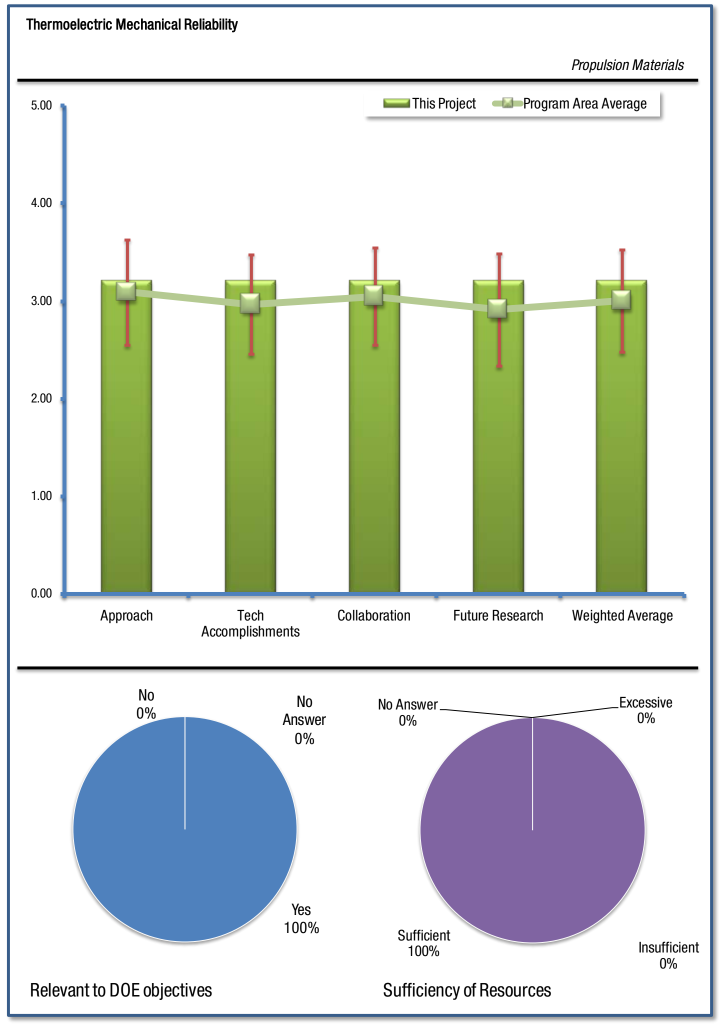
properties have been measured which relate to the illustrated failure mode. These are important contributions to the public domain literature. The focus on porosity is appropriate. A reviewer noted the good progress being reported towards characterizing properties that influence the lifetime of DPF's. This will lead to a computational methodology for a lifetime prediction model.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?
A positive review mentioned how the cooperation between partners is well coordinated, and also mentioned how cooperation is sought with SUNY Stony Brook in the area of NDE to create progress in this area. While another reviewer recognized Cummins and Corning are involved with the PIs, the reviewer felt their precise roles should be better articulated in future presentations.

Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?
One reviewer was pleased that such highly-advanced characterization will continue. Another reviewer commented on how plans are in line with the outcomes of earlier research and are focused on overcoming remaining barriers, but in the field of NDE the plans are not so clear and it is less clear that barriers are overcome. A reviewer felt the future efforts seem to be on the same trajectory as the work performed in the past year. Some of their plans are vague (e.g. "collaborate with Dr. Sampath": what does "collaborate" mean?). Again, the PIs need to make a stronger effort to indicate how their data would be used.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?
One reviewer commented the amount of results is in line with the budget provided.

Thermoelectric Mechanical Reliability: A.A. Wereszczak (Oak Ridge National Laboratory (ORNL))



Reviewer Sample Size
This project had a total of 5 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?
Several reviewers commented on the potential for positive outcomes. One reviewer stated the project does support DOE's objectives, and as support offered how the PI is carrying out experiments that would ultimately allow for improved models of TE material packages. The PI states that mechanical properties are the weakest link in TE material development for waste heat recovery. Another reviewer stated the project is focused on solving barriers that are preventing TE materials to be used in automotive industry. These materials will improve the overall fuel efficiency of cars and trucks as such supporting the overall DOE objectives. A reviewer focused on potentially positive outcomes, commenting thermoelectric systems offer promising means to recover heat that would otherwise be rejected; this is a direct way to increase the utilization of energy input to heat engines. It was also noted, in another review, that the project is addressing TE materials are inherently brittle nature and susceptible for thermal-induced fracture, will achieve 5000 hours of life, and will combine measured data to design TE components to perform expected life.

A mixed review noted how scavenging of waste heat provides an increment of efficiency. For automobile applications, the "capital cost-for-efficiency gain" seems marginal and diminishing as technologies such as diesel allow more of the energy to be captured in the primary engine, with lower and lower exhaust temperatures resulting. With lower exhaust temperatures, the arguments for thermoelectric recovery tend to become weaker.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?
For one reviewer, while the approach is well suited to find out what parameters are important to improve the lifetime of TE materials, it's not very clear how the endurance target is met. No clear approach to reach this target is provided. For another reviewer, the practical reliability of designs with brittle materials for electronic applications can benefit from use of the engineering tools that have been developed for heat engine materials. The experiments incorporate measurements to describe the anisotropy of the materials. The FEA tools provide good promise of selecting improved designs, without the reliance on the out-dated thermal-shock stress approximations.

A reviewer noted how there is a lot of testing in this project. Further, the PI is on the right track to provide data for the models that would be developed. The TE package may lend itself to failures of the types of interest here. The PI should consider examining other types of packages for TE materials which might be configured to provide better resistance to the sort of expansion that would lend itself to such failure. Interfaces are important. The PI should attempt, if possible, to measure thermal contact resistance and the role of interfaces in his continuing testing. Another reviewer noted how the project will generate thermomechanical property database on a candidate material in 2008, compare properties against those of mature TE materials, and execute FEA to model thermomechanical stresses.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.

The reviewers recognized the great amount of data accumulated. For instance, one reviewer commented lots of good data on present commercial materials properties have been produced. This set of results is evidence of good progress. Another reviewer echoed this sentiment, commenting the progress during last FY was good. A great number of material data were measured. These data were combined with probabilistic methods to create insight and use of these data in modeling activities.

Another reviewer commented on the focus on R_{therm}. It should be as large as possible to provide a resistance of shock. Yet, a large R_{therm} is counter to an effective TE material which requires a high ZT which means low k. The reconciliation of the two was unclear. A reviewer noted how the project established a strength database for reference TE material, studied fracture in a reference TE material, examined the roles of independent parameters on strength, measured thermal conductivities, CTE, E, and Poisson's ratio of a reference TE material; and possible failure initiation locations in leg area were identified.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?

The collaborations were received positively by several reviewers. One reviewer mentioned the collaboration with Marlow, GM, and Michigan State, with the focus here on developing mechanical properties of certain selected TE materials. The reviewer felt the collaborators are good, and that Marlow will provide materials. The PI will test the materials provided to him. Hopefully, advice will flow from the PI to the manufacturers to help improve their product and the collaboration will not be entirely passive. Another reviewer mentioned the collaboration with Marlow Industries, General Motors, and Michigan State. A reviewer mentioned the cooperation with Marlow was formalized, and how there is collaboration with automotive manufacturers and other research institutes however, in the report it is not visible how the different partners provided input for the mentioned results.

Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

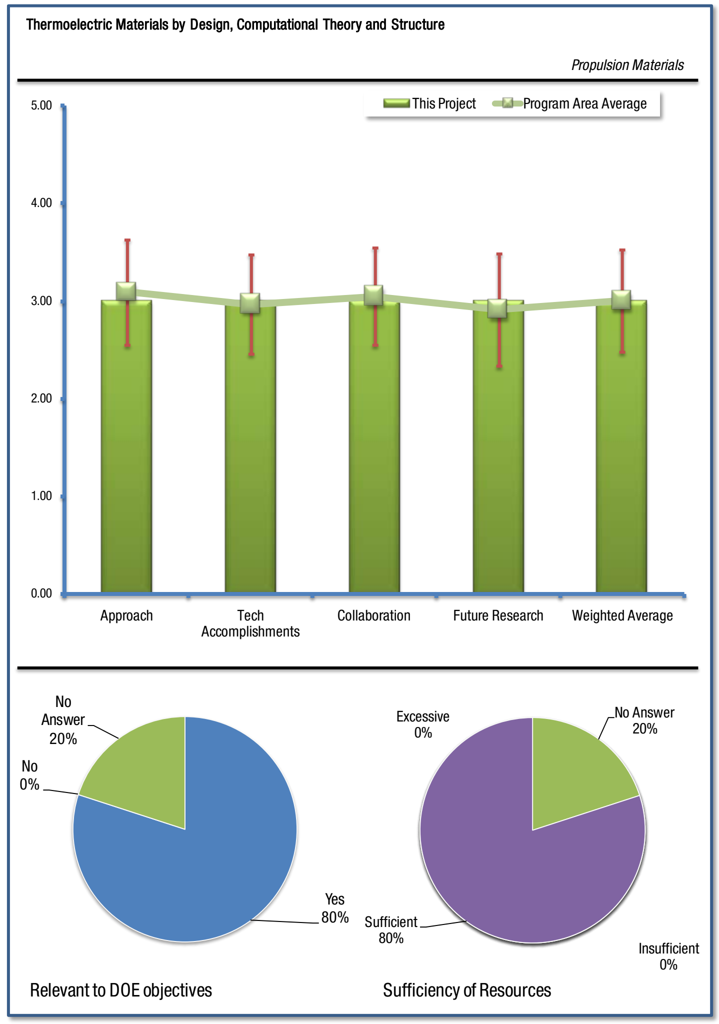
A reviewer commented that the work presented so far will be the baseline for mechanical testing of innovative compositions in the future. With planned work for mechanical tests with thermal gradients present, the researchers may be able to use FEA to say which of the (out-dated, but simple) approximations for thermal shock (i.e., with or without a thermal conductivity term) is a better approximation for these low thermal conduction materials. Another reviewer felt the three proposed activities for the future are sharply focused on barriers. It will be important to have insight on the effect of flaw distributions. This could be of use in future quality control measures during production.

One reviewer suggests better coordination between ZT (which is not considered in this project) and Rtherm. They are not entirely unrelated regarding developing an effective thermal module for TE waste heat recovery. A high Rtherm and high ZT seem to be a bit contradictory. Some elucidation of this point should be considered in future work. Another reviewer suggests work with a manufacturer and contribute to the reliability improvement of their candidate TEM, develop a thermomechanical test system, and develop method to quality strength-limiting flaw population.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

A reviewer felt the results are in line with the budget mentioned for 2008. It would be nice if a Gantt chart was provided comparing current achievements with the original planning. For another reviewer, resources are adequate, though the precise breakdown of what the funds are used for was not provided. A third reviewer noted how the project has funding for 2009.

Thermoelectric Materials by Design, Computational Theory and Structure: David Singh (Oak Ridge National Laboratory (ORNL))



Reviewer Sample Size

This project had a total of 5 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?

Most reviewers commented that the project has positive outcomes. One reviewer commented TE devices for waste heat recovery can be very important for waste heat recovery. The target is waste heat recovery as an application is relevant. The PI indicates a high ZT (>2) as a target for his efforts. Another reviewer remarked that it does support DOE objectives a little, and that scavenging of waste heat provides an increment of efficiency. For automobile applications, the "capital cost-for-efficiency gain" seems marginal and diminishing as technologies such as diesel cause the energy to be captured in the primary engine, with lower and lower exhaust temperatures resulting. With lower exhaust temperatures, the arguments for thermoelectric recovery become weaker. Another reviewer noted how the project discovered practical material that can yield fuel saving of 10% in vehicle, developed lower cost TE materials, and used science base approach for design TE materials.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?

Some reviewers reacted positively to the technology. A reviewer commented that the technology looks like very good basic research that could have significant pay-off. Another reviewer remarked the emphases are on a high ZT and to identify materials that would allow high values to be obtained. The analysis appears quite rigorous and good, being based on first principles calculations. A range of materials are considered, including metallic oxides which is very anisotropic. It was unclear how the anisotropic effects are accounted for in the analysis; presumably this point could be addressed (or clarified) in future work.

Another reviewer notes how the project applied first principles calculations to obtain electronic structure and vibrational properties, focused on materials such as oxides and chalcogenides that promise potential low cost, and focused on 3D materials. A more mixed review described how the fascinating physics of thermoelectrics -- so far -- have not meshed well the constraints for automotive, namely, hazardous materials restrictions and need for low cost. Further, the continued pursuit of lead and arsenic is not reasonable in the light of RoHS regulations today. Of course, the difficult problem is made only more difficult with such automotive constraints. Many technologies do not "make it" in automotive.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.

