5. Fuels and Lubricants Technologies

Introduction

The Fuels Technology subprogram supports fuels and lubricants R&D to provide vehicle users with cost-competitive options that enable high fuel economy with low emissions, and contribute to petroleum displacement. Transportation fuels are anticipated to be produced from future refinery feedstocks that may increasingly be from non-conventional sources including, but not limited to, heavy crude, oil sands, shale oil, and coal, as well as renewable resources such as biomass, vegetable oils, and waste animal fats. The impact of changes in refinery feedstocks on finished fuels is an area of relatively new concern to engine manufacturers, regulators and users. Advanced engine technologies are more sensitive to variations in fuel composition than were earlier engines, in addition to facing tightening emissions standards. This subprogram consists of two activities: Advanced Petroleum-Based Fuels (APBF); and Non-Petroleum-Based Fuels and Lubricants (NPBFL). The goals are: (1) to enable post-2010 advanced combustion regime engines and emission control systems to be more efficient while meeting future emission standards; and, (2) to reduce reliance on petroleum-based fuels through direct fuel substitution by non-petroleum-based fuels. These activities are undertaken to determine the impacts of fuel and lubricant properties on the efficiency, performance, and emissions of current engines as well as to enable emerging advanced internal combustion engines. These advanced engines operate in low-temperature combustion regimes that are expected to become more prevalent in the marketplace because of their higher efficiency and continually improving emissions performance. These activities are coordinated with and supportive of EPA's fuels and emissions-related activities, as mentioned in their strategic plan.

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
APBF Effects on Combustion	Bruce Bunting (Oak Ridge National Laboratory (ORNL))	5-5	3.33	3.00	3.50	3.17	3.17
Fuels For Advanced Combustion Engines (FACE)	Scott Sluder (Oak Ridge National Laboratory (ORNL))	5-7	3.67	3.80	3.67	3.50	3.71
Quality, Performance, and Emission Impacts of Biodiesel Blends	Robert McCormick (National Renewable Energy Laboratory (NREL))	5-9	3.57	3.43	3.50	3.43	3.47
Fuel Effects on Advanced Combustion: Heavy-Duty Optical-Engine Research	Charles Mueller (Sandia National Laboratory (SNL))	5-12	3.67	3.50	3.50	3.17	3.50
Mid-Level Ethanol Blends Test Program	Keith Knoll (National Renewable Energy Laboratory (NREL))	5-14	3.11	3.22	3.11	3.00	3.15
Advanced Lean-Burn DI Spark Ignition Fuels Research	Magnus Sjoberg (Sandia National Laboratory (SNL))	5-19	3.00	3.00	3.00	2.86	2.98
Non-Petroleum-Based Fuels: Effects on Emissions Control Technologies	Scott Sluder (Oak Ridge National Laboratory (ORNL))	5-21	3.56	3.56	3.11	3.33	3.47
Non-Petroleum Based Fuel Effects on Advanced Combustion	Jim Szybist (Oak Ridge National Laboratory (ORNL))	5-23	3.40	3.40	3.60	3.00	3.38

Presentation Title	Principal Investigator and Organization	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
Advanced Petroleum Based Fuels Research at NREL	Brad Zigler (National Renewable Energy Laboratory (NREL))	5-24	3.38	3.25	3.63	3.13	3.31
The Use of Exhaust Gas Recirculation to Optimize Fuel Economy and Minimize Emissions in Engines Operating on E85 Fuel	Ko-Jen Wu (General Motors Corporation)	5-26	3.13	3.13	2.00	3.00	2.97
DOE Optimally Controlled Flexible Fuel Powertrain System	Paul Kilmurray (Mahle)	5-28	3.40	3.20	3.20	3.20	3.25
E85 Optimized Engine	Apoorv Agarwal (Ford Motor Company)	5-30	3.29	3.14	2.43	3.00	3.07
Flex Fuel Vehicle Systems	Hakan Yilmaz (Bosch)	5-32	3.00	3.00	2.71	3.00	2.96
E85 Optimized Engine through Boosting, Spray Optimized GDi, VCR and Variable Valvetrain	Keith Confer (Delphi)	5-34	2.88	3.00	2.75	2.88	2.92
Investigation of Bio-Diesel Fueled Engines under Low-Temperature Combustion Strategies	*Chia-Fon Lee (University of Illinois at Urbana-Champaign)*	*5-36*	*3.50*	*3.00*	*3.00*	*3.50*	*3.19*
Fuel-Cycle Energy and Emissions Analysis with the GREET Model	*Michael Wang (Argonne National Laboratory (ANL))*	*5-37*	*3.50*	*3.75*	*3.25*	*3.50*	*3.59*
OVERALL AVERAGE FOR FUELS			**3.31**	**3.26**	**3.10**	**3.13**	**3.24**

NOTE: Italics denote poster presentations.

Overview of Fuels Technologies: Kevin Stork, 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 the sub-program was adequately covered. They don't feel that some of the important issues and challenges were properly identified. For example, the new renewable fuel standard for advanced biofuels (next generation biofuels) is pushing for an immediate need to invest into non-corn produced biofuels. The challenge for this area is that these fuels simply aren't there yet, at least for commercial viability, and they think DOE has an opportunity to really get involved into funding the development of both cellulosic ethanol and higher alcohol biofuels. The reviewer thinks Kevin brings up an important point about trying to develop both petroleum and non-petroleum based fuels that are fungible in the existing infrastructure. Aside from a small presentation dealing with funding in the budget over the last three years, they don't know if progress was clearly presented. The reviewer also thinks this could be addressed by having some clearly defined goals in the budget. Another reviewer commented that the DOE Fuel Technologies sub-group has a clear understanding of the challenges and issues that must be dealt with prior to qualifying bio fuels and ethanol enhanced fuels. For several years this group has worked closely with the industry stakeholders who manufacture those products that are most susceptible to enhanced ethanol fuels. There has been some progress to date on the research and testing area and these efforts have been documented and made available to the stakeholders and public. In the short time period allowed for the presentations the program was very interesting and the material covered adequately. They weren't part of last year's review, so it would be difficult to compare the progress made since then. Two reviewers answered yes to this question, with one adding that the presentation covered the key areas addressed in ongoing projects. Interest in future research topics was provided, which can help to guide researchers' efforts to address future DOE needs.

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

A reviewer stated the evaluation of bio fuels, specifically enhanced ethanol in gasoline, needs to be thoroughly studied prior to its introduction into the U.S. fuel supply. They believe that the DOE group is doing a good job with limited funding and time which it has no control over. Their recommendation is that the testing be accelerated in light of the political effort to accelerate the introduction of E-15 and E-20. Another reviewer commented they think Kevin outlines a good general approach to dealing with some of the issues and challenges about proceeding with research of this kind. It is important to engage stakeholders and other government agencies in order to focus R&D on projects that not only perform well in the lab, but that also have tangible benefits in terms of emissions and public health by engaging in programs that can be applied nationally. Two reviewers answered yes to this question, with one adding some of the program emphases seem driven by political and year-by-year "reactive" responses to needs. Coal-to-liquids (direct and indirect) seems to be an area that has not received much attention, while one might say that there is excessive emphasis on ethanol. The emphasis on ethanol is counter to the larger DOE long term objective of efficiency improvement and dieselization.

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

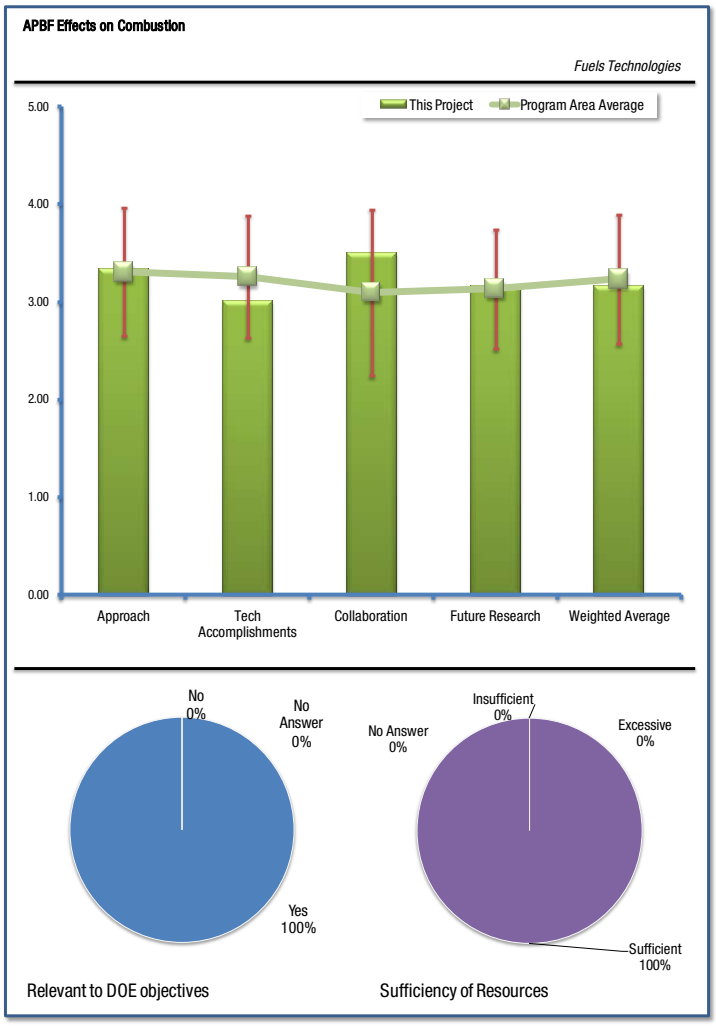
A reviewer stated the sub-program is focused and well managed, but the political agenda appears to be outpacing the R&D schedule in this area. The 280 day clock for EPA to approve or deny the E-15 waiver is running and this project needs to be the data source for making technical decisions regarding the introduction of E-15 and E-20 into the nation's gasoline supply. There is much work to be done in this area as gasoline is the fuel for our immediate future and any changes to the nation's fuel supply is of utmost importance. DOE (and specifically this subgroup) is chartered with this responsibility and the need for good data on ethanol enhanced fuels is great, with the Fuels group understanding these needs. Another reviewer noted the program does appear to be focused, well-managed, and effective. Two reviewers answered yes to this query, with one mentioning it is clear that political, as well as technical, pressures have driven the focus of the program to shift year-by-year, which can be detrimental to real problem solving.

It would help if this program were more insulated from political pressures and could be driven by National Research Council or other non-partisan programmatic reviews.

4. Other comments:

A reviewer stated more resources are needed in short term for E10+. They recommend more structured DOE/CRC planning. The reviewer also recommends refocusing fuel effects on advanced combustion into areas that are most likely to be commercialized. They suggest making best use of current commercial fuel (including biofuels) since need for new fuels will slow technology introduction. Another reviewer commented that it was very timely and an interesting issue and presentation. In summary they would like to see more R&D effort in the coming year in this area so that DOE can provide guidance to the nation on the issues, challenges and potential benefits of introducing ethanol enhanced fuels. One reviewer mentioned the NSF and DOE-BES are moving from cellulose-to-ethanol to cellulose-to-hydrocarbon biofuels strategies.

APBF Effects on Combustion: Bruce Bunting (Oak Ridge National Laboratory (ORNL))



Reviewer Sample Size

This project had a total of 6 reviewers.

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

Reviewers unanimously expressed that this project supports DOE's objective to displace petroleum. Reviewers cited the fact that the project promotes advancement in engine hardware, and emissions control systems, as well as gasoline and diesel fuels technologies and related alternative fuels. More than one reviewer noted that the program supports the goals clearly outlined by the Energy Independence and Security Act of 2007 or that it improves energy security and energy efficiency. Reviewers acknowledged that improving efficiency of ICEs could be a very cost effective, emphasizing the importance of research in advanced combustion and enabling fundamental research on HCCI, fuel properties, and critical fuel parameters. An HCCI engine will be more efficient and use less fuel–fuel which may cost less to refine.

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 were generally positive about the new system approach taken in this work. In fact, one reviewer suggested other programs should be patterned after this template. They cited the facts that collaboration between various laboratories and academic institutions is progressing well, that combustion experiments are difficult to base on first principles since the combustion phenomena are so complicated (thus the benefit of systems approach), and that the system approach provides a pathway for input and program modification as the data is developed. One reviewer added that this allows for changes to the core program while staying true to the research principles.

Suggestions were made by reviewers that this work be conducted with the latest engine technology since fuel effects depend on engine technology, that a focus be made on gasoline/ethanol blends due to increasing use of ethanol and potential for surplus in the gasoline pool, and that a wide range of fuels and vehicles be used–one reviewer emphasized that the use of bulk fuel properties like octane/cetane to optimize provide the benefit that fuel producers can optimize fuel production. It was also suggested that solicitations of private industry to partner in the research should continue.

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

Reviewers observed that the program continues to evolve relative to the data it has developed and its support of DOE policy goals. One reviewer noted that the recognition of new fuel blends and components is appropriate and worthwhile, and that even though the process may be lengthy, the information appears to be very useful, especially for comparative purposes. Furthermore, continued focus on optimizing fuel efficiency and engine performance with

nontraditional gasoline/ ethanol fuel blends (outside of E10, E85, etc) is key to improving the acceptance of new fuels and new fuel blends–it is "thinking outside the box".

Adequate funding for the project and the focus of the principal investigators has resulted in good progress toward the program goals. Reviewers noted that the project is about 75% complete and has made good progress toward understanding fuel effects. A reviewer noted there is no coherent fuel effect theory yet developed and results seem to depend on engine technology. Good progress in understanding fuel effects.

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

Most reviewers acknowledged good collaboration between this program and other institutions, noting in particular good collaboration between various laboratories and academic institutions, especially relative to HCCI information and the CRC FACE team. The CRC is a premier organization for research. There was a suggestion that there could be improved contact with certain OEMs.

The project includes current and future engine design for both gasoline and diesel, but, with the exception of Cummins, OEMs did not seem to be included as partners in the research. DOE programs have traditionally worked closely with all affected industry members, and solicitations for collaboration on future fuels and fuel changes being considered proves the effectiveness of this open approach. Continued nimbleness in this research approach will serve the fuel industry and consumers well. One reviewer would like to see the DOE renewable fuel programs include more of the renewable fuel industry producers--noticeably missing were any ethanol and biodiesel producer partnerships. These relationships should be developed as they are the future fuel suppliers.

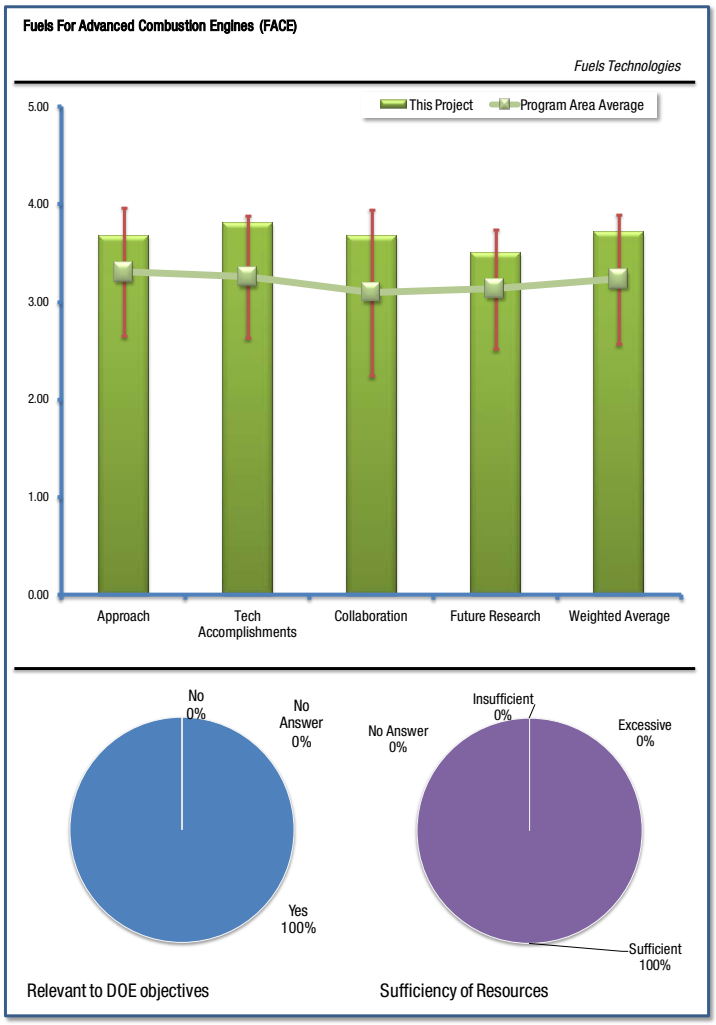
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

Reviewers had a few suggestions relative to planning future work. More than one lauded the inclusion of ethanol blends in future work; one questioned whether compression ratio studies of higher level ethanol blends might be limited by the test engine. One reviewer suggested that greater focus is needed such that the program is not trying to handle too many variables and is focused on a few technical conclusions in more depth. Another reviewer made the suggestion that emission evaluation is a great next step since it is necessary prior to commercialization–concluding that continued availability of the data generated by this program is highly recommended. Finally, one reviewer commented that the program should do well to progressively evaluate fuels so as to provide insight on HCCI.

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

Reviewers felt funding should be continued. They noted that the recognition of new fuel blends and components is appropriate and worthwhile. They further noted that continued focus on optimizing fuel efficiency and engine performance with nontraditional gasoline/ ethanol fuel blends (outside of 10%, 85%, etc.) is key to thinking outside the box and improving the acceptance of new fuels and new fuel blends.

Fuels for Advanced Combustion Engines (FACE): Scott Sluder (Oak Ridge National Laboratory (ORNL))



Reviewer Sample Size

This project had a total of 6 reviewers.

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

Reviewers strongly felt this program supports DOE's overall goals. One noted that the overall goals are very well defined and are closely related to promote advancement in future engine hardware, emissions control systems and fuels technologies. A couple of reviewers commented that the data being collected could be instrumental in creating useful research tools used to improve fuel quality and to better understand fuel property impacts on advanced combustion processes and efficiency. The future-reaching technology effort for this activity makes is appropriate for meeting the DOE objectives. It was noted that this program for FACE fuels for both gasoline and diesel provides a benchmark for various researchers investigating HCCI and alternate cool combustion technologies. This coordinates the fuels for these tests so comparisons and insight can be made.

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 very favorably commented on the approach used by this program. One noted that bringing researchers together to cooperatively combine efforts on new combustion systems is outstanding and well above the normal approach of separate limited collaboration on a challenging area of research. Another reviewer felt the program was very well planned and they really liked to see the FACE group mission statement enclosed as a part of presentation. Another noted the approach is methodical, based on understanding of collective stakeholders. A suggestion was made, even though it's difficult to create a manageable number of fuels in the test matrix, that gasoline-ethanol blends and potentially other higher alcohol-gasoline blends should be in the matrix somewhere. Good or bad, ethanol is here to stay, and DOE is putting a lot of funding toward testing non-petroleum based fuels. One potential barrier faced by the team was developing a mechanism by which researchers could obtain the standardized set of fuels. A reviewer commented that the team overcame this barrier by identifying an industrial fuel blending company that was willing to make batches of fuel with the desired properties and to make them available for purchase to the researchers. To a large extent, this project is addressing the barriers well.

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

Reviewers felt the sharing of data will be very useful toward DOE goals and improving the understanding of new combustion approaches, as well as the quality/performance of petroleum based fuels. One reviewer felt it will be very useful to stakeholders and other government agencies to have the results of this research at their disposal. Others echoed that, noting the sharing of diesel fuel analysis and research supports the main program objectives. Data sharing

appears to be working well, which is key to advancing the general understanding of new combustion approaches. Reviewers understood that there may be the need for some focus on a gasoline fuel matrix as well.

Reviewers were impressed with the progress made, especially with the detailed analytical characterizations that have been conducted with diesel fuels (both standard ASTM analyses and emerging advanced characterization techniques). This work will be very useful to relating fuel composition and properties to results that combustion researchers obtain with these fuels and to help optimize performance in advanced combustion engines. They noted that the team developed a diesel fuel set matrix based on three key properties of importance to combustion. It then worked with fuels blender to make those fuels. They sensed the effort was successful and fuels are now available for purchase by researchers from the blending company.

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

Reviewers found a strong theme of collaboration in this program. DOE has selected a good mix of stakeholders and government agencies to work on the development of this project. Reviewers noted that FACE should be a model for other programs within DOE, that very good collaboration was obtained through the FACE subcommittee of the CRC/AVFL committee, and finally that the collaboration between various laboratories, academic institutions, energy companies, auto companies, and engine manufacturers was excellent.