Reviewers continued to focus on first principles calculations. For instance, one reviewer felt first principles calculations are being performed of some of the electric properties which are providing good insights into performance of candidate materials for TE. The results are cast in terms of "thermopower". The PI has provided good insights from his calculations on such things on phonon scattering or dispersion which relates to why conductivity can be low. The reviewer also feels it would be good to attempt to provide estimates of ZT if possible, which is the accepted measure of performance. Design rules for oxides were provided (some attempt to synthesize them). The PI identified some high performance oxide candidates, focusing on materials with reasonably isotropic properties and potential low cost. This reviewer also is of the opinion it might be worthwhile to consider finding ways to both create high low k but high Seebeck coefficient.

Another reviewer noted how many materials are being examined experimentally. There appear to be many parallel efforts to find high thermoelectric performance compounds. What might distinguish the EERE funded work would be a focus on materials with properties that influence packaging and reliability aspects favorably. A reviewer also noted how GM data supported the predictive curve, LDA band structure is shown to be in quantitative agreement with experiment, Spinel type titanates, $YCuO_2$+x Delafassite were studied, the project showed doping can be controlled by treatments, and the project identified principles for thermoelectric performance in PbTe and La_3Te_4.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?

While one reviewer felt the collaborators are quite good, but do not include a company which fabricates TE packages (e.g., Marlow, BSST, etc.). Perhaps they should consider adding such a partner. Another reviewer saw the work has evidence of good interchange between the physical theorists and experimentalists. The combination is powerful to establish properties. A reviewer noted work with GM R&D, Oregon State, and North Carolina State.

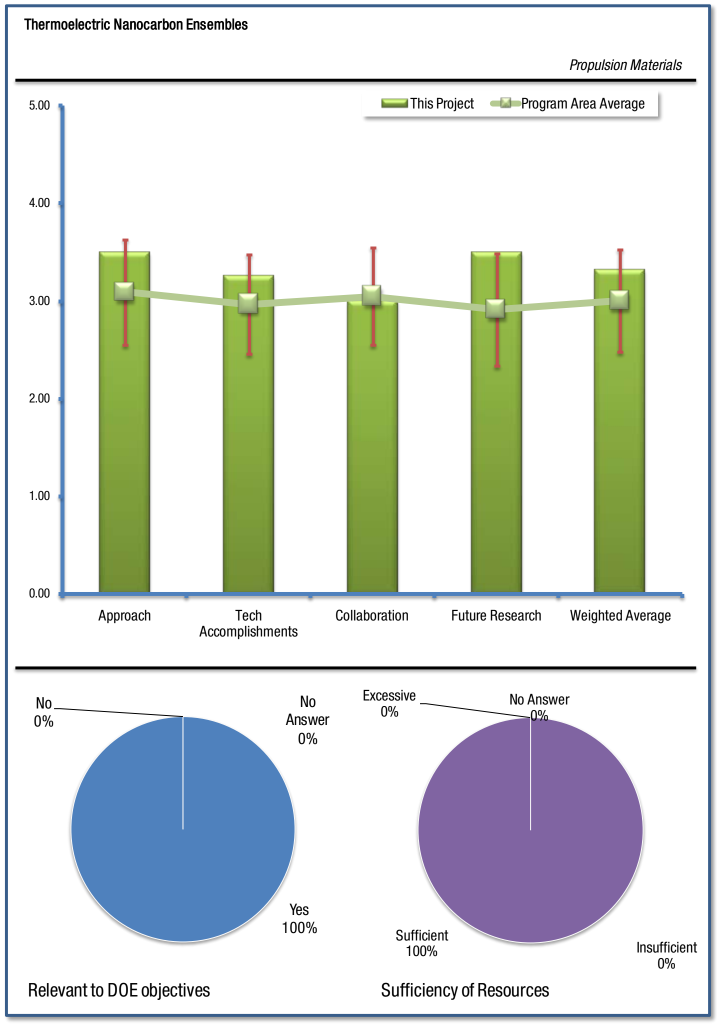
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

A reviewer noted how both oxides, chalcogenides and antimonides will be examined in the theortical calculations. The reviewer also suggested the PI should consider, if possible, presenting results in terms of ZT. If k is the problem, perhaps he can find a way to measure or predict it (difficult as this may be). Also, the T dependence of ZT would be very good to predict, again if possible. Another reviewer notes how the project appears to have similar trends to the unexpected finding of ceramic superconductors which was unexpected. Does any of that work apply in a conceptual fashion to the thermoelectrics? A reviewer noted how the project studied alternate oxide compositions, Tellurium free analogues of telluride thermoelectrics, and Zintl phases.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

One reviewer commented that resources are adequate. Another noted that FY 2009 funding has arrived.

Thermoelectric Nanocarbon Ensembles: D.M. Gruen (Argonne National Laboratory (ANL))



Reviewer Sample Size

This project had a total of 4 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?

The reviewers approached this technology positively. One remarked the development of novel TE materials is very important for waste heat recovery applications with an expected improvement in efficiency. The hope is to increase efficiency by 3% to 10% that could also be applicable to solar applications. Another reviewer commented the thermo electric effect belongs to the top three potential energy recovery methods in cars and trucks in the future. Energy recovery will lead to improved overall fuel efficiency. An efficient in bulk produced thermo electric material would lead to a significant contribution to the overall DOE objective.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?

Some of the reviewers had a positive assessment of the approach. For instance, one reviewer remarked the approach taken here is to develop high ZT materials through high electrical transport (as contrasted to the more conventional low k). The concept is to attempt to work independently with the parameters that factor into the ZT formula. The materials targeted are nanocrystalline, in particular nanocarbon doped with boron. Both Seebeck and electrical conductivity are measured in what seem to be very precise devices. This reviewer also remarked, the theoretical computations which are density functional theory provide interesting insights into the reasons why the electrical properties behave as they are found from the experimental measurements.

Another reviewer had insight on the barriers, commenting the report clearly describes the barriers–a focused approach is provided to overcome these barriers. Focusing on nano carbon material opens the opportunity for a bulk producible TE material with low impact on material resources. It is taken into account that there are still a great many uncertainties inevitably coupled to innovative projects.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.

Reviewers recognized the project has proven significant improvements. For instance, a reviewer remarked how results based on density functional theory were provided, which provide interesting insights into the reasons why the electrical properties behave as they are found from the experimental measurement. The data on power factor show a strong monotonic increase with T. The effects of annealing appear to be strong. In the past year the PI appears to have shown a significant improvement of the power factor. Another reviewer concurs, noting that a significant improvement in power factor is proven in past period, but that little information is provided on the efforts to decrease the thermal conductivity. In itself this is a critical parameter towards overall success. It would be good to compare the results with the performance of the existing traditional TE materials.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?

A reviewer noted that collaborators include BES, CNRS and the Naval Surface Weapons Center. However, the precise roles of these partners were a bit unclear. Another felt that a broad consortium is formed with other institutions also outside the U.S. The activities are performed at different locations. The results are promising so industrial interest should become reflected in the consortium. This would also underlines the promising future for this material.

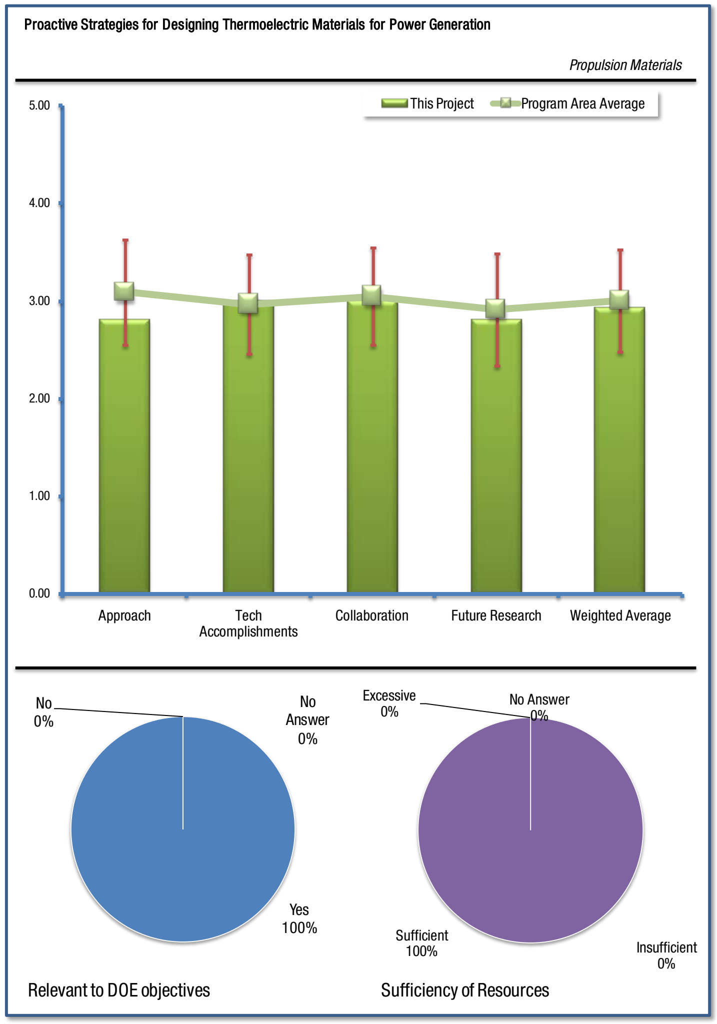
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

Reviewers perceived that activities are promising. For instance, according to one reviewer, the plan to focus on increasing the Seebeck coefficient through nano-ensemble composition (as by annealing) and to decrease thermal conductivity (by density and porosity structuring) is interesting. Hopefully, the PI will be able to accomplish this since the prior art has shown some challenges in this regard. Another noted how the proposed future work focuses on the four critical barriers. The activities are in line with past results.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

One reviewer felt the funding was adequate. Another commented that reported results are in line with the provided budget, but it would be good to have a Gantt chart of the project comparing achieved milestones with the original project planning. Another opined that this project is beginning to show promise. Increased funding should be considered after FY 2009.

Proactive Strategies for Designing Thermoelectric Materials for Power Generation: Terry Hendricks (Pacific Northwest National Laboratory (PNNL))



Reviewer Sample Size

This project had a total of 5 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?

Reviewers saw possibility for petroleum displacement. For instance, one reviewer commented that developing TE materials has significant promise for efficiency gains in waste heat recovery. Another reviewer recognized that this project aims to increase 10% fuel economy of heavy-duty engines over 2010, to improve light-duty vehicle fuel efficiency up to 10%, and to improve Cost-Effectiveness and Performance of Exhaust Heat Recovery. A reviewer opines that waste heat recovery is applicable across the board to light- and HD engines of all conventional and advanced types. Another reviewer had a similar viewpoint, commenting that the project focused on bringing TE materials to the market. TE materials potentially lead to recovery of waste heat improving the overall fuel efficiency of vehicles.

Another reviewer identified possibility for a little displacement, remarking that scavenging waste heat will help overall efficiency a little. As new engine technologies (or fuel cells) pull more energy directly from the fuel, the exhaust temperatures are tending to lower temperatures. The thermoelectrics contribution would be expected to decrease with the more modern engines with lower-temperature exhaust.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?

Among positive reviews, one reviewer answered yes, this project will systematically investigate Dual-& Tri-Rattler Skutterudites, refine n-type Materials, Characterize at Higher Temperatures & Transition to TE Couple, systematically Develop p-type Materials with Performance Similar to n-type Levels, conduct TE Property Measurements at OSU Laboratories, and conduct structural / Thermal Property Measurements at PNNL. Another commented that Skutterudites will be examined with a target ZT of 1.6 as the goal. The university measures Seebeck coefficient, thermal conductivity, expansion coefficient, and electrical conductivity; PNNL will measure mechanical properties. PNNL itself will also fabricate the materials. A similarly positive response was offered by one reviewer, who commented the project builds on the outcome of various other projects. To link the material research results to overall TE system performance helps to introduce this technology in the market place.

Another reviewer showed concern for cost, commenting that the fascinating science of thermoelectrics is being approached in this work without apparent concern for the extreme costs of some of the elements involved. The emphasis is "to be on Rh" was stated. Rhodium is a very expensive choice. Rh certainly is used in automotive applications, but only in catalytic quantities.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.

One reviewer identified significant progress, commenting that investigators measured Material Strengths at Room Temperature, determined Elastic Material Properties Over Elevated Temperatures, modified existing Quasar RI-2000 Resonant Ultra-Sound system, and developed structural testing plans and identified test equipment. Another held a similar perspective, remarking on how the most promising materials are identified and test plans are developed. In addition, the structural characterization is addressed in this project. However, based on the provided information it is difficult to assess what is accomplished in this project and what is the result of previous projects. Another reviewer commented on how the PI has developed a high T furnace for high T measurements of electrical and structural properties. The PI has measured strength properties at room temperature and elastic properties at elevated temperatures. Seebeck coefficient and electrical resistivity measurements were also measured as a function of doping level. Power factors as a function of T which showed a peak at about 450K (without Rattlers). Another reviewer noted there are thermoelectric property results for more materials being provided in this work. Some of these seem to be nearing physical property targets for thermoelectric performance for gasoline engine exhaust temperatures, such as InCeCoSb. Cost is a concern.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?