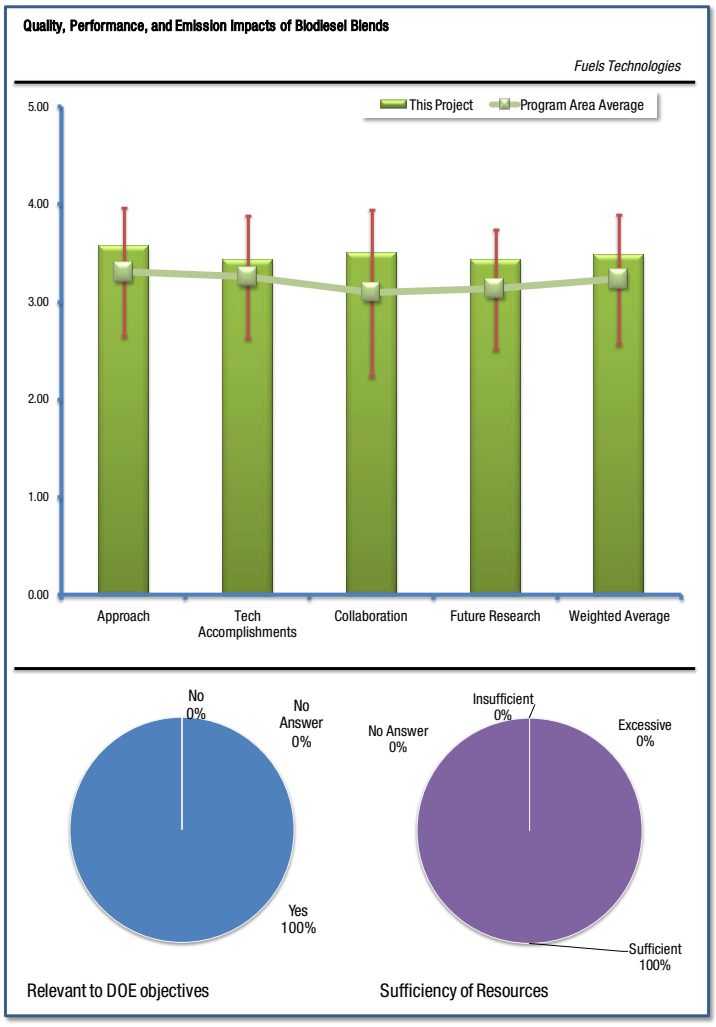
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

Reviewers felt there is very good focus in this program, with not too many variables proposed to be examined. One reviewer emphasized there is a very good plan to extend the successful work with diesel fuels to gasoline fuel set. Also, given the vast political interest in increasing renewable fuels rapidly over the next decade, it is difficult to develop an appropriate fuel matrix that will include new feedstocks or gasoline-alcohol blends. That being said, it is going to be necessary to put some fuels in the mix in order to get a closer more "real world" approximation. One reviewer agreed, noting that with the gasoline and diesel matrices identified, and alternate feedstock effects being contemplated, the plan for future work is well guided.

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

Reviewers commented that CRC has allocated funds through AVFL Committee and beyond that, little information was provided but resources are evidently sufficient.

Quality, Performance, and Emission Impacts of Biodiesel Blends: Robert McCormick (National Renewable Energy Laboratory (NREL))



Reviewer Sample Size

This project had a total of 7 reviewers.

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

Reviewers agreed that this program supports DOE goals to displace petroleum. The overall goals tie in to promoting advancement in engine hardware, emissions control systems and fuels technologies. One reviewer favored biodiesel versus corn ethanol, noting that biodiesel serves the key function desired by the DOE of displacing petroleum with a domestic and renewable resource. Moreover, it does it with a much higher "Fossil Energy Ratio" than corn ethanol. Biodiesel is the one "first generation" biofuel that has sufficiently desirable characteristics to be maintained in the future as part of the fuel solution, while corn ethanol does not.

One reviewer noted the core values and questions being answered by this research program support both the continued understanding of the properties of this fuel and commercial side of the fuel industry. The support of the fuel industry through the analytical support and data generation to eliminate barriers to market development is key. The data developed in support of the regulatory and safety concerns, ASTM and UL, has tangible results that are sometimes forgotten in long range research projects. No doubt that these activities promote the continued and increased use of biodiesel in diesel fuel. Again, this is important because it helps with energy security, petroleum dependence. This work has brought data to the table enabling the advance of biodiesel in the U.S. market by way of improving quality.

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 felt this program was well-designed to overcome technical barriers it is addressing. A reviewer expressed that it includes consideration of fuel production, use and aftertreatment effects. Furthermore, it continues to produce informative and authoritative results, such as the biodiesel quality survey, which is helping to reform the biodiesel industry and protect consumers. Also, the impacts of biodiesel on advanced vehicle platforms with state-of-the-art aftertreatment systems is essential to anticipate problems in the field as we head into 2010 vehicle systems. Another reviewer continued, noting that a broad cross section of fuel industry, both petroleum and renewable, engine manufacturers and research organizations were utilized. The flexibility to respond to industry needs must continue in support of advanced use of nonpetroleum based fuels. They also noted that performance testing and chemical analysis of commercial fuels are planned, and that engine and vehicle dynamometer work will commence soon.

The work is well-designed to successfully overcome barriers, with good reliance on development of technical information that directly relates to fuel performance. This approach has resulted in the improvement of bio diesel

quality in the U.S. This has upset some biodiesel stakeholders because they were not focused on making a quality product for the U.S. diesel fuel market, but in the end, this work has improved the viability and reputation of the biodiesel fuel component.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.
Reviewers understood that the quality survey and fuels effects studies address key challenges with biodiesel and help to protect the consumer and the biodiesel industry from bad fuel and potential adverse effects of biodiesel. A reviewer noted this project continues to produce essential knowledge to guide industry and consumers. An example is the UL listing for B5, which was based on NREL data on fuels impacts. The program is geared to be responsive to industry needs, which is excellent. The commercial attributes of this program are directly in support of the overall goals of the research: to eliminate the barriers to additional NPBF production and use. As some of the DOE research programs develop technology advancements looking several years out, this program is directly supporting the present challenges in today's fuel industry.

Another reviewer suggested there should be continued work in support of identifying the synergistic effects of fuel components and nontraditional fuel blends. The concomitant effects on fuel performance continue to be a developing concern and need further exploration. As increasing renewable content in fuel is incorporated, additional information needs to be developed and identification of primary effects will steer the industry to the optimal fuel blends. The fuel quality work directly supports the commercialization efforts and was not only timely, but widely recognized, and the quality of the analytical data is to be commended. Also, continued work in the engine emission arena is in direct support of the EPA goals to clean up diesel exhaust emissions.

Other reviewers noted that, although good sets of new data were generated, lubricant/after treatment studies recommended by reviewers in 2008 had not been conducted. The reviewer felt nonetheless that the list of publications was impressive. Noted too were the completion of the nationwide B20 survey, the approval by ASTM of biodiesel properties standard–an important step–and the validation of low temperature operability and minor species tests for biodiesel blends. There was excellent progress on understanding cold flow and emissions issues as well.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?
Reviewers felt that collaboration between various laboratories and academic institutions, CRC, and OEMs is progressing well. A reviewer noted that the industry partnerships developed and utilized here should be the example of the DOE programs. A broad cross section of fuel industry, both petroleum and renewable, engine manufacturers and research organizations were utilized. The flexibility to respond to industry needs must continue in support of advanced use of nonpetroleum based fuels. One reviewer added that the project involves a great many stakeholders and collaboration with standards organizations (ASTM, UL). Greater reliance on University collaboration could help to provide additional fundamental information on biodiesel impacts and help to identify fuel chemistry, materials development and process chemistry changes that could circumvent or alleviate problems with biodiesel. The collaboration with the Colorado School of Mines on biodiesel analyses is a good example of the benefits of University collaboration with this project, but more such collaborations are recommended.

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 some recommendations relative to future work. One noted that long term programs (like fleet testing) are not defined in detail. A suggestion was made that work be conducted to support use of biodiesel blends in petroleum product pipelines. This would significantly reduce cost of using biodiesel. One main issue is small quantities in jet fuel. Stability and CF work are also high priorities. As EPA continues to ratchet down the emissions from diesel engines, new technologies will be developed to assist with these efforts and evaluation of the compatibility will be

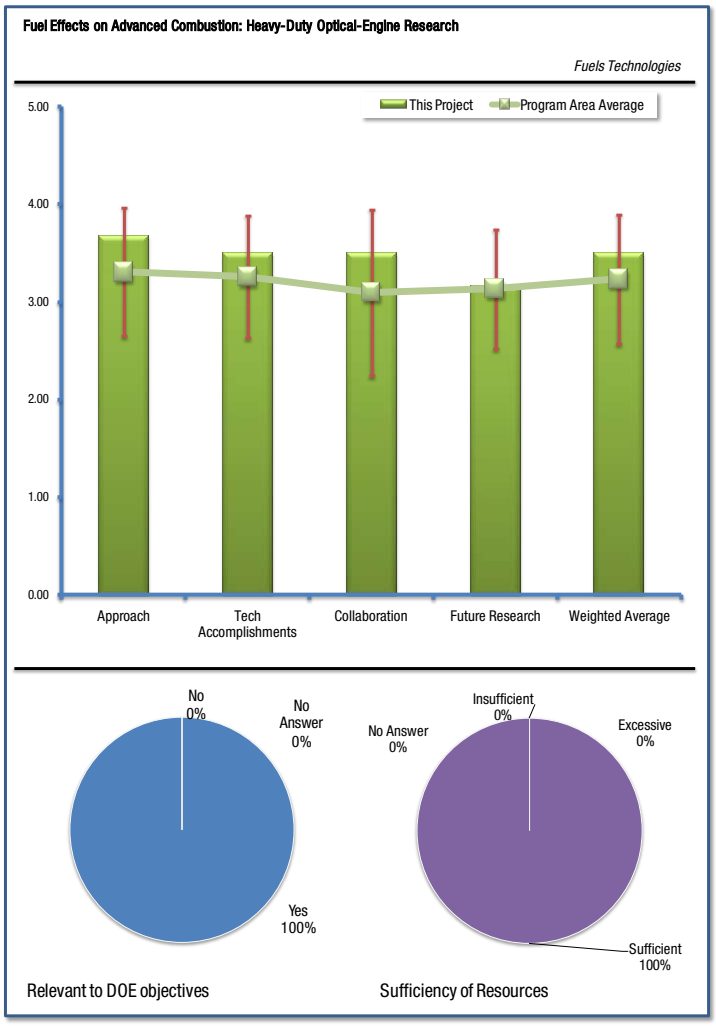
needed with various fuel blends. And work toward understanding the fundamental aspects of biodiesel cold flow properties is a critical research area.

Reviewers also noted that the past success of the program supports the plan to continue this work. The DPF durability study is timely and may help to address longer term concerns with customer acceptance of clean diesel technology and biofuels. The cold weather HD truck tests demonstrated what is needed for winter use of quality biodiesels. And increasing the understanding of minor components/processes by products found in biodiesel fuels is needed.

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

Reviewers expressed that, given the breadth of this project and its need for on-vehicle and long term experiments, as well as fundamental bench top experiments, more resources would be justified. This is especially the case since biodiesel remains the largest contributor to renewable content in the diesel fuel supply. One reviewer suggested that growing the effort to include more university involvement would be beneficial. Another reviewer felt that the resources were appropriately scaled at present. All felt the program was in good shape with current funding.

Fuel Effects on Advanced Combustion: Heavy-Duty Optical-Engine Research: Charles Mueller (Sandia National Laboratory (SNL))



Reviewer Sample Size

This project had a total of 6 reviewers.

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

Reviewers found the program supportive of the DOE objective of petroleum displacement. One commented that the program's goals of promoting advancement in engine hardware and fuels technologies are closely related to the overall goals. Another noted that a better understanding of fuel effects on heavy duty combustion will lead to improved engine efficiency and lower emissions. The advancement of the fuel effects and engine combustion science base is essential, commented another. The project is designed to search for the root causes of NOx contribution and improve efficiency using bio diesel. Bio diesel is being used in engines and improvements in emissions and efficiency are the goals of the DOE program. Further, one noted that the work may lead to identification of an optimal non-petroleum based diesel fuel. Lastly, it was commented that the work is responding to the 21st Century Truck Partnership Roadmap.

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?

Overall, reviewers were very positive in response to the approach taken by this program. One mentioned that outstanding analytical tools (lab equipment and expertise) were focused on understanding and more importantly attempting to solve real-world technical barriers. It was also noted that program is well planned, with detailed program goals and deliverables. Other reviewers observed that the use of optical engine to better understand combustion is an excellent approach, utilizing good graphic examples. Lastly, a reviewer did express some doubt regarding combustion and emission formation of NPBF. They were unsure if optical engines can simulate the real world situation.

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

Reviewers found the program well explained and expressed clear understanding. They found the project was on schedule and had accomplished its goals. A reviewer found the relevant accomplishments were clearly stated and aimed at improved fuel efficiency and petroleum displacement. Also, there appeared to be interesting fundamental knowledge achieved regarding early Di operating conditions. Another reviewer noted that results suggest plausible reasons why (some) researchers have seen NOx increases with biodiesel. Good work was done showing that higher volatility fuel leads to less wall impingement, which in turn leads to lower emissions. One reviewer felt it was good recognition that another option is to change fuel injection strategy. One reviewer noted "the explanation of biodiesel NOx effect was the most concise and easy to understand of any explanation I've heard." Avoiding wall impingement

by increasing fuel volatility to control liquid penetration length is an interesting concept to lower emissions. They expressed it may be of interest to study for both biodiesel and heavy end molecules in ULSD.

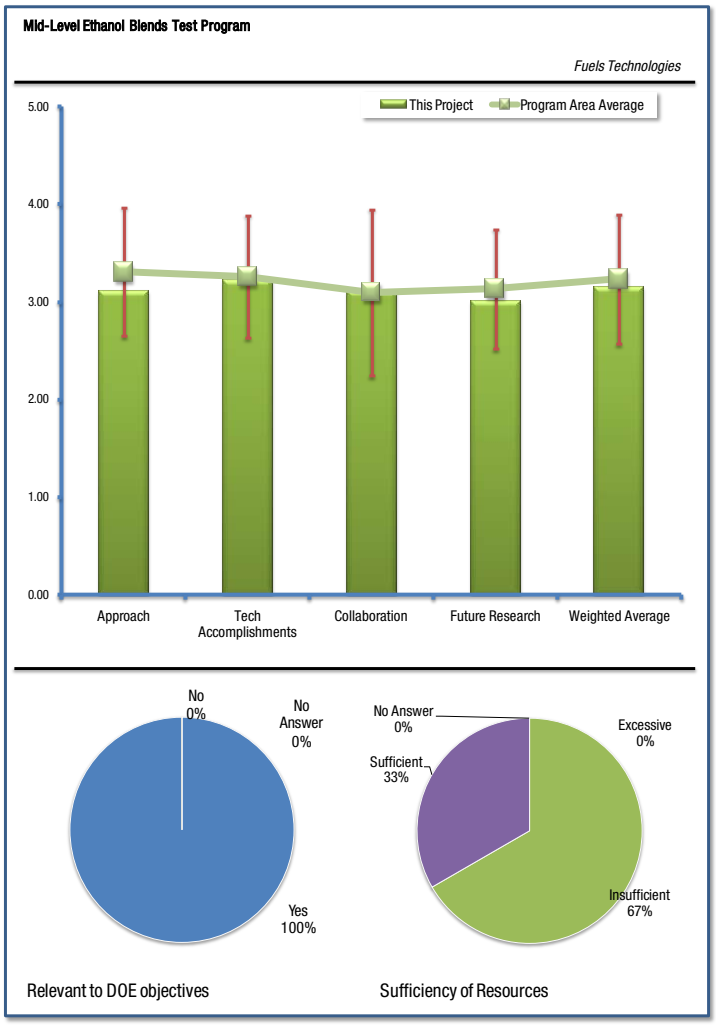
A couple of questions were raised. The first was whether a mechanism was formulated to explain NOx increase with biodiesel. The second expressed curiosity about composition effects–i.e. is there a need to understand and predict fuel composition effects?

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?
Reviewers found the program coordinated well with other institutions–it was well connected with industry, especially for a basic research activity. One reviewer found the collaboration between various laboratories and industry progressing well–with particular mention by another of the very good linkage with industry via AEC Working Group and CRC. One reviewer was aware of the project from the biomass conference and found it useful to his industry.

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 had several suggestions regarding the program. One found it was very good, if not as strong as previous work. It was expressed that more detailed definition of the goals for AVEL-18 program are needed, though other reviewers found the future work is carefully planned. There was a clear focus on continuing to better understand fuel properties on liquid phase fuel penetration. It was also suggested that capabilities could be increased by implementing new high pressure common rail fuel injection system. Also, diesel surrogate development work should be very useful for linking fuel properties to performance in engines.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?
Reviewers found the project funding appears to be sufficient and that it is on schedule.

Mid-Level Ethanol Blends Test Program: Keith Knoll (National Renewable Energy Laboratory (NREL))



Reviewer Sample Size

This project had a total of 9 reviewers.

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

Reviewers broadly expressed that this project supports DOE objectives. One noted that directly higher level ethanol blend directly displaces petroleum meeting both DOE and congressional objectives. The overall goals are closely related to promote advancement in engine hardware, emissions control systems and fuels technologies. A reviewer echoed that, stating that the US cannot meet renewable fuel targets with ethanol unless the E85 vehicle dramatically expands. Another viable option is to increase the blend ratio in conventional SI vehicles. This work enables getting past the "E10 wall" which may or may not be a practical limit in the current vehicle fleet. Some corn market experts have said that E20 is the best overall option for ethanol use in terms of impact and efficiency, which this project can help to enable. Another reviewer felt this program absolutely supported DOE goals–the project is designed to evaluate the effects on engines when operated using E-15 and E-20. This is critical information as the political agenda is to require that E-15 be permitted in the nation's gasoline supply.

Other reviewers expressed that the program supports the goals clearly outlined by the Energy Independence and Security Act of 2007, in particular, by focusing on the advanced use of alternative fuels and on improvements to both current and future engine engineering and design for both gasoline and diesel. The core values and questions being answered by this research program support both the continued understanding of the properties of this fuel and commercial side of the fuel industry. It was expressed that the program is a very high priority for research in the U.S. to determine whether E15 will work with hundreds of millions of vehicles and non-road engines in our country.

Another reviewer agreed, noting that the program directly addresses the ethanol blend wall by looking at whether increasing ethanol content above the legal limit of 10% is feasible for existing vehicles that may not be designed to use fuels containing 15 - 20% ethanol. Increasing ethanol content of conventional gasoline and burning it in as many vehicles as possible in today's on-road fleet is one solution to meeting the 2007 EISA renewable requirements.

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?

Most reviewers supported the approach taken in this program. Several noted that extracting the science-based views from the politics-based views is difficult. Indeed, one reviewer stated that we must keep political views of the pro's and con's of ethanol out of this program and just report good science. Another reviewer put it simply that, with an issue

this sensitive, it will be difficult if not impossible to satisfy the requirements for all interest parties. That being said, the data being generated through this project will not only inform an EPA waiver decision, but also aid in the development of regulations involving air quality rulemakings. More work could be used to address phase separation and corrosion issues with underground storage tanks for fuel. The safety/warranty issues being examined through the durability study (V4) is the first of its kind, and given the amount of resources necessary to conduct these tests, DOE has done a good job of focusing a program that answers the uncertainty of the effects of intermediate blends on a representative fleet (as measured through vehicles miles traveled). Other reviewers noted there was broad partnering with industry groups and stakeholders, combined with the capabilities of several laboratories. One noted it is a large program with many sites and participants, which seems the best approach to generate comprehensive and authoritative results. Using variety of driving cycles to probe multiple means of fuel (ethanol) effects on emissions, performance and system durability is helpful. Another simply said the program took a very good approach of testing the ethanol blends in real equipment. Another reviewer expressed an understanding of the positive aspects of partnering with industry and other government organizations, but also that the limitations to data publication for this project drag out the release date and data availability, and the collaboration that has developed is thus all the more appreciated. Any improvement for future programs for data release would be beneficial to industry. The programs are thorough and address the concerns that have been expressed by the regulating bodies and industry. Concerns were also raised. One reviewer felt lubricant considerations seem to be missing from the program. Another major concern expressed was that many final reports seem to have been written with the agenda to qualify the use of ethanol enhanced fuels, while the data do not support this. The reviewer noted: "The presentation I reviewed today was more forthcoming in its evaluation of the challenges and I would like to see future final reports better reflect the actual test results."

Still another reviewer commented that there are many tasks to this project. Most of the tasks do an outstanding job of focusing on technical barriers. For instance, V1 was a pilot program that looked for quick problem areas to address. There is concern that on some of the other tasks, the test plan has been scaled back to meet available funding or to address a perceived need to collect as much E15 data as possible for an EPA waiver, without due regard for impact these changes will have on the quality of the scientific data to be generated. For instance, on task V4, it looks like the goal has shifted from identifying problem models/years to finding as many new models as possible that will run on E15. This approach is fair at best. What is the test tolerance? Should the testing be done at E20 to prove E15 works? Original plan was to run E0, E10, E15, and E20 on all models. What do the statisticians say when many models will only collect data on E0 and E15? Will there be enough data to find an acceptable ethanol range for non-adapting vehicles, or will these tests have to be repeated to collect the missing data points?