For the most part, reviewers identified collaborators and felt the collaborations were worthwhile. For instance, one reviewer noted that there is a very good division of responsibilities among collaborators. Another reviewer noted that the collaborators include a university with whom the PI interacts. However, there did not seem to be a TE manufacturer (e.g., BSST was mentioned but does not appear to be formally part of the program). A reviewer mentioned collaborations with Oregon State University, Corvallis and ONAMI. While a reviewer recognized that a well balanced consortium is formed and activities are coordinated, it is not clear if there is a role for end user from automotive. This was the case in the previous project but no cooperation was indicated in the provided material.

Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

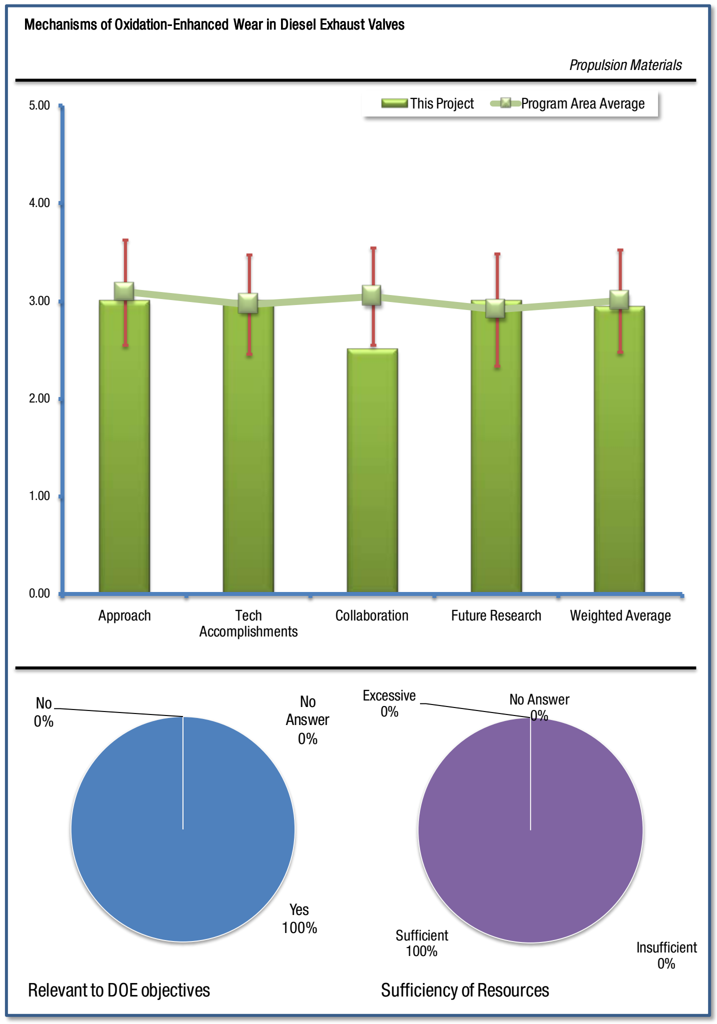
Several reviewers responded positively. One reviewer felt that future research is in line with the outcome of the first months of the project. The proposed activities are in line with the relative short remainder of the project. Another reviewer concurred, commenting that logical follow-on work is planned. Another reviewer remarked yes, and explained that future work includes Optimize Synthesis Procedures for n-type $(In,R)Co_4Sb_{12}$ Compositions, Introduce Single & Multiple "Rattlers" (In, Rare Earth) in $Co_{0.6}Rh_{0.4}SbO_3$, Characterize TE Properties & Validate with Third Party Testing, Structural Property Measurements, and Transition to TE Couples & Measure Performance.

A more mixed review expressed concerns over cost. Specifically, the reviewer remarked the cost is a concern for bulk application of material with large proportion of Rh. The associated cost will be extreme. Some estimates of this raw material cost should be considered in a device design. Another reviewer remarked the PI wants to optimize the synthesis of the n-type materials for future work. The structural properties will be measured at PNNL and OSU will be evaluating the TE properties. The challenge of quality control in manufacturing will also be a topic for continuing work. The PI should consider cost issues for large scale production, especially at x=0.6 for rhodium.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewers responded that the budget is adequate. One reviewer noted that this project is funded for one year, and the budget is in place. Another felt that results are in line with the provided budget. A reviewer also said that this project appears to be producing good value for the money invested, and future funding might be increased with good effect.

Mechanisms of Oxidation-Enhanced Wear in Diesel Exhaust Valves: Peter Blau (Oak Ridge National Laboratory (ORNL)) - POSTER



Reviewer Sample Size

This project had a total of 2 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?

One reviewer responded that this project supports informed selection of exhaust valve alloys to improve fuel efficiency, and notes that it is to reduce wear around valve seat to improve fuel efficiency. Another reviewer commented that this project is attempting to elucidate materials behaviors that directly influence the efficiency of heavy-duty engines by the most basic mechanism, i.e., retention of cylinder pressure during the compression and power strokes.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?

A reviewer noted that the project used customer-designed high temperature repetitive impact system to study the effect of oxidation with seat alloys, and also developed model to understand the wear-oxidation effect.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.

One reviewer responded positively, commenting that differentiation of alloy behaviors under high-temperature, oxidizing conditions and the interplay between mechanical stress/deformation and surface chemical chemistry is particularly interesting. Another noted that the project selected 4 alloys for study and conducted baseline oxidation rate studies, conducted oxide scale healing experiments, and developed a customer-designed high temperature repetitive impact system to study the effect of oxidation with seat alloys.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?

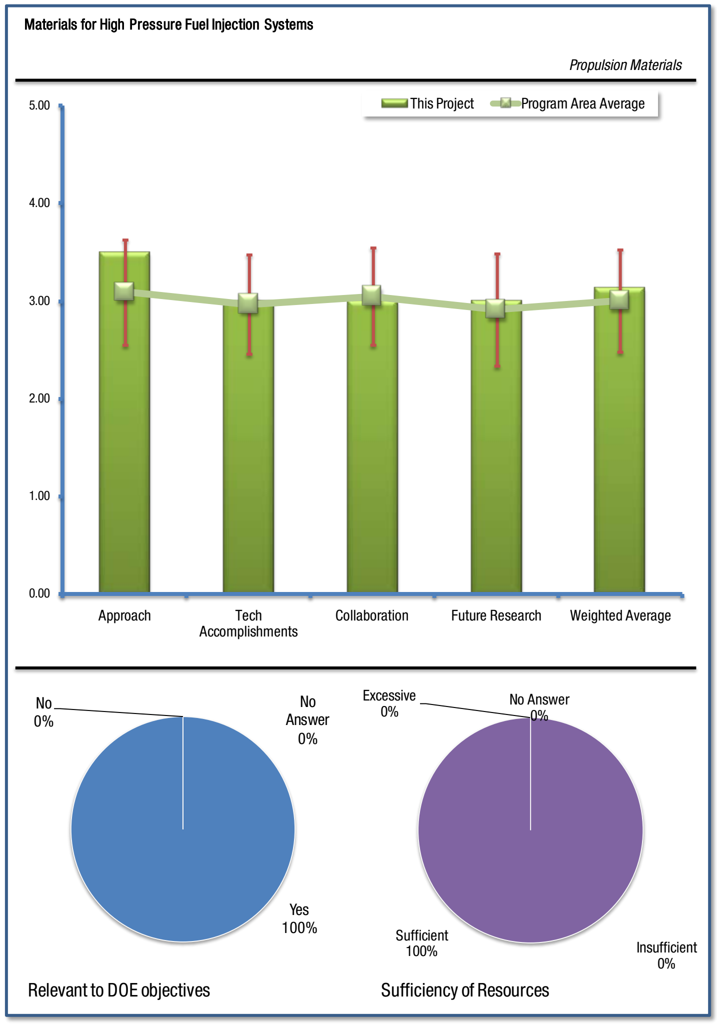
The reviewers did not see much collaboration. One reviewer noted that this project doesn't appear to rely on collaboration with other institutions, having only a single industry partner, but its results will be of use to the entire heavy-duty engine industry. Another reviewer noted informal collaboration with Caterpillar to share results and to provide valves for testing.

Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

A reviewer commented that it appears this project will end in the next FY and that its results will then be available to industry to use. It's not clear that any direct follow-on work is planned at ORNL. The above rating of "Good" is therefore conditioned on the assumption that industry will find the work helpful and carry it on. Another reviewer noted the project's model development and its final report.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?
A reviewer noted that the project is 80% complete and will be completed in Sept. 2009.

Materials for High Pressure Fuel Injection Systems: Peter Blau (Oak Ridge National Laboratory (ORNL)) - POSTER



Reviewer Sample Size

This project had a total of 2 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?

Many of the reviewers commented on the practical nature of the project. For instance, one reviewer commented that the success of this work will aid in improvements to practical diesel combustion and in the efficiency of diesel engines using the technology, over and above the advantageous utilization of petroleum within the category of diesel-fueled engines. Another reviewer commented this is very basic work designed to answer fundamental and practical questions of manufacturability and durability of engine hardware essential to achieve goals (elevated injection pressures, enhanced mixture formation and improved combustion) that have been long established as key to engine efficiency.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?

A reviewer commented on the efficacy of the project. The reviewer remarked the project is a multiple-task characterization project. The project appears to be well-positioned to identify which are the better materials choices for high pressure diesel that promise to provide improved combustion and efficiency.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.

Some of the reviewers identified that the work is just starting, but is on the right track. Specifically, one reviewer remarked the work is at an early stage, and that characterization techniques for nozzle hole roughness have been established is a marker of good progress. Another reviewer noted that some of the geometric and stress measurement techniques initially identified have proved unequal to the task. This is useful information in and of itself, and the investigators appear to know what to try next.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?

Reviewers remarked on the CRADA. One reviewer felt that CRADA provides linkage, and another reviewer noted that the CRADA is with a major industry actor.

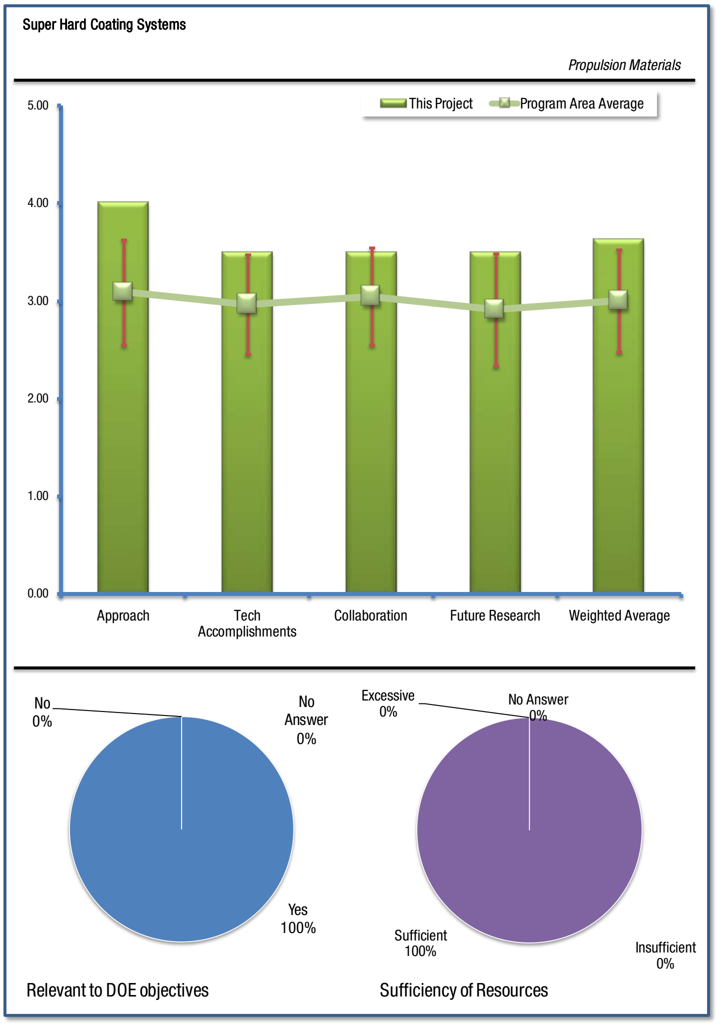
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

There were no responses to this prompt.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

A reviewer noted that the resources appear adequate with industry time-share.

Super Hard Coating Systems: Ali Erdemir (Argonne National Laboratory (ANL)) - POSTER



Reviewer Sample Size
This project had a total of 2 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?
Reviewers recognized petroleum displacement opportunities. One reviewer commented on how coatings that reduce the friction coefficient lead to improved efficiency of the engine. These hard coatings will have the highest impact on fuel efficiency in difficult to lubricate location (example; piston ring cylinder wall contact). Another reviewer noted how reduction of fmep is one of the most basic (and last) areas in which to search for incremental gains in engine efficiency and low-friction coatings for internal engine components is a logical area to explore. Wear-resistant coatings will extend engine life and TBO, making it easier to recoup the additional cost of such surface treatments.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?
A reviewer opined that the chosen approach is very well suited to introduce these coatings in engine application. First build up thorough understanding of the materials and have it proven in a fired engine.