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.
Reviewers expressed their overall understanding of the technical accomplishments achieved by this program toward DOE goals. One noted that DOE has made effective changes at expediting the mid-level test program; however, it just takes a long time to run vehicles for 120k miles. One reviewer cautioned that greater focus and more resources are needed. It was noted that some results were already published and contributed to the Biomass Action Plan announced by the previous Energy Secretary.

A reviewer noted that the program demonstrated only minor effects on emissions for E15 and E20 and the first round of results (V1) has guided the subsequent test designs. The reviewer continued, noting completion of two of three phases in the second round tests (V2). This shows good progress for the program. What is unclear is whether more fundamental questions of the mechanisms of E20 impacts are being examined, which could be done through extensive post mortem analyses of the test vehicles. There appears to be good progress and extensive testing so far on a number of the projects in the program. Another reviewer was especially pleased when it was mentioned during the question/answer period that DOE plans to test marine and non-road engines.

One reviewer noted benefits and provided suggestions for the program. They noted the data being developed by this program is clearly in support of the EISA 2007 legislation, which calls for a systematic increase of renewable fuel content in transportation fuels. The "canary in the coal mine" approach was necessary and proved to be an essential part of the data development in the mid level ethanol blends investigation. However, once no fatal preliminary results were found and as supporting data continues to be developed, additional resources and funding should be allocated to this research. The time line for these projects appears fixed and neither dynamic nor responsive to the research results. With that said, projects of this magnitude and scope should proceed in a purposeful direction and that does appear to be the approach by DOE. Additional resources should be allocated to this project in support of the research findings.

Unlike other fuel producers, the renewable fuels industry feels that the data analysis and summary conclusions are well supported by the data that was developed. DOE takes a neutral, if any at all, position on data conclusions. Additional negative feedback, as was expressed during the question and answer portion of the session, from the small and nonroad engine communities, further underlines their own limitations and lack of responsiveness to changing energy forms.

One reviewer cautioned that, while there were good accomplishments to date, data results were a little weak on the hand-held equipment evaluation of E10+. We should have had toxic emissions reported (aldehydes) on the hand-held equipment since this is an important aspect of E10+ evaluation for EPA's decision.

Again, many tasks to this project and some tasks are achieving outstanding progress, while others appear to be good. Driveability and evaporative emissions tasks seem to have been well run. Not much data will be available by end of E15 waiver request comment period this summer. However, many tasks should be completed by Spring, 2010 in time for EPA to take into account before making any final ruling. As data is collected, it will be interesting to see if extensions or new areas of study will be initiated to address knowledge gaps as these are identified.

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

Reviewers generally expressed, given the complexity and controversy surrounding this testing program, that DOE has admirably engaged interested parties from many sectors. One felt this program has been very open to discussion with manufacturers. Industry seemed to be well represented though involvement of CRC, OPEI, ISMA, NMMA, and MIC. Collaboration between various laboratories and academic institutions is progressing well too, noted another reviewer. Yet another found university involvement to be “minimal” and questioned whether fundamental questions were being answered. One expressed that the level of coordination was not so clear and thought that more university involvement would be beneficial toward analyzing aftertreatment catalysts and engine components. Although no side has gotten exactly what they wanted--mainly because of financial and logistical constraints--DOE has done well to find compromises that may address the questions.

One review felt the industry partnerships developed and utilized here include a broad cross section of fuel industry, petroleum, engine manufacturers and research organizations. This reviewer would like to see the DOE programs that include renewable fuels to include more of the renewable fuel industry producers. Noticeably missing were any ethanol producer partnerships. These relationships should be developed as they are the future fuel suppliers.

Finally, a review observed a perception that collaboration with other institutions can be improved. Project V1 seemed to be run mostly in-house, where the body of interim report has good information in it, but a lot of key findings/areas of concerns did not make it up into the executive summary. This report was updated recently, but reviewer comments suggested changes be made (especially to the executive summary) have not been addressed yet. Even on projects where part of the work is co-funded from outside sources, more collaboration on research goals, changes to test plan when goals shift, and even on sharing of raw data in a timely manner is needed for close coordination with partners.

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, in general, found the program to be heading in the right direction relative to future planning. There are several areas with "shovel ready" programs that are in need of funding which could potentially benefit from the increased interest in increasing ethanol consumption to meet national standards. This is an important ongoing process that could have immediate effects. EPA and others are relying on this information and data decisions on ethanol content in fuel. I believe that this project is still in the R&D phase rather than developing plans for implementing ethanol enhanced fuels. This is the proper place for this project to be at this time.

There were some questions raised. One reviewer did express the desire for a summary of data analyses from proposed programs. Cellulose to ethanol production is lagging way behind the targets established for ethanol production. Will the need for mid-level ethanol blends really become a reality? It is unclear if the NSF and DOE-BES shift to an emphasis on cellulose to hydrocarbons will impact the future need for this work. One reviewer cited the completion of unfinished work by 2010 and the uncertainty of availability of combined dataset. And another noted the flexibility to respond to policy and industry needs must continue in support of advanced use of nonpetroleum based fuels. The future investigations are supported by concerns voiced by government and industry. It was hoped that EPA's decision on E10+ lets us complete this work to make an informed decision.

Finally, one reviewer stated that plans build on past progress and generally are addressing barriers to overcome. In some areas, like task V4 for instance, focus on just E15 fuels to address EPA's need for data on the E15 waiver request ignores the fact that a partial waiver only moves the ethanol wall a year or two into the future. To adequately address this barrier, data needs to be collected on a larger portion of the existing fleet (i.e. older vehicles) and data needs to be collected with E20 fuels. Because of changing fuel properties as new batches of gasoline are made, adding an E20 vehicle later on Task 4 really means adding two vehicles, since you need a base case (E0) vehicle to compare to. This doubles the cost of running an E20 vehicle later versus keeping it in the test program now. Also, repeating models later in the program will make it difficult to compare data back to the E15 test fuels if the fuel properties change significantly.

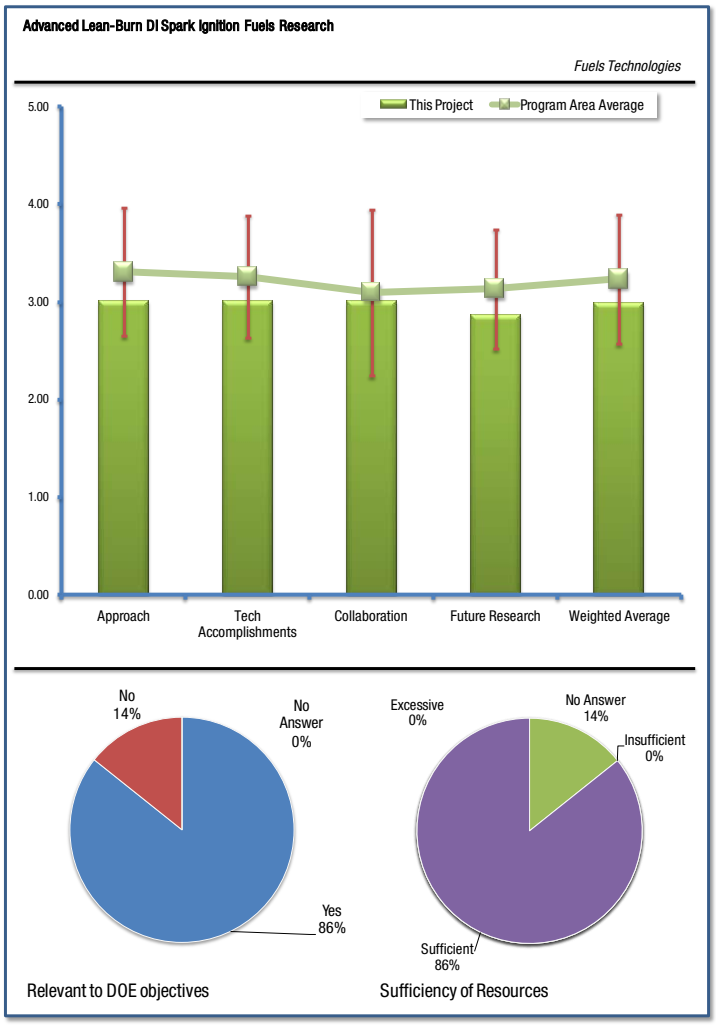
Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewers held strong views on how sufficient and how well utilized are the resources for this program. One reviewer felt this test program is perhaps one of the most comprehensive test programs for the effect of a fuel on vehicle and engine performance. Notable areas that need more funding/focus are: the health effects study and the OBD study. Now that funding from ARRA and FY2009 are fixed, perhaps DOE should explore financially backing this area. The reviewer concluded that increased resources would help other areas of this evaluation. Another reviewer felt that as long as ethanol remains the primary route to meeting renewable fuels targets, this program needs to be funded. A further reason is because E20 is the best route to increased ethanol use. It is unclear if the NSF and DOE-BES shift to an emphasis on cellulose to hydrocarbons will impact the future need for this work. Other reviewers cited the fact that this project has become a major data source for government decisions regarding the ethanol content in gasoline, and that for timely completion, these programs need enormous resources.

One reviewer stated flatly that this project is grossly underfunded. This is significant, because there are areas that we don't even know what we don't know yet. Although not highlighted in the presentation, there are critical tasks that have not even started due to lack of funding. For instance, is there any engine durability testing? Won't that be needed, no matter if any future waiver is for E15 or E20? As some of the tasks stand now, the focus has shifted to collecting data just on an E15 waiver; but doing this and not collecting critical data on E20 will increase the overall program cost if have to add back in later. Any rush to get partial data out as quickly as possible may significantly degrade the quality of data collected. Principal Investigators should have sufficient project management control to say when good science and sound statistical analysis is taking a backseat to funding and/or time constraints.

Finally, another noted, the time line for these projects appears fixed and not dynamic nor responsive to the research results. With that said, projects of this magnitude and scope should proceed in a purposeful direction and that does appear to be the approach by DOE. Additional resources should be allocated to this project in support of the research findings.

Advanced Lean-Burn DI Spark Ignition Fuels Research: Magnus Sjoberg (Sandia National Laboratory (SNL))



Reviewer Sample Size

This project had a total of 7 reviewers.

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

Reviewers had mixed opinions about the direct injection spark ignition research in the program. Reviewers acknowledged that lean-burn, highly-boosted SI engines can provide a significant increase in thermal efficiency/fuel economy and thereby displace petroleum through reduced demand. They further noted that coupling that advanced engine with alternative fuels (ethanol) provides additional potential to displace petroleum. They expressed interest in seeing what information is generated from this lab as this project moves forward. The comment was made that some objectives appear to be of academic interest.

In a related comment, one reviewer noted that due to the demand increase for HD diesel as economy expands and increased ethanol supply, improvement in gasoline/ethanol blend efficiency should have higher priority than LD diesel research.

One reviewer did not find the DISI effort to be sufficiently long term, stating this is not an activity for a national lab, but rather competitive research for industry. Project funding should be diverted to longer range R&D, not R&D for the OEM's. The reviewer emphasized the sentiment is not biased against the researcher or Sandia, but that this project is not long term R&D.

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?

Most reviewers found the work to be a good blend of experimental tests and modeling, and a useful effort that could result in fuel efficiency gains. One noted that by looking at ethanol/gasoline blends, the project retains practical relevance. Suggestions were made that other fuels options would make sense, such as butanol, which is a competing option to ethanol with significant benefits relative to ethanol. Also, building a boosted DISI engine lab capability and doing boosted HCCI work on ethanol blends would be helpful. When the advanced DISI optical engine is available, the impact of operating parameters on robustness, performance and efficiency could be considered. There is also opportunity for companion work in combustion simulation.

One reviewer felt it was a good idea to use both an optical version and metal version of the same engine platform. Another agreed that it was a very good design. The lab will be valuable in collecting information on technology and its impact on fuel efficiency using various fuels. Reviewers noted that the existing lab and engine is used as a basis for improvement, that the lab collaborated with General Motors, and that optical diagnostics could be applied and kinetic modeling could be conducted.

Finally, one reviewer found it unclear from the presentation what main barriers are. And another strongly felt that work studying conventional gasoline and ethanol in SIDI engines is not a subject for taxpayer dollars, but rather should be done by OEM's in-house using their funds.

Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.
All reviewers noted good progress was made in developing the lab, including specific comments applauding the design considerations made in the operation of the optical engine, innovative work to ensure balancing of the engine (which is a concern for single-cylinder engine systems), and the completion of the ethanol-gasoline boosted HCCI study.

One reviewer noted the purpose of this project is to provide the science-base needed by industry to understand how future fuels will impact the performance and robustness of new light-duty engines that employ advanced combustion strategies such as highly boosted direct-injection stratified-charge spark-ignition (SI) combustion. A few reviewers noted the project is on schedule, has made good progress in developing engine tools, but it is still early in its development to fully evaluate performance. One added that understanding ethanol performance in advanced combustion is high priority.

Finally, one reviewer acknowledged that the lab's set-up is good but disagrees with the project premise.

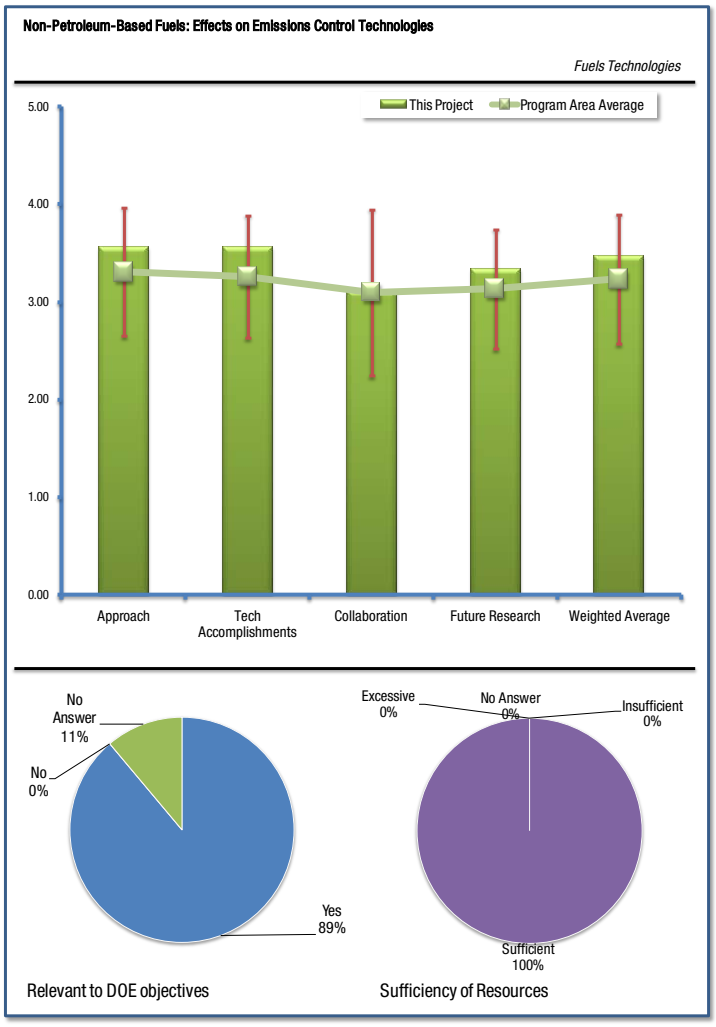
Question 4: What is your assessment of the level of collaboration and coordination with other institutions?
Reviewers found this program had marked collaboration with industry and the national labs, and some with academia. Reviewers cited the engine simulation activities with GM and the Advanced Combustion MOU, work with LLNL and indirect involvement with the University of Galway. Also noted was interaction with the AEC. One reviewer commented that the new engine should be a good resource to support other DOE fuel and advanced combustion engine projects.

One reviewer acknowledged collaboration with this effort, but stressed that this is really competitive research that should be funded by industry and not performed at one of our premier national labs.

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 noted the future work is relatively well planned although the effort is in its early stages–most of the experimental work is yet to be completed since the facility had to be developed first. A reviewer commented the project should be performing boosted DISI work by 2010. They suggested including butanol in the test matrix since it may compete effectively with ethanol, and that it should continue the evaluation of gasoline and ethanol. A comment was made that key barriers are unclear. And, finally, one reviewer emphasized that no further work should be done by Sandia on this project.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?
One reviewer noted that a highly capable and innovative facility like this requires significant investment. But, previous facilities at Sandia have provided enormous benefits relative to the investment in their development. Another reviewer was unsure of the funds, while a third objected to funding the project altogether, suggesting that it should be ended.

Non-Petroleum-Based Fuels: Effects on Emissions Control Technologies: Scott Sluder (Oak Ridge National Laboratory (ORNL))



Reviewer Sample Size

This project had a total of 9 reviewers.

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

Most of the reviewers found this program does support DOE goals. Reviewers noted that application of emissions controls to engines burning alternative fuels is an appropriate role for DOE, whereas EPA's focus should be on existing commercial fuels. DOE's objective of displacing petroleum is closely related to promoting advancements in engine hardware, emissions control systems and fuels technologies. This is a fundamental study of the combustion particles from diesel vs. biodiesel and significant mechanical and chemical differences between the two. It was noted by more than one reviewer that biofuels, while addressing sustainability and energy security–lessening the dependence on petroleum–may have adverse (and/or beneficial) impacts on exhaust aftertreatment. If biodiesel is producing more soot than ULSD it is important to understand why and how to minimize it. Another reviewer noted that fuel property effects on combustion, engine and emission control systems are important. So are an improved understanding of EGR cooler fouling processes and an increase in engine efficiency. All of these effects must be understood to maintain vehicle system durability and to promote clean diesel technology.

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?

All responding reviewers found the approach worthwhile. They noted the real world application of research such as this is the most valuable approach–they found it very well-planned, a fundamental knowledge program with detailed program goals and deliverables. It was found that the program has a very good approach of linking engine test results to lab kinetics tests and analytical characterization techniques.

Reviewers added that examining fuels effects in engine and aftertreatment systems with various diagnostic techniques and high level materials characterization strategies is needed. And the project identified the issue well and also identified the problem associated with EGR cooling–thus this is a good approach with good focus.

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

Reviewers were favorably impressed with the progress and technical accomplishments. They found the program is addressing some interesting issues, with impressive progress made about understanding EGR cooler fouling. The program further elucidates effects of soot characteristics (including condensable hydrocarbons) on soot oxidative reactivity. One found it explored and explained differences in the organic fraction of particulate matter, answering an

old but important question about VOF vs. SOF. Considering EGR cooler fouling and examining impacts of biodiesel, one reviewer observed that B20 did not worsen EGR cooler fouling, but provided significant insight into deposit formation rates and PM oxidation kinetics.

Another reviewer noted very good progress was seen to date in following areas: understanding soot formation from various biodiesel blends and reasons for similarities and differences with conventional ULSD; analyzing composition of soot and linking composition to performance issues such as EGR cooler fouling & valve sticking; and determining how the biodiesel PM oxidizes differently than ULSD PM. One reviewer also noted the chemical analysis of the combustion products is providing some insight to the effectiveness of exhaust after treatment technology.

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

Most reviewers found collaboration among other institutions. While the program is addressing topics of interest to industry, and commercial applications, one reviewer did not find deep involvement from stakeholders to be apparent, and another noted that the quality of data interpretation would improve if a lubricant additive manufacturer were included. Most reviewers, however, did sense collaboration, citing CLEERS, several auto makers and engine manufacturers (GM, Ford, & Cummins) and universities (University of Wisconsin & Penn State). One reviewer said that expanding external collaborations with other institutions, such as the collaboration with Vander Wal, is an excellent idea to bring more techniques to bear on the soot characterization research.

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?