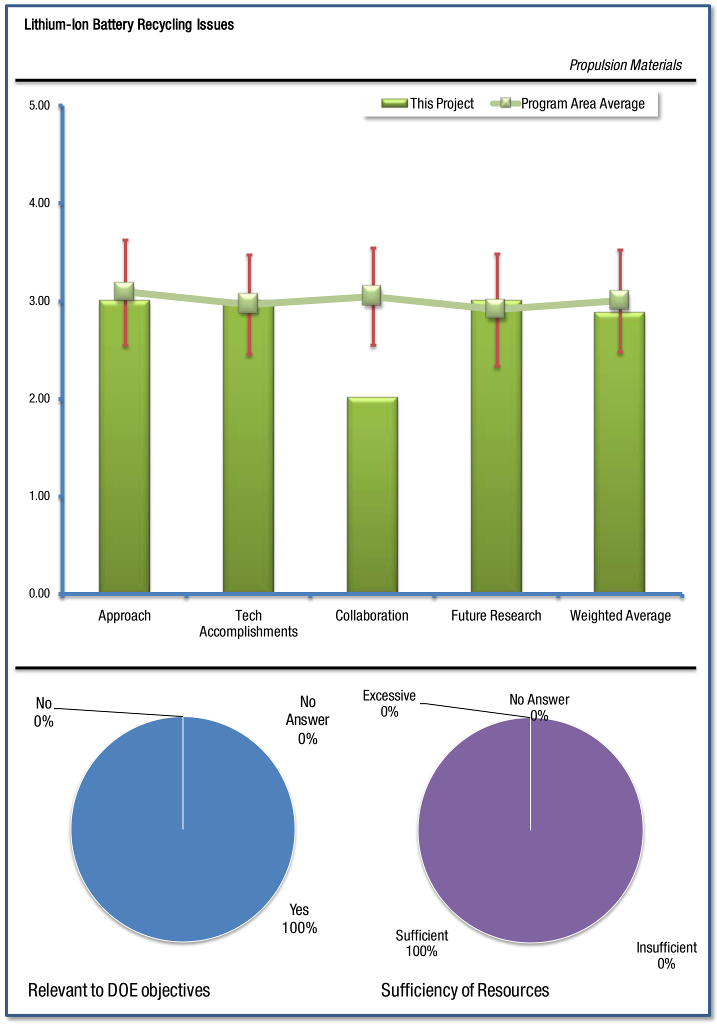
Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.
A reviewer felt that the presentation included proof that a further reduction of the friction coefficient was realized. One of the advantages of these coatings is the potential to reduce further the viscosity of the engine oil leading to further reduction of parasitic losses. The reviewer felt this was not mentioned in the report.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?
The reviewers positively evaluated collaboration. One reviewer felt a good cooperation with industry is present in this project, but that a wider cooperation with other institutes would be beneficial. Another reviewer felt that industry interest in licensing and commercializing technologies is compelling evidence of successful collaboration.

Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?
A reviewer thought the next steps indicated show a clear path towards commercialization of the outcome of the project. Critical will be the outcome of the engine tests.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?
A reviewer saw that results are in line with the provided budget.

Lithium-Ion Battery Recycling Issues: Linda Gaines (Argonne National Laboratory (ANL)) - POSTER



Reviewer Sample Size

This project had a total of 1 reviewer.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?

A reviewer commented on how EVs, HEVs and PHEVs are probably the most important mid-term technologies to minimize the petroleum demand of the highway transportation sector. However, according to the reviewer they will present unique resource challenges of their own, among which will be the demands imposed by the large aggregate electrical energy storage capacity they will impose.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?

A reviewer felt the relative importance and market shares Argonne assigns to passenger cars and light trucks might merit reexamination in light of recent trends.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.

There were no comments on this question.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?

A reviewer commented that the project appears to be solely the work of ANL. Collaboration and coordination with other institutions may not be a relevant metric.

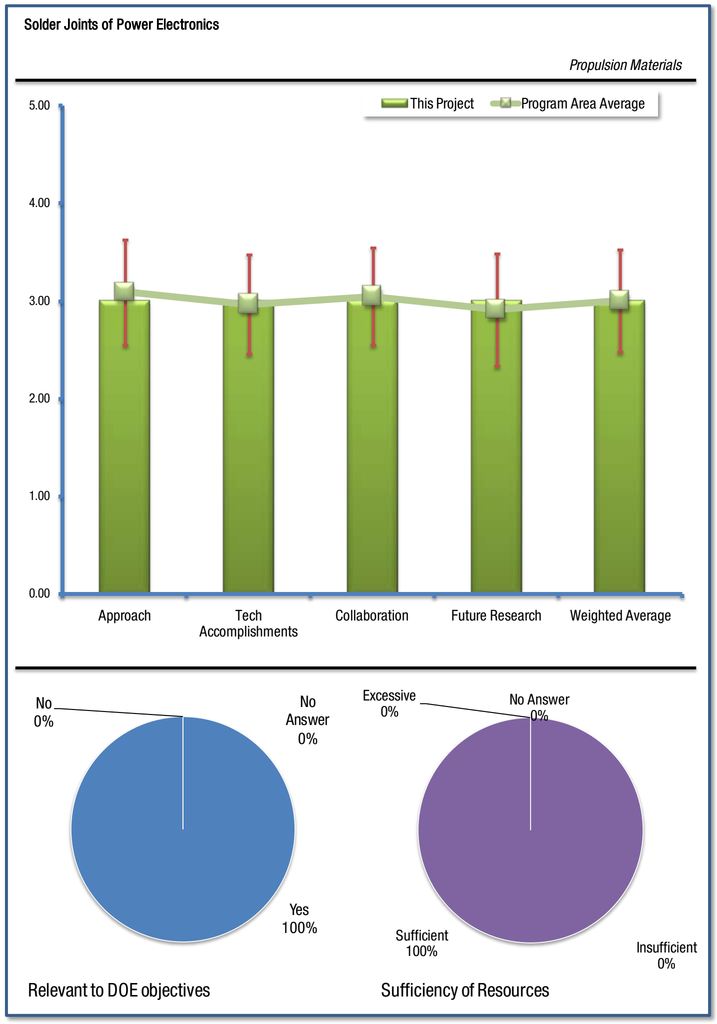
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

There were no comments on this question.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

There were no comments on this question.

Solder Joints of Power Electronics: Burak Ozpineci (Oak Ridge National Laboratory (ORNL)) - POSTER



Reviewer Sample Size
This project had a total of 1 reviewer.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?
A reviewer commented that EVs, HEVs and PHEVs are straightforward means to displace petroleum in the highway transportation sector. Reliable power electronics are key enabling technologies or all such vehicles.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?
A reviewer expressed concerns about one element of the approach, commenting that the selection of -65 C for the lower limit of thermal cycling testing seems severe, at least for the contiguous 48 states.

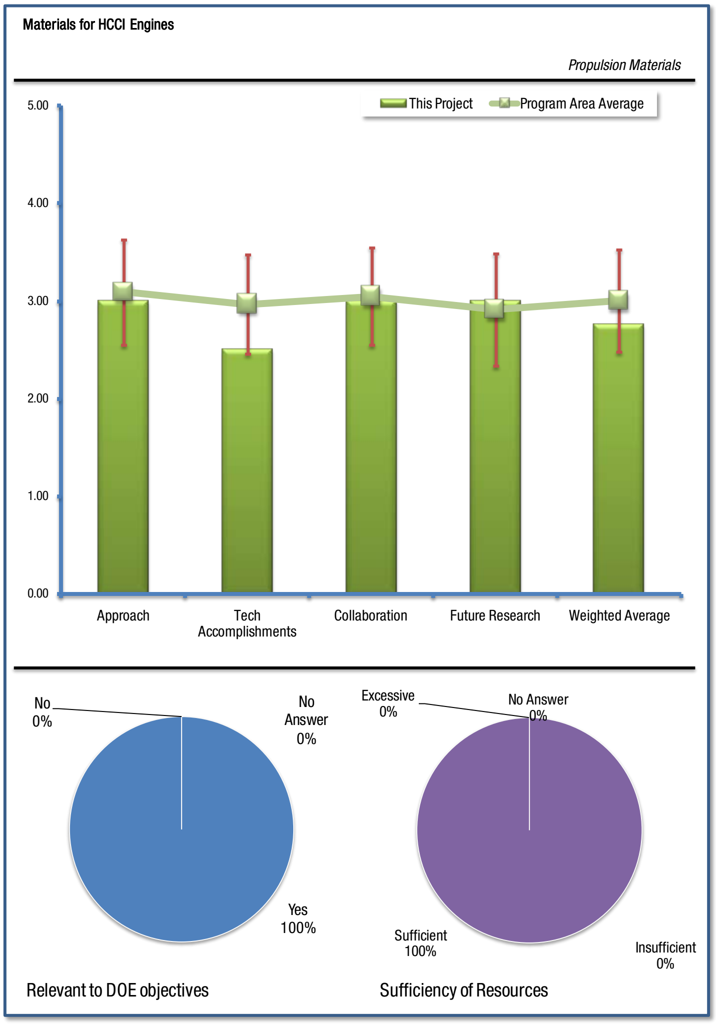
Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.
There were no comments on technical accomplishments.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?
A reviewer felt the initiation of contact with major U.S. auto manufacturing is appropriate and timely.

Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?
There were no comments.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?
A reviewer commented positively on the funding, noting if this work can be brought to a satisfactory conclusion on the funding delineated in the poster, it could represent a bargain. Is it contemplated that there will be future cost share (other than in-kind) from auto manufacturing and current industry partners?

Materials for HCCI Engines: Bruce Bunting (Oak Ridge National Laboratory (ORNL)) - POSTER



Reviewer Sample Size
This project had a total of 2 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?
A reviewer felt the project does support DOE objectives, commenting that higher combustion temperatures/pressures, although they stress engine components and can shorten their service life, are apt to result from efforts to increase engine efficiency and specific output, which can reduce petroleum consumption.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?
While a reviewer felt the approach is very good, the reviewer noted that HCCI combustion tends to be cooler than that of conventional CIDI engines, causing this reviewer to wonder if the principal application of this work is, in fact, to HCCI engines.

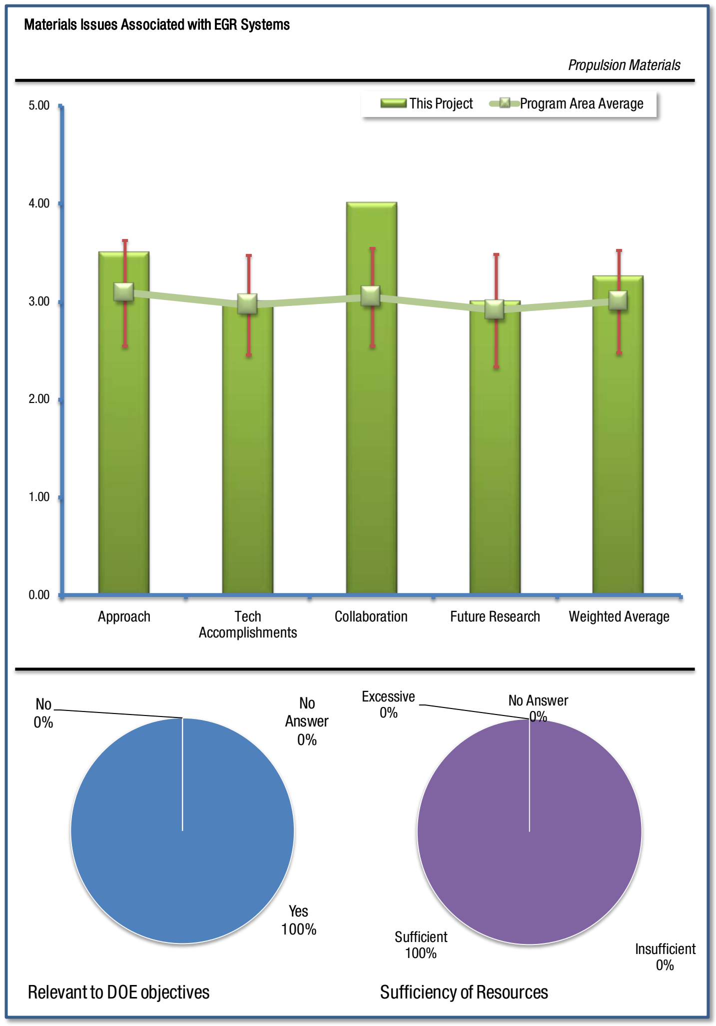
Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.
A reviewer felt the rate of progress in this early phase of the project is unavoidably slow. But, progress is likely to accelerate once the initial correlations of alloy microstructure with mechanical properties of interest are established.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?
A reviewer commented on how selection of collaborators - component manufacturing and materials supplier - is well-considered.

Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?
There were no comments.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?
A reviewer saw that funding levels for FY '08 and '09 suggest a lean program.