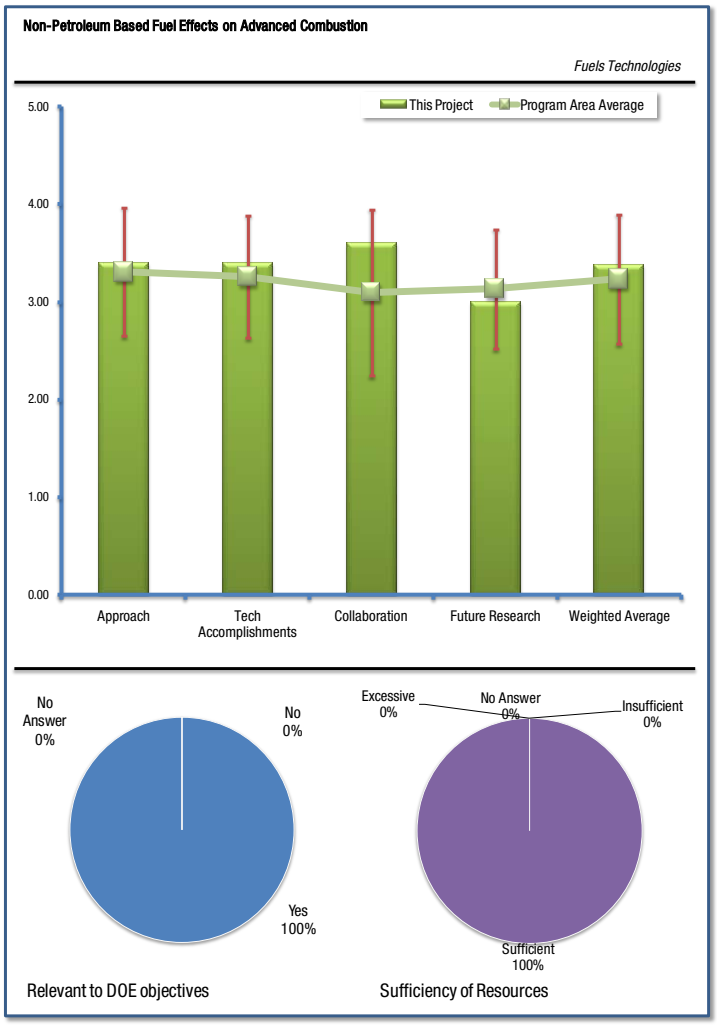
Reviewers found there were a few aspects of the future work that could be augmented. It was suggested that the program foster deeper involvement of potential commercial users in design and participation of future programs. It was also suggested that detailed chemistry of deposits formation should be examined. It was also noted that the program is yielding significant insights and the program plan continues in these paths, with an added collaboration with NREL on the soot characterization.

One reviewer observed that the future plans build on recent progress, with a focus on continuing to address fundamental causes of issues in real engines (such as EGR cooling fouling and DPF monolith failure) and possible solutions and comparing performance of biodiesel to conventional diesel. And finally, it was noted that soot oxidation kinetics, analytical development, degradation of a DPF monolith cause are planned for future research–and that plans for future are consistent with alternative fuel developments.

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

Reviewers found that that the budget appears to be sufficient for work underway, but that the significant importance of these problems would merit further support.

Non-Petroleum Based Fuel Effects on Advanced Combustion: Jim Szybist (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 had some reservations about the program, though one did note that advanced fuels and advanced combustion systems are appropriate for DOE work. The concerns centered on the relatively few barriers to use of biodiesel and tar sands in advanced combustion. Another reviewer cited a lack of adequate data and predictive tools available to assess fuel property effects on advanced combustion, emissions and engine optimization, though another reviewer did note that biodiesel fuel is available and needs to be optimized.

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 found the program was very detailed and produced extremely high quality work, focusing experimental and data analysis and chemical kinetics. Fuel effects experiments were well designed. That said, a reviewer did mention it was not clear whether there are any significant barriers to use of biodiesel/tar sands in advanced combustion.

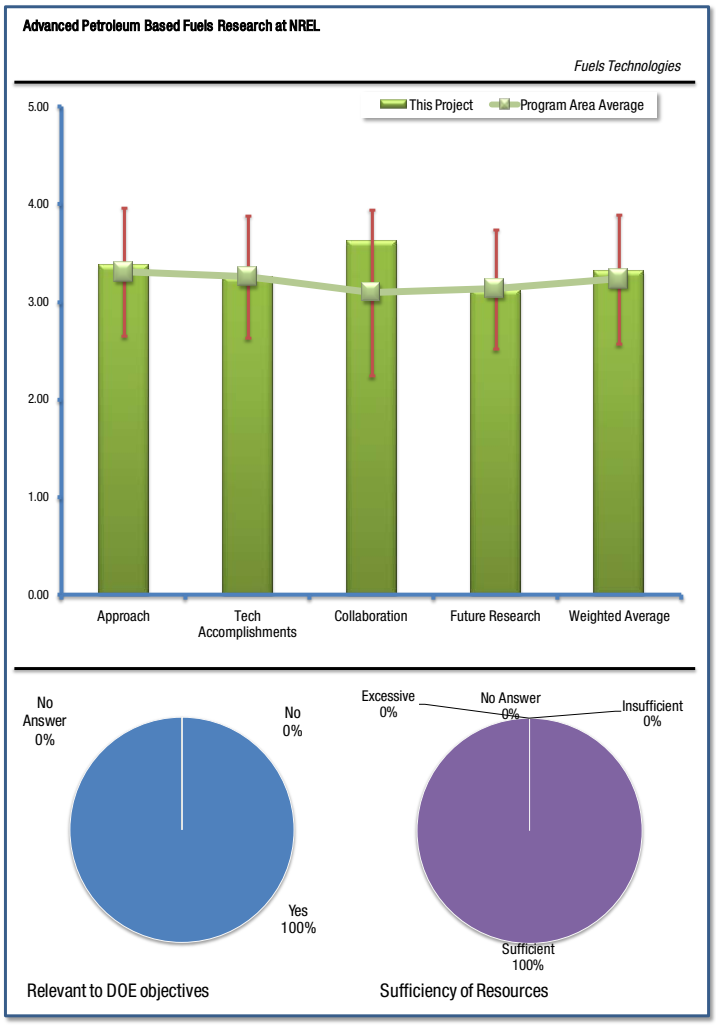
Question 3: Characterize your understanding of the technical accomplishments and progress toward overall project and DOE goals.
Reviewers who commented found detailed results were reported on fuel effects and that good progress has been made.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?
Four reviewers commented on collaboration, noting there was very good research collaboration with the stakeholders via the Model Fuels Consortium, through engine/fuel groups, and others.

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 found some shortcomings in the plans for future work. While a number of fuels related research efforts are planned, one reviewer found the multi-cylinder HECC engine plans for 2009 need strengthening. Another recommend additional focus on gasoline/ethanol and it was suggested work on oil dilution with biodiesel.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?
Two reviewers commented on allotted resources, one finding funding adequate, the other expressing they were not sure.

Advanced Petroleum Based Fuels Research at NREL: Brad Zigler (National Renewable Energy Laboratory (NREL))



Reviewer Sample Size

This project had a total of 8 reviewers.

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

All reviewers found the program supportive of DOE goals. The work on advanced fuels and advanced combustion in advanced engines are all needed to promote cleaner and more efficient combustion, thus displacing petroleum. Reviewers agreed that fuel effects on advanced combustion and long term impact of lubricants and emission control systems need to be characterized to understand how to enable advanced combustion.

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 found good use of new instrumentation to get at data to overcome barriers in this project, with a variety of activities underway. One reviewer notes that considering fuel properties, via programs like FACE, and impacts on lubricants permits consideration of how to change fuel to enable advanced combustion. This involves application of IQT and a new single cylinder test engine. The work supports the broader FACE program through the CRC, in turn supporting improved tools and models for engine development. And, it bridges fundamental combustion experiments to engine combustion.

Another reviewer found it was a good approach in trying to correlate fundamental fuel ignition/combustion parameters to performance in IQT instrument and other engines. There is a need to quantify fuel effects and lubricant effects. There is a concern about use of IQT to evaluate NOx emissions since not clear that IQT is relevant to engine conditions.

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

Reviewers found a good linkage of the effort to DOE's goals with NREL's Biomass Program through testing butanol and various ethanol blends. One reviewer felt there is a need to have improved focus on deliverables and their applications and how these are coordinating among the various activities.

Another found the published work on the FACE program through CRC, working on a single cylinder engine facility and adding MS capability to the IQT instrument to be positive. The IQT work is a key part of the APBF and FACE activities at NREL and other labs. The engine is installed but a new dynamometer instrumentation is in progress. The team members are also developing the advanced techniques for speciated exhaust emissions that were needed, as was having preliminary results from the CLOSE project on lubricant and fuel derived emissions impacts.

One reviewer found that the program is making good progress. The reviewer cited the ignition parameters of the CRC FACE diesel fuels that have been characterized in the IQT instrument. This should be useful information for combustion researchers using the FACE diesel fuels. The reviewer also noted: that the work to set up a single cylinder engine has been initiated; that in CLOSE program, testing has been completed on the light duty vehicles; and that advancements have been made in quantitatively speciating unregulated exhaust emissions.

And another reviewer noted the optimization of fuel chemistry for advanced combustion engines, the enhancing of IQT research capability, the characterization of pure compounds and the development of fuels for FACE. With all the new construction and starts of new projects, it was difficult to understand if the rate of progress is modest or significant.

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

Reviewers found good, multi-stakeholder collaborations. They cited partnerships with University of Michigan, WVU, LLNL, ORNL, UC Berkeley, Colorado School of Mines, SwRI and many other entities through the CRC. Reviewers commented that a good choice was made to use the 1.9L Opel engine in order to correlate data with other projects, and commended the focus on IQT work to support other projects.

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?

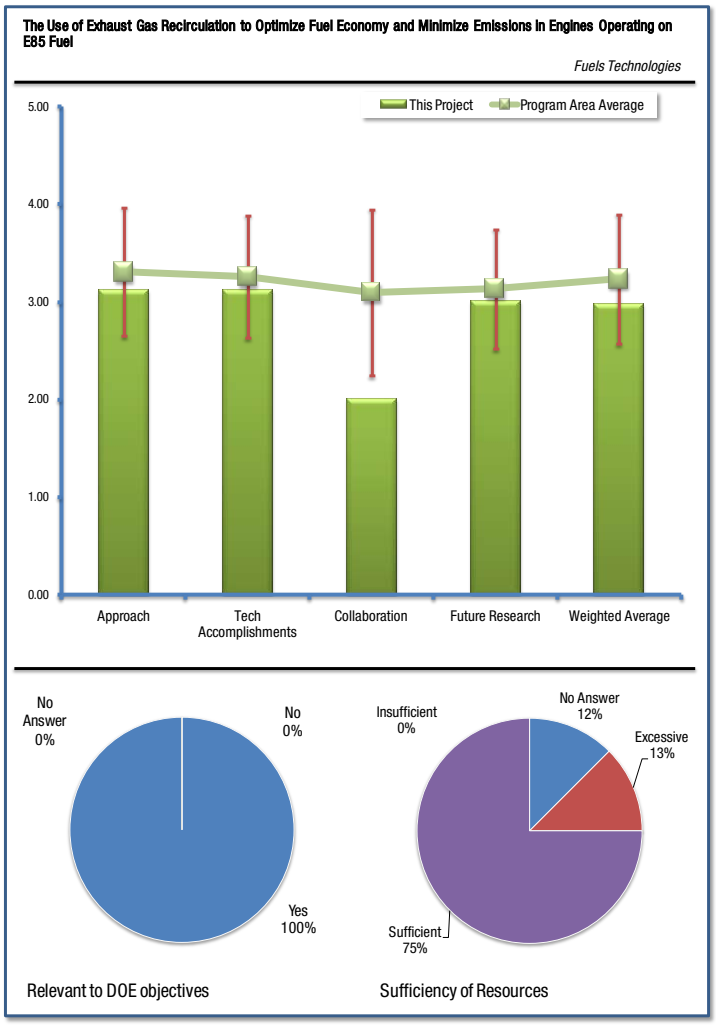
Reviewers held mixed opinions on the plans for future work. Most found the plans linked well with past accomplishments, though some suggestions were raised. One reviewer noted a need to build a stronger future plan showing the benefits of each activity. A reviewer did note that both fuels impacts advanced fuel and lubricant impacts are being studied.