Materials Issues Associated with EGR Systems: Michael Lance (Oak Ridge National Laboratory (ORNL)) - POSTER



Reviewer Sample Size

This project had a total of 2 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?

A reviewer offered an enthusiastic evaluation, commenting the success of this project will help the effort to widen the market for modern, highly fuel efficient, low-emission diesels. Diesel is recognized as a highly efficient means of converting chemical energy to mechanical energy. However, some of the ideas for further improvement of efficiency are creating new concerns to be addressed, as is the case here. Another reviewer commented CIDI engines must remain viable and economical in operation to contribute to petroleum conservation in highway sector. Current and pending emissions regulations will compromise CI engine performance, especially economy of operation, making it imperative that the deleterious effects of exhaust gas aftertreatment be minimized.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?

Reviewers offered positive feedback. One reviewer noted this project is "sharply focused" on critical issues identified by a multi-company industry team that is guiding the work. The insights from project investigator having a materials background is helping to guide which deposit properties to look for in this study. Another noted that the project had an excellent approach, and should result in highly detailed description of EGR deposits.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.

Reviewers recognized the accomplishments. One reviewer identified that techniques have been developed for sampling the EGR cooler deposits for a variety of thermophysical property measurements. Work has been reported recently at a major automotive meeting (SAE). Another reviewer felt it was too early in project to rate accomplishments fairly, but based on approach, collaborators, etc. significant accomplishments can reasonably be expected.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?

Reviewers noted the depth of collaboration. One reviewer commented on how the project's multi-company involvement reinforces the high interest in the solution of the EGR-cooler-deposits concern. Another reviewer agreed, commenting collaboration with and selection of industry partners to date could hardly be improved upon.

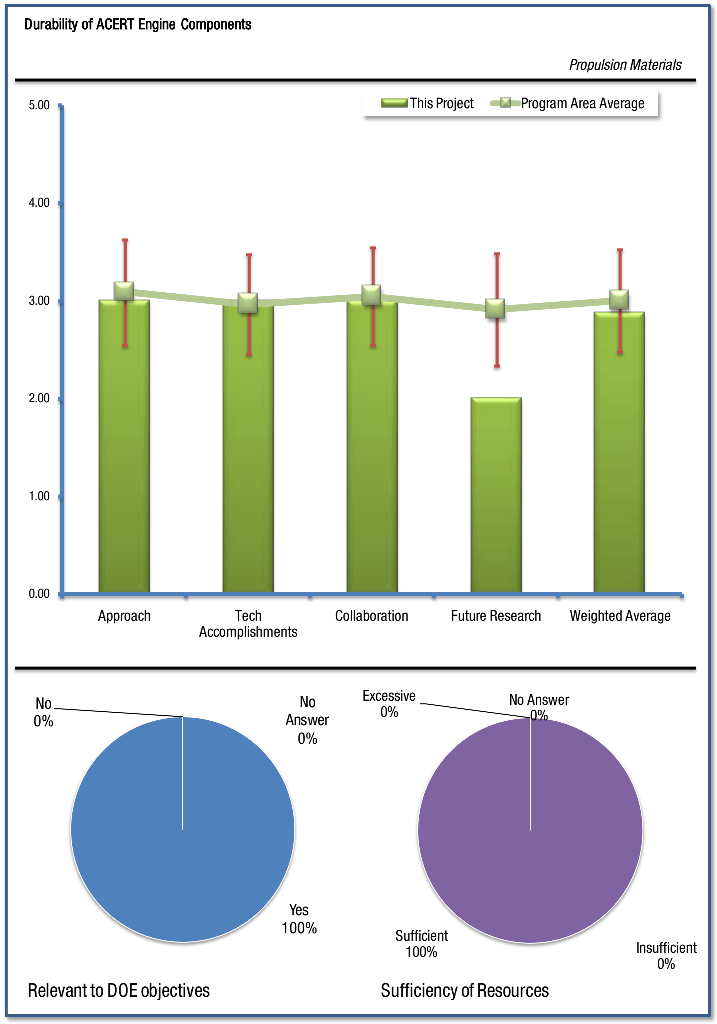
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

A reviewer noted how the proposed work is responsive to the occlusion conditions found in real engines.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

There were no comments on resources.

Durability of ACERT Engine Components: H.-T. Lin (Oak Ridge National Laboratory (ORNL)) - POSTER



Reviewer Sample Size

This project had a total of 2 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?

A reviewer commented that within the project materials are those evaluated that enable lightweight solutions for structural components. This will contribute to the goal of 55% efficiency in 2012. Another reviewer commented that achieving HDD engine efficiencies >50% will directly reduce petroleum consumption. Materials offering greater durability in the high temperature ranges that will characterize such engine will be needed to enable long-term operation.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?

A reviewer's assessment was that the chosen approach to evaluate materials in real engine conditions will help to overcome the barriers more quickly. The approach will not provide answers to the contribution of the improving the fuel efficiency from 42% to 55%. It is recognized that the two chosen materials are likely candidates. No supportive documentation was provided to support this choice.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.

Reviewers commented on the potential for the program to progress. One reviewer expects significant progress, given expertise and experience of project collaborators, but progress to date had been modest. Another reviewer noted how there is good progress being made, but felt that the only setback is the failure of the valve retainers in the engine test. It would also be good to evaluate the current material in the same manner as the new materials. This would give more insight in the progress made so far.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?

Reviewers saw cooperation, but with some reservations. One reviewer perceived the cooperation between partners is good. However, there is little collaboration with other institutes. Still missing is the cooperation with a valve manufacturer. Their expertise on manufacturing of valves and assemblies could be beneficial. Another reviewer sees the CRADA with Caterpillar as a good vehicle for collaboration. However, Cat has announced its withdrawal from the on-highway engine market. This project is apt to result in materials and techniques for their application that will be relevant to all CIDI engine market sectors, but does Cat's exit from the highway truck engine market compromise the value of this project to that key sector?

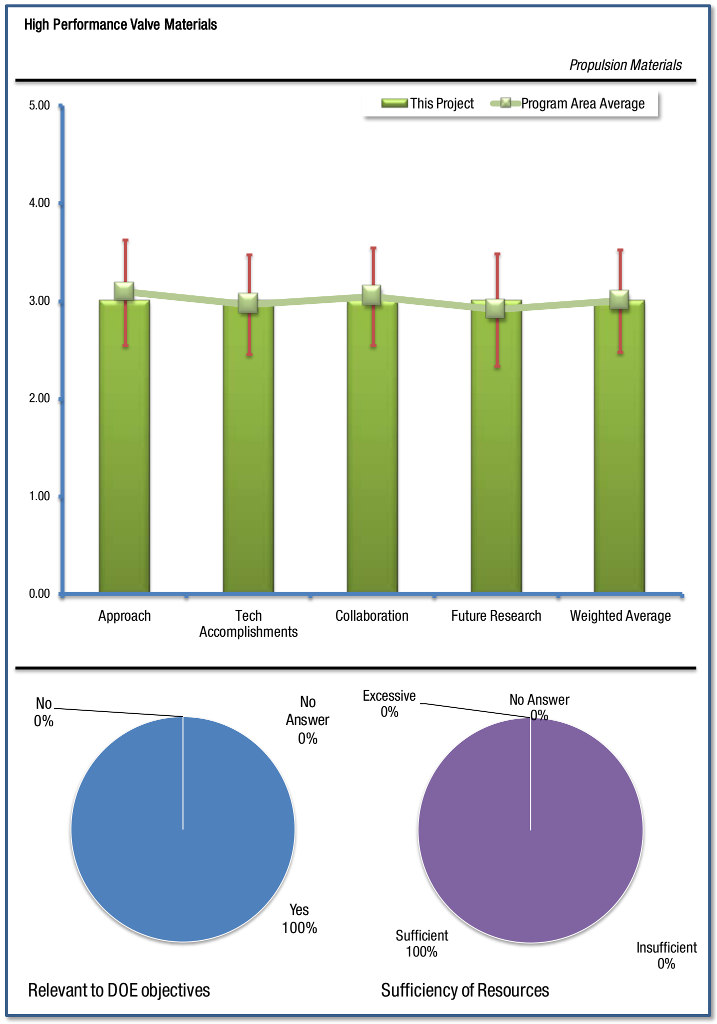
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

A reviewer commented that the sheet provided was the same as in PM 06 09 by Kass. The information provided was not applicable to this project.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

A reviewer felt the project's results are in line with the provided budget.

High Performance Valve Materials: Philip Maziasz (Oak Ridge National Laboratory (ORNL)) - POSTER



Reviewer Sample Size
This project had a total of 1 reviewer.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?
A reviewer felt that higher CIDI engine efficiencies directly reduce petroleum consumption, but demand higher operating temperatures/pressures, which in turn demand higher-performance materials.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?
No comments provided on this question.

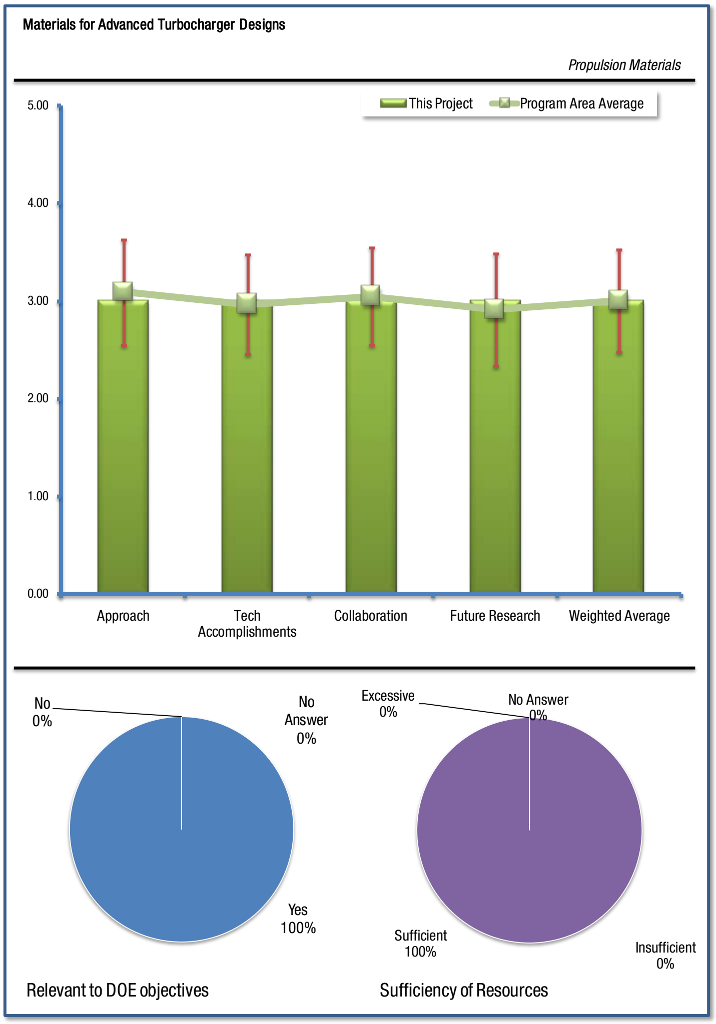
Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.
A reviewer felt the early "instant success" speaks to significant technical accomplishments.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?
A reviewer felt the choice of collaborators was excellent and logical.

Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?
To a reviewer, the twelve-month project extension appears justified based on early success and expectation of further progress.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?
There were no comments on this question.

Materials for Advanced Turbocharger Designs: Philip Maziasz (Oak Ridge National Laboratory (ORNL)) - POSTER



Reviewer Sample Size

This project had a total of 1 reviewer.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?

For a reviewer, the relevance of the project is obvious - higher operating temperatures are needed for additional efficiency, but stress engine components past current physical (and economic) limits. Turbochargers are universally applied to current and future CIDI engines.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?

To a reviewer, the description of planned approach seems logical.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.

A reviewer felt it is too early to assess any accomplishments beyond selection of collaborating companies, but that and research plan appear to have been done well.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?

A reviewer commented on how Honeywell is largest turbocharger manufacturer and supplier to CIDI engine industry and thus obvious choice for project partner.

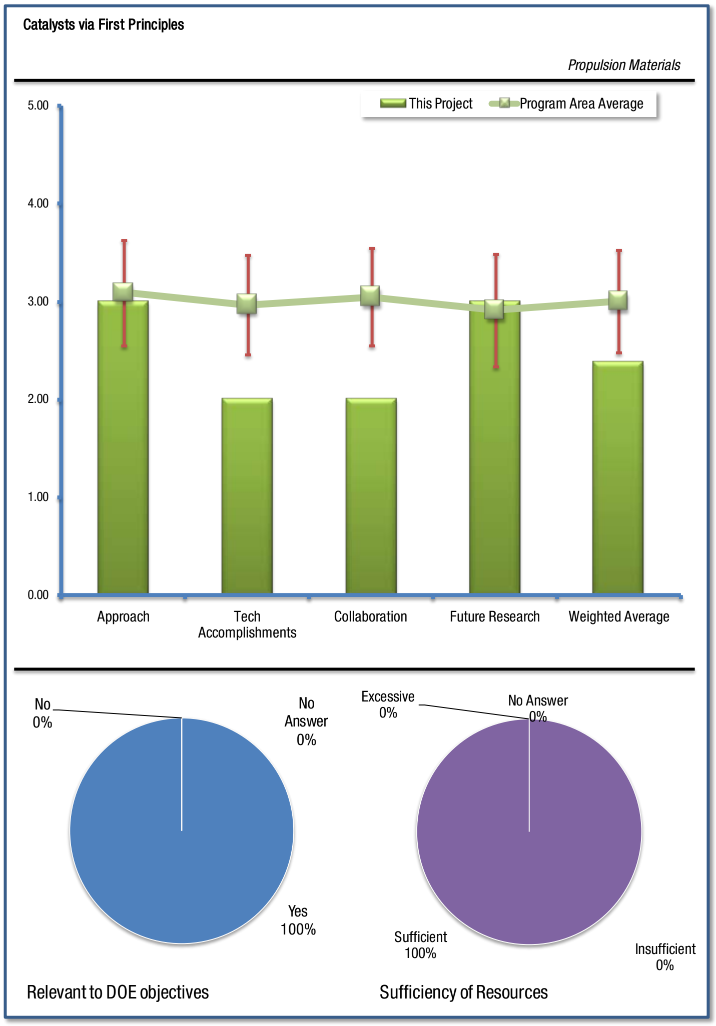
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

There were no comments on this question.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

A reviewer felt funding is clearly sufficient and 50% industry cost share is appropriate.

Catalysts via First Principles: C.K. Narula (Oak Ridge National Laboratory (ORNL)) - POSTER



Reviewer Sample Size
This project had a total of 1 reviewer.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?
A reviewer commented that more rational and rapid catalyst design methods would make it possible to more economically tailor exhaust aftertreatment catalysts (which are universally acknowledged to be indispensable to meeting current and future exhaust emissions standards) and improve their performance. This could indirectly allow improved engine efficiency (and thus reduced petroleum fuel consumption) by permitting efficiency-optimized engine calibrations.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?
There were no comments on this question.

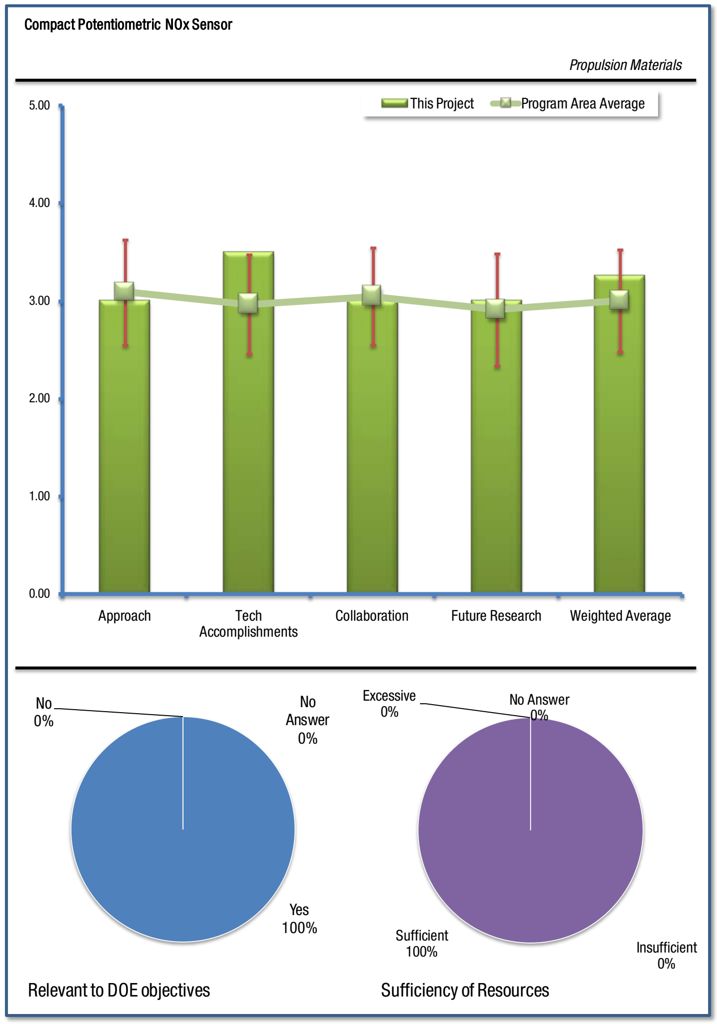
Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.
There were no comments on this question.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?
A reviewer felt the active participation of one or more catalyst manufacturers would be desirable.

Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?
There were no comments on this question.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?
A reviewer asked whether this work duplicates current efforts of catalyst manufacturer(s), or has that been determined? Closer collaboration with a major catalyst manufacturer could help optimize cost-effectiveness of this project.

Compact Potentiometric NOx Sensor: Dileep Singh (Argonne National Laboratory (ANL)) - POSTER



Reviewer Sample Size

This project had a total of 2 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?

Reviewers saw potential for displacement. A reviewer noted how this project develops high temperature sensors to monitor combustion gases (NOx, O_2, CO, CO_2) for an internal combustion engine to optimize the combustion process (maximize fuel efficiency) and minimize pollutants. Another reviewer felt that practical exhaust gas species sensors could facilitate combustion optimization for the best balance of engine efficiency, emissions.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?

A reviewer suggested that the project should develop a high temp O_2 sensor and then modify it to sense NOx in combustion environments, develop high temperature plastic joining technology to join the YSZ sensor components to produce a leak–proof package, and conduct extensive tests to validate the performance of the sensor.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.

A reviewer saw an excellent program made in the project, and noted how the project developed a basic sensor package design, developed and demonstrated an O_2 sensor with an internal reference, made progress in the development of a novel high temperature ceramic electrode material (LSAM), and demonstrated joining of LSAM to YSZ ceramic.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?

A reviewer noted that work on gas sensors must be ongoing at any number of companies, given the importance engine and vehicle manufacturers attach to the subject. This reviewer asked, does the approach employed in this project mirror the approach(es) employed by others, or does it represent an altogether different approach to this important problem? Another reviewer noted the work with Marathon Sensors, McDaniel Ceramics, and Integrated Fuel Technology to develop the sensor, and recommends work with end-users such as automotive manufacturers or diesel engine manufacturers to further put the senor to test on the real engines and vehicles.

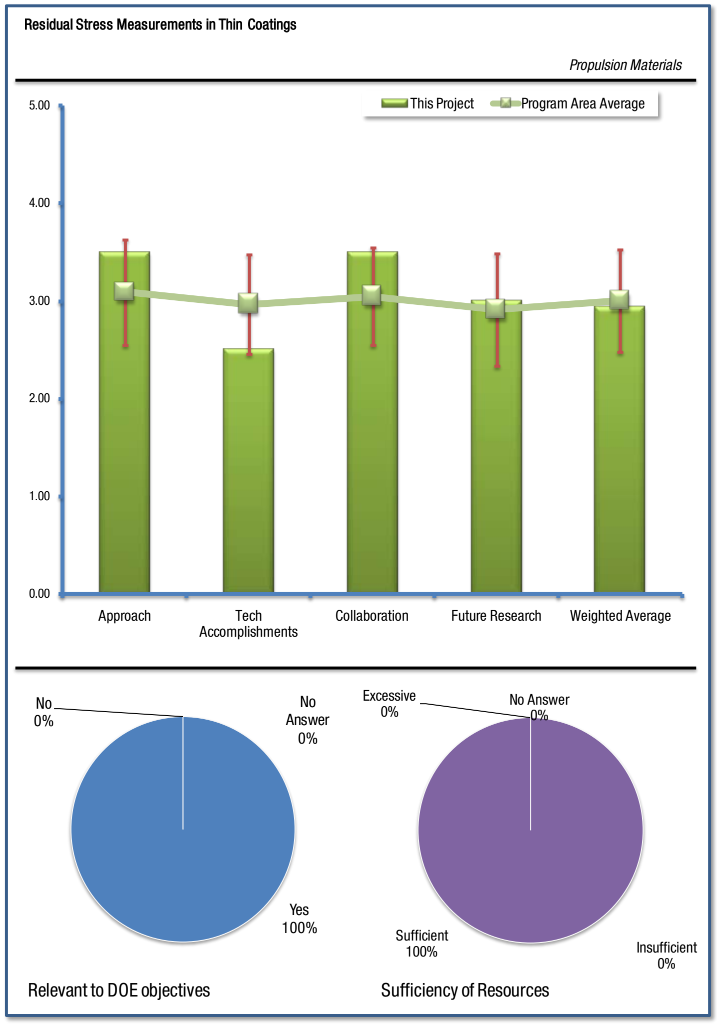
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

A reviewer felt the aim of ultimate commercialization is laudable. Another reviewer commented that the project should continue to develop the sensor packaging, further develop the NOx sensor, fabricate the NOx sensor and characterize sensor performance, establish durability of the sensors, and should work with OEM to initiate discussions with OEMs for technology demonstration and eventual transfer.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

A reviewer felt the funding level seems relatively modest, given the ambitiousness of the project goals. However, if this work duplicates R&D ongoing elsewhere (in the private sector), modest funding may not represent such a bargain. Another reviewer commented the funding for FY 2009 has been distributed and work with partners on the development work.

Residual Stress Measurements in Thin Coatings: Dileep Singh (Argonne National Laboratory (ANL)) - POSTER



Reviewer Sample Size

This project had a total of 2 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?

Reviewers saw potential for petroleum reduction. One reviewer commented the use of coatings have a history of aiding engine performance. Advanced diesels are looking at higher cylinder pressures and pushing the limits of existing materials. The knowledge of residual stresses will help give a physical understanding of how to obtain reliable coatings choices. Once a coating's reliability is proven for use in advanced diesels, broader acceptance and wider petroleum savings can be obtained by use of that coating. Another reviewer commented, understanding the mechanics of thin coatings will tend to make them more widely applicable and practical. Thin coatings include low-friction and anti-wear treatments for internal engine components which reduce FMEP (thus increasing efficiency) and extend engine life (thus reducing the life-cycle costs of advanced engines, accelerating their market penetration). Both those factors tend to reduce petroleum demand.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?

A reviewer saw that this is a coatings characterization project using a variety of simple (scratch and indentation) and complex (X-ray determined stress versus depth) methods.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.

A reviewer recognized how the researchers have gained a physical understanding of the limitations of the indentation method, and they are now proceeding with setting up for scratch testing.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?

According to a reviewer, this work appears to be tightly integrated with the coatings' synthesis efforts.

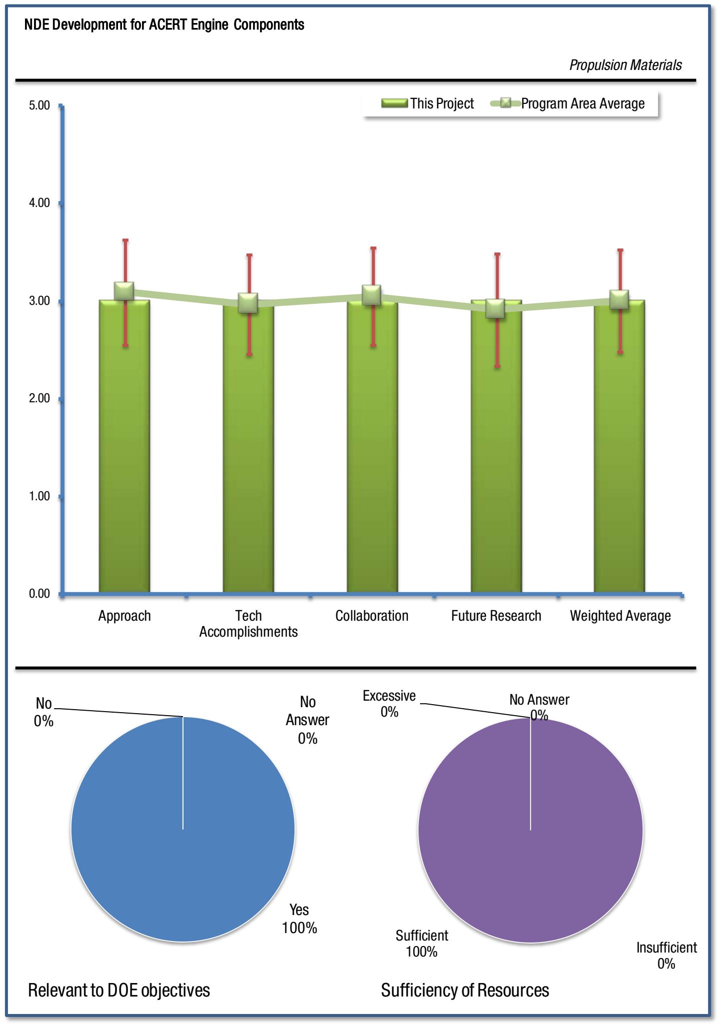
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

For a reviewer, the choice of scratch testing appears to be appropriate for the specific adhesion character of the coatings of interest to the larger project team.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

There were no comments on this question.

NDE Development for ACERT Engine Components: J.G. Sun (Oak Ridge National Laboratory (ORNL)) - POSTER



Reviewer Sample Size
This project had a total of 2 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?
Reviewers saw the project as aiming to provide the means for petroleum reduction. A reviewer felt that achieving CI engine thermal efficiencies as high as 55% (which will self-evidently help to reduce petroleum consumption) will be difficult, requiring stringent management of thermal energy and the development of materials and components capable of tolerating long-term (1 million mile) exposure to very high temperatures. Rapid and reliable means to qualify and confirm the characteristics of such materials and components will be required if they are to be practical in mass production. This project aims to provide those means. Another reviewer saw that to reach the 55% efficiency in the field it is necessary that the engine components used are reliable. For this, it is necessary to have technologies available to check the components integrity before assembly.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?
A reviewer thought the approach to first scan various methods and select one to optimize more thoroughly is a good approach. Furthermore, the team also considered experience from other industries into their evaluation.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.
A reviewer commented on how in its first year, the project resulted in a clear direction for solving the NDE challenge for TBC.

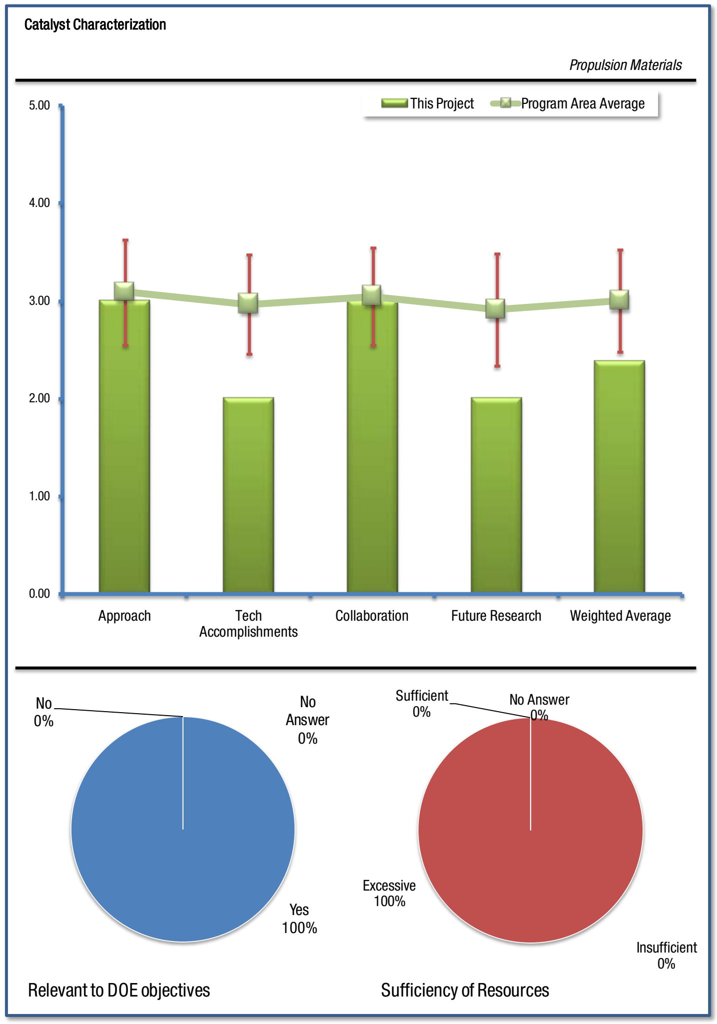
Question 4: What is your assessment of the level of collaboration and coordination with other institutions?
Reviewers saw evidence of collaboration. A reviewer was cognizant of collaboration with other institutes and industry. There is exchange with other institutes, like Imperial College. Another reviewer saw collaboration, but had concerns. Specifically, collaboration with Cat is valuable, but will that restrict the application of any NDE techniques developed to that one engine manufacturer? The extent of collaboration with ORNL was not well-defined in poster presentation.

Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?
A reviewer commented that the proposed work is a clear follow-up of the accomplishments so far.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

A reviewer perceived that accomplishments are in line with the provided budget. Another reviewer felt funding appeared to be weighted fairly heavily toward the last two years of the project. Is this by design, and what, if any, will be the co-funding level provided by the project partners?

Catalyst Characterization: Thomas Watkins (Oak Ridge National Laboratory (ORNL)) - POSTER



Reviewer Sample Size
This project had a total of 1 reviewer.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?
A reviewer recognizes the project's importance. Specifically, the reviewer commented SCR exhaust gas aftertreatment will be one of the principal routes to compliance with the 2010 HDD engine standards. SCR offers the possibility of calibrating the HDD engine for maximum fuel economy - which will help reduce petroleum consumption - despite the concomitant tendency to increased engine-out NOx. But SCR catalysts must be able to provide reliable NOx control over an extended time/mileage. Understanding the mechanisms that degrade SCR catalysts is the first step in learning to control them, and is therefore of key importance.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?
There were no comments on this question.

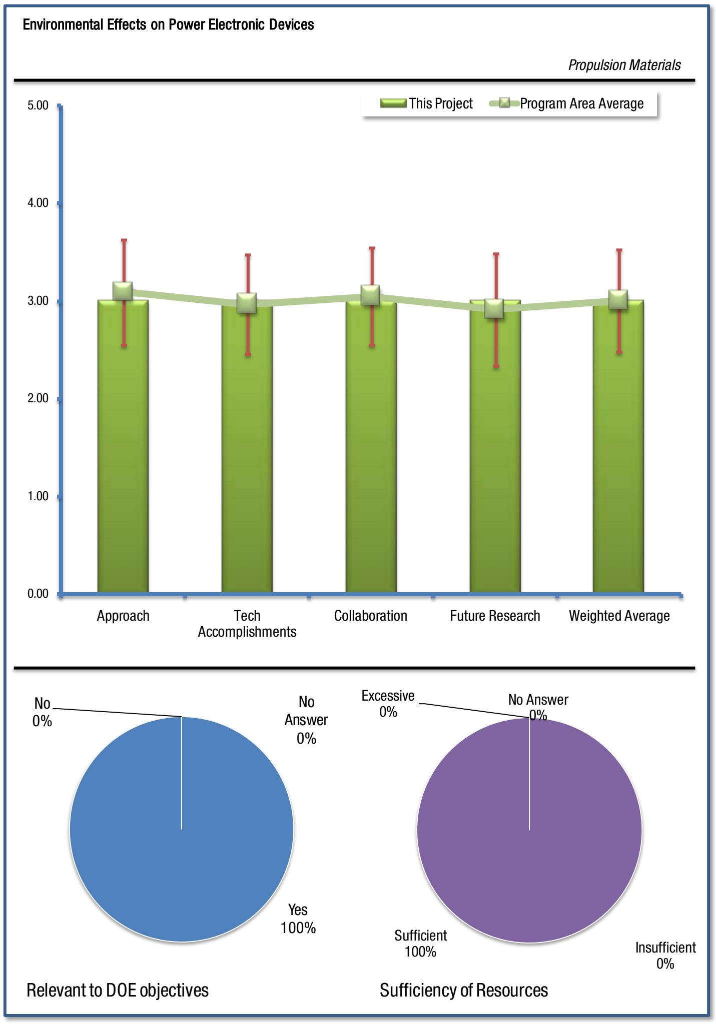
Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.
A reviewer commented on the project's immediate milestones, noting that the milestone cited for '08 ["continued evaluation of commercial zeolite urea SCR catalyst"] is not, strictly speaking, a milestone. It is not clear, from the posters provided, that a 3-yr. extension of this project reflects encouraging progress or the slowness of progress to date and the need for additional time/work.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?
A reviewer saw project collaborators as both good and logical choices.

Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?
There were no comments on this question.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?
There were no comments on this question.

Environmental Effects on Power Electronic Devices: A.A. Wereszczak (Oak Ridge National Laboratory (ORNL)) - POSTER



Reviewer Sample Size
This project had a total of 1 reviewer.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?
A reviewer commented that electrically driven vehicles (all types) offer a direct means of reducing transportation-sector petroleum consumption. Power electronic components for these vehicles must be capable of performing reliably for times/mileages comparable to those of current ICE vehicles if EVs are to be commercially successful. This work directly addresses that requirement.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?
There were no comments on this question.

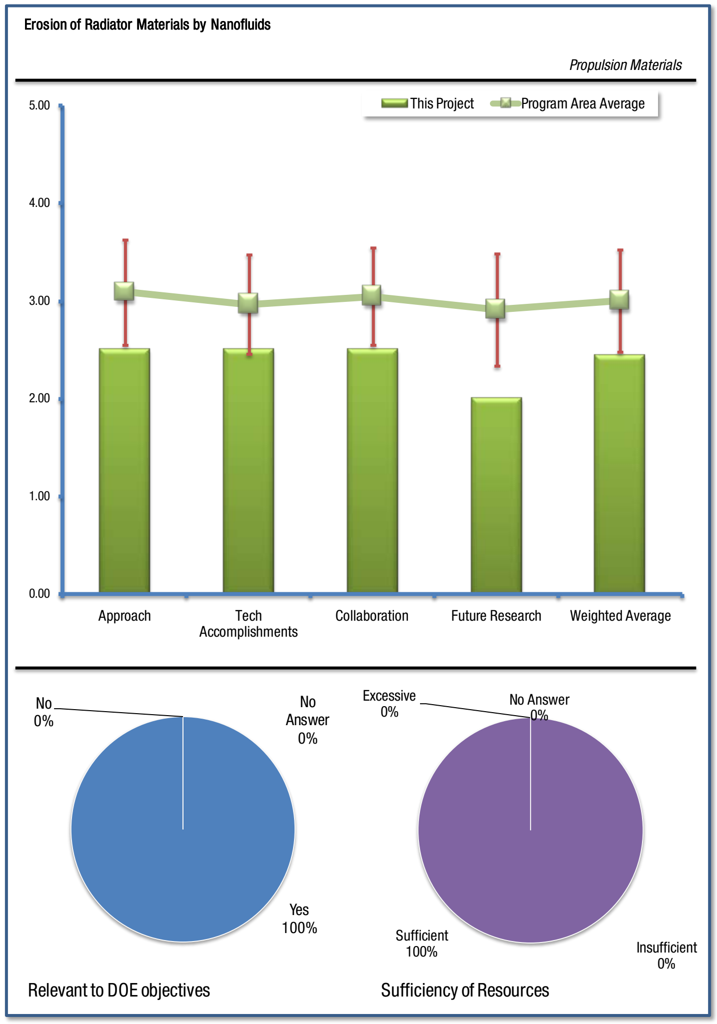
Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.
There were no comments on this question.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?
There were no comments on this question.

Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?
There were no comments on this question.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?
There were no comments on this question.

Erosion of Radiator Materials by Nanofluids: Dileep Singh (Argonne National Laboratory (ANL)) - POSTER



Reviewer Sample Size
This project had a total of 2 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?
A reviewer offered a positive evaluation, commenting that nanofluid engine coolants, if otherwise acceptable (cost, environmental impacts, etc.) for long-term use, could enable a reduction of radiator size/frontal area. This could translate to a reduction of vehicle weight and aero drag, both of which could enable a reduction of petroleum consumption in the heavy truck sector. Another reviewer saw a limited expected improvement in petroleum displacement, seeing perhaps a distant second order effect.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?
A reviewer definitely would determine thermal stability, etc. before erosion testing. Another reviewer asks, “Has any consideration has been given to the environmental safety of these nanofluids and their ultimate disposal? Their materials costs and the costs of their preparation?” Also, the presentation seems to draw a parallel between galvanic pitting corrosion rate and the rate of uniform corrosion. As a practical matter, the two are not equivalent and do not predict equivalent equipment life.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.
There were no comments on this question.

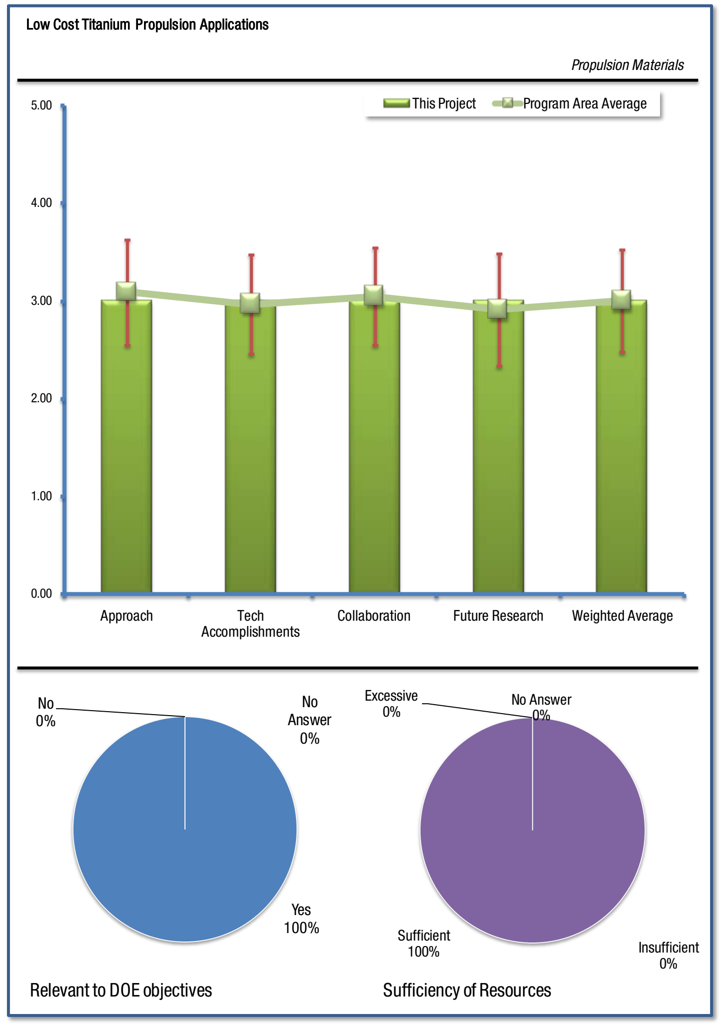
Question 4: What is your assessment of the level of collaboration and coordination with other institutions?
Reviewers see potential for additional collaboration. One reviewer commented that other nanofluids should be tested. Also, does the nanofluid remain in suspension or does it eventually "plate" out or coagulate and thereby lose the effectiveness? Another reviewer feels the addition of a heat exchanger manufacturer might be desirable.

Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?
Reviewers see potential for other development pathways. For instance, according to a reviewer, erosion of cooling system components may not be the most significant barrier to widespread use on nanofluid coolants. Could other coolants (non-nanoparticle-based) offer comparable (ca. 5%) reductions in radiator size without the possible complications of nanofluids? Another reviewer suggests including some aging studies to determine stability and effectiveness of the fluids.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

There were no comments on this question.

Low Cost Titanium Propulsion Applications: Curt Lavender (Pacific Northwest National Laboratory (PNNL)) - POSTER



Reviewer Sample Size

This project had a total of 1 reviewer.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?

A reviewer sees potential for this technology, commenting that the relevance of this project to the primary DOE goal is not obvious on its face. However, this project seeks to explore and hopefully, to confirm the relevance of an emerging technology to this goal. If the anticipated cost and performance targets can be achieved, there seems to be little doubt that the lighter, stronger engine components the technology would enable would in turn contribute directly to DOE's objectives.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?

There were no comments on this question.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.

A reviewer saw the project as not being far enough advanced at this time to permit a fair assessment of its technical accomplishments. The "good" rating is based more on the reasonableness of the approach to future work and the likelihood that it will yield definitive answers.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?

A reviewer found the eclectic mix of industry partners an appeal aspect. However, selection of an "expert in engine efficiency analysis" [see slide 10, for example] shouldn't be delayed. This is a key part of the overall analysis and it would seem to be a straightforward step to find such a collaborator (perhaps within the Cummins organization?) and get him/her to work promptly.

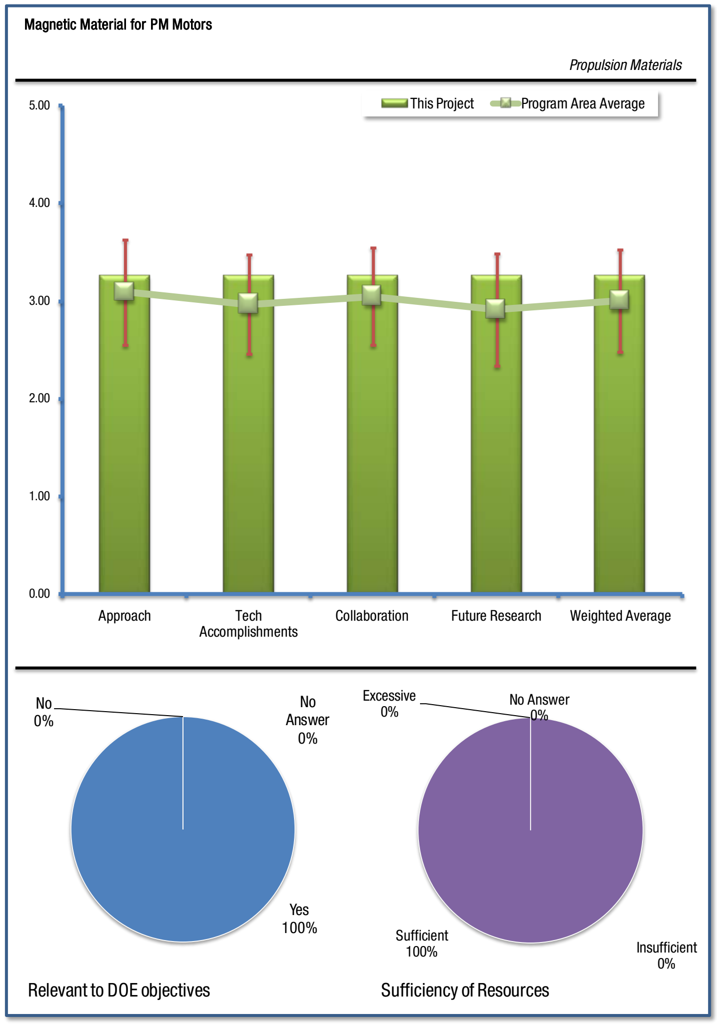
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

There were no comments on this question.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

A reviewer opined that funding level of this project makes it appear to be highly cost-effective if its goals can be realized.

Magnetic Material for PM Motors: Iver Anderson (NASA Ames) - POSTER



Reviewer Sample Size

This project had a total of 4 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?

Several reviewers saw the technology as key to meeting petroleum displacement objectives. One reviewer saw the development of low cost high temperature magnets as important to the future of electric motors needed for hybrids and electric vehicles. Another reviewer perceived that high-temperature magnets are an enabler for the higher coolant inlet temperature and the high power density motor. A third reviewer found common ground, commenting high-power, compact electric motors are a key to the commercial acceptance of electric vehicles and the ability of such motors to tolerate high operating temperatures will minimize he need for motor cooling with its attendant parasitic losses. Electric and hybrid electric vehicles are a straightforward means to minimize the petroleum consumption of the transportation sector. Another reviewer commented permanent magnet motors are of interest as components within electrical machines for use in hybrid-electric vehicles and all-electric vehicles, to make large gains in petroleum fuel reduction (or elimination). The magnets may also provide incremental energy efficiency gains in the many small motors used on conventional vehicles.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?

Among positive reviews, one saw the importance of this work is to develop high temperature low cost rare earth magnets. There is no such product commercially available now. The approach is innovative and builds upon past work and successes. The PI is looking at new processes that could become commercial is a few years. Another reviewer commented on how the work uses advanced metals processing to gain performance-enhancing anisotropy in a way that can be molded to align the microstructure to the most favorable directions within an electrical machine.

One reviewer would like to see a more focused approach, stating the approach is good but it seems that the project is pursuing many directions (an isotropic sintered, an isotropic bonded, and rare earth free magnets) and more focus on a few of them will be more beneficial

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.

Several reviewers saw progress being made. To wit, a reviewer noted that technical accomplishments may rate higher than indicated, and noted that the results are encouraging. According to another reviewer, benefits of anisotropic particles and a sintering aid (aluminum) are showing magnetic property gains. These gains are interpreted from a physical understanding of the microstructures that are developed. Another reviewer notes that excellent progress is being made in improving the temperature range, however this has been done by adding dysprosium, which is a very rare and high cost metal. Ultimately, the value of this work may depend on the world market price for Nd, which has been rising over the years due to the monopoly held by China. If the cost of Nd makes it impractical for PM materials in electric motors, then companies will seek other solutions.

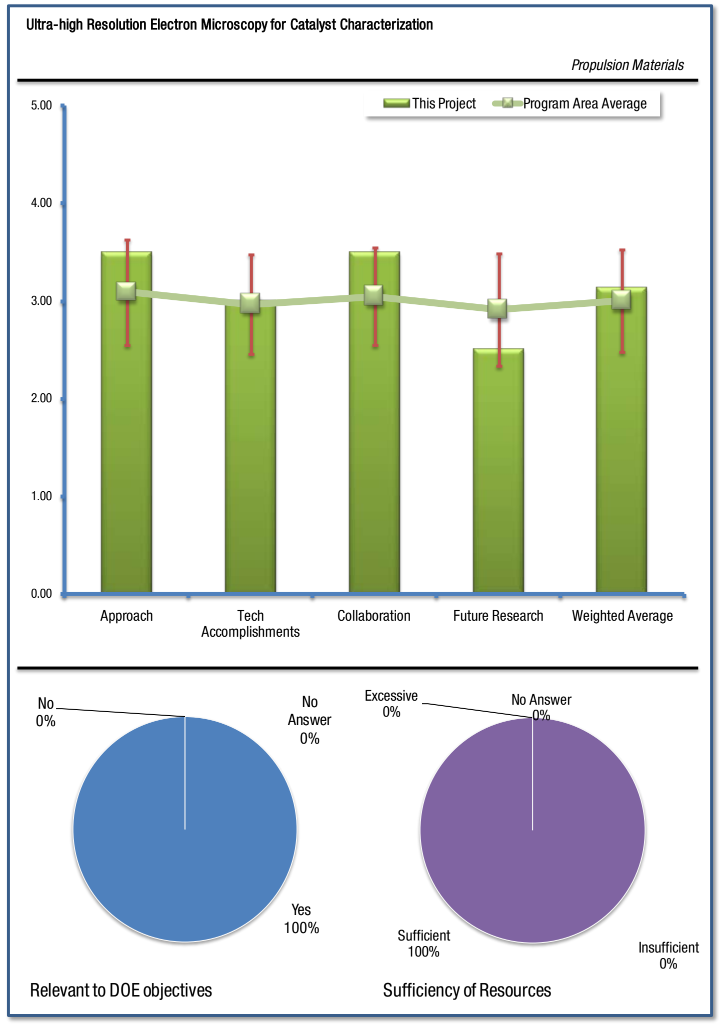
Similarly, another reviewer states that there are good accomplishments, but not enough testing has been done to support the analysis. More coupons need to be produced to verify the energy product at higher temperatures. To this reviewer, the predicted energy products at higher temperatures are still low compared to SmCo, for example. A cost comparison with today's SmCo that can go to very high temperatures will be useful.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?
Reviewers saw evidence of good collaboration with external partners, and collaboration well integrated with potential manufacturers. Another reviewer states that the PI is working with the top experts in the field.

Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?
Among positive reviews, one thought the PI has very clear plans for the work product in the future. Another reviewer is concerned about the cost of materials. According to this reviewer, for the anisotropic-particle lanthanide materials, processing modifications are likely to provide improvements in properties. The stretch-goal of finding a non-"rare-earth" permanent magnet chemistry is to be encouraged, but in a way that makes clear that the high risk associated with the quest. A third reviewer sees that the work is so diverse, more focus and actual testing is needed.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?
Reviewers believe resources are sufficient, with one reviewer commenting the project has sufficient people and labs to create the desired materials.

Ultra-high Resolution Electron Microscopy for Catalyst Characterization: L.F. Allard (Oak Ridge National Laboratory (ORNL)) - POSTER



Reviewer Sample Size

This project had a total of 2 reviewers.

Question 1: Does this project support the overall DOE objective of petroleum displacement? Why or why not?

A positive review saw that fundamental, atomic-level understanding of heterogeneous catalytic processes will likely enhance the performance of practical bulk catalysts. Since these are indispensable both to vehicle exhaust gas aftertreatment and to fuel refining, they can be expected to contribute, ultimately, to petroleum conservation. Another reviewer commented that after examining the evolution of fuel efficiency over recent years, it becomes clear that progress is slow. The reason is in the introduction of exhaust gas regulations. Measurement of fulfill these requirements hamper fuel efficiency improvement. With this in mind, this project aims at more efficient exhaust gas treatment giving room to engine internal measures to improve fuel efficiency.

Question 2: What is your assessment of the approach to performing the work? To what degree are technical barriers addressed? Is the project well-designed, feasible, and integrated with other efforts?

A reviewer found the project to have a clear approach on how to improve the insight in catalyst reactions. The development of in situ capabilities will be very beneficial. Another reviewer stated that investigators make a good case for the integration of their work with that of others. To this reviewer, the second barrier slide (slide #2) appears to be a goal of the project.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.

One reviewer found that the reported progress is good, and sufficient proof was provided. Because this project is in its final phase, some results should be available concerning the reduction of aftertreatment cost.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?

Evidence of well-coordinated cooperation with partners was apparent. A reviewer noted how a large number of collaborations with other institutions is mentioned.

Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

While a reviewer saw plans built on past progress, no plan is provided on how to reduce cost of catalytic materials.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

While one reviewer saw results in line with the budget provided, another reviewer asked whether $860,000 in total funding over a 6-year project is sufficient to accomplish all project goals.