A reviewer noted the GM engine will permit DISI work on FACE gasolines and addition of the MS capability for IQT will permit enhanced understanding of reaction kinetics. It will continue work on fuel impacts on advanced combustion and will expand CLOSE to include lubricant development for advanced combustion engines. It is not clear why this latest engine is being added to the NREL facilities, since such engine test capabilities have typically been located at ORNL. Another reviewer noted that supporting increased emphasis on gasoline would de-emphasize diesel emissions control as these systems are becoming commercial.

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

Three reviewers commented on the funds for the program, one noting that there is a large budget across many activities, and another that there is ample research funds provided in the project. The third was not sure.

The Use of Exhaust Gas Recirculation to Optimize Fuel Economy and Minimize Emissions in Engines Operating on E85 Fuel: Ko-Jen Wu (General Motors Corporation)



Reviewer Sample Size

This project had a total of 8 reviewers.

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

Reviewers were clear that this program attempts to increase fuel efficiency, which itself advances DOE goals. Since energy content for E85 is lower, increasing fuel efficiency for FFVs would lead to more appeal for E85. One reviewer found this an excellent application project for DOE to improve fuel efficiency of alternative fuel and vehicle system.

Consideration of ethanol combustion in advanced combustion (high boost and EGR) operation supports improved efficiency, clean combustion using renewable fuel and thereby addresses key DOE objectives of displacing petroleum through efficiency improvements and use of domestic renewable fuels.

Another reviewer noted this program supports the goals clearly outlined by the Energy Independence and Security Act of 2007. This project focuses on the advanced use of alternative fuels, namely E85, as well as includes improvements to both current and future engine engineering and design for flex fuel vehicles. Lastly, a reviewer felt the project is relevant but not as important as optimizing fuel economy for lower level blends since volumes of E-85 are smaller.

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 were impressed with the approach taken in this program, noting, for example, the outstanding approach of leveraging technical know-how from industry. Optimizing for E85 operation in a flex fuel vehicle was lauded. Reviewers were impressed that experiments were preceded by engine simulation to define engine design parameters. Also impressive was the shift of the scope of the project to a smaller vehicle platform in response to market trends.

One reviewer expressed some skepticism, expecting that GM would be farther along on this project. Another felt the barriers and opportunities for optimizing E85 were not clear from the presentation.

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

One reviewer commented that it is difficult to measure achievement without dynamometer data. However, another noted outstanding improvements in alternative fuel-vehicle performance. It was observed that the project timeline is 50% complete but project objectives are only 34% complete, and that some aspects of the project scope were changed. And there was identified a 4 cylinder crossover SUV vehicle platform for the demonstration of the results, this in the midst of an "applied research and exploratory development" phase. One reviewer added that if the goal of the project

is to study technology for optimizing E-85 then GM is doing that. Work to optimize the current engine parameters and improving existing engine design is more easily incorporated and has a shorter payback period. Research and improvement of emission control equipment or fuel delivery affecting emission control equipment supports compliance with stricter environmental goals. Today's flex fuel engine design and settings "tolerate" ethanol blended fuels and more work needs to be done to optimize the engines to run efficiently on gasoline/ ethanol fuel blends, primarily where ethanol is the primary component in the fuel. Flex fuel vehicles are expected to increase in availability over the next few years and understanding the needs in engine/ fuel system design and controls in order to maximize vehicle performance and efficiency. Since there is only simulation results thus far, progress assessment is more difficult. And it was noted that this is a fast track project, with the goal of commercialization.

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

Reviewers did not find much collaboration on this project–it is largely GM specific. One reviewer noted that aside from providing money, DOE did not seem to have much of a role in this project's development. At least, the presentation did not mention DOE's contribution. The program involves built in integration of the technology.

Another reviewer agreed, noting the project is GM specific comprising largely internal product development. It is unclear that any partners, particularly National Labs or Universities, are involved. Technology transfer appears to be focused toward future GM flex fuel products.

Another reviewer felt this question was not applicable, noting it is a GM-only project. This reviewer recommended that Mr. Wu plan to publish an SAE paper when the project is complete.

The industry partnership developed and utilized here should be the example of the DOE programs. Partnering with the largest flex fuel vehicle manufacturer to improve design in support of legislative goals is fantastic. The most important aspect of this program is that the findings of the research are being considered for incorporation into vehicle designs. Commercialization of the research provides tangible payback for the project.

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?

The reviewers all found this project's future plan to be well established, with progress nearing completion. There was excellent move to in-house development of the final deliverable. The program will move to vehicle and controls integration in 2009 and begin vehicle testing.

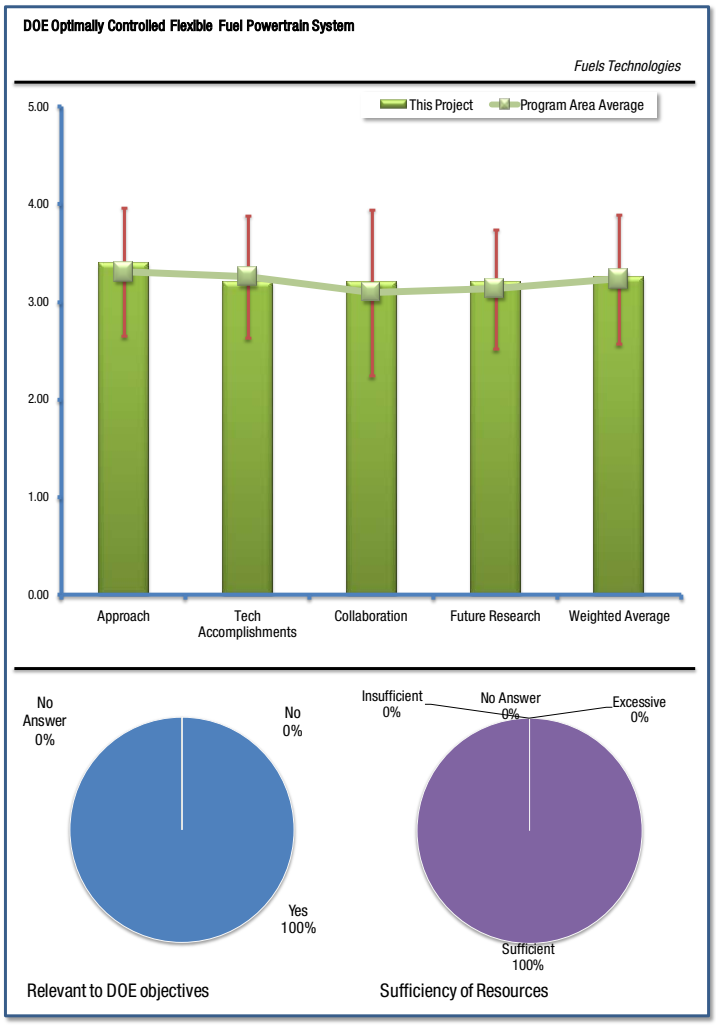
One reviewer felt this was DOE-subsidized product development. They noted optimization of FFV is an important goal. It was speculated that if FFV were fully accepted and fuel was readily available, GM and other engine manufacturers would be optimizing these engines on a very fast schedule. It appears that this project is nearing completion and final steps of the research program will be completed. Another reviewer looks forward to the future project updates and eventual SAE paper when dyno test data become available.

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

Most reviewers found the project well supported. One noted there is excellent leveraging with industry. While this engine and vehicle development activity is a company-specific product development, it is responsive to national needs. Further support should be predicated on the commitment by GM to deploying this product in the marketplace.

A reviewer agreed, noting GM Powertrain has the resources to improve efficiency on its products that use E-85. It is an interesting project and if FFV and E85 become more prevalent this data will be useful. It will be interesting to see if significant FFV improvements drive the market. None of the reviewers foresee additional large scale financial obligation for this project.

DOE Optimally Controlled Flexible Fuel Powertrain System: Paul Kilmurray (Mahle)



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 found this program beneficial toward achieving DOE goals. One noted that if successful, this project would help decrease the loss of fuel efficiency in FFV's while using ethanol-gasoline blends up to E85. Spending more effort to design engines to run on E85 will hopefully lead to greater FFV production and E85 utilization in those FFVs. Another supported expanding the use of alternative fuels, and suggested optimization of FFV's is important.

Another reviewer said the project aims to optimize E85 engine development to enhance public acceptance and use of E85, which will displace gasoline and fulfill a major DOE objective. Improving fuel economy of lower level blends is more relevant, said another. Many system components could also be applied to low-level gasoline/ethanol blends.

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 found the approach taken in this project to be very positive. They noted this appears to be a very realistic, intuitive approach to improving FFV fuel economy. The economic/social analyses are relevant and a nice addition to this project. Another noted there is an excellent detailed program plan to meet performance objectives.

One observed that engine simulation was used to define engine design and operating parameters, with the optical engine being developed for validation of diesel to permit transition to a product. Technologies include low pressure DI, turbocharging, increased compression ratio, variable valve timing and EGR in closed loop control.

Reviewers felt the technical barriers have been addressed. Development of a flexible fuel powertrain is the basis, and the project milestones and deliverables are clear, using a variety of tools.

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

Reviewers noted several technical achievements. One noted the simulation data seems very promising, and that it will be interesting to see how increasing the compression ratio will yield further efficiency benefits, or if these savings can be maintained after development. Engine modeling completed with contour plot documentation and vehicle simulation modeling with Advisor were highlighted.

One reviewer summarized the project, noting it is considering a high compression ratio variant of a current gasoline engine. Engine simulations were completed, showed that the E85 fuel economy has a penalty from 30% to 9%, but that the 0-60 mph acceleration time was reduced by 20% by increased engine torque. Also simulated the GHG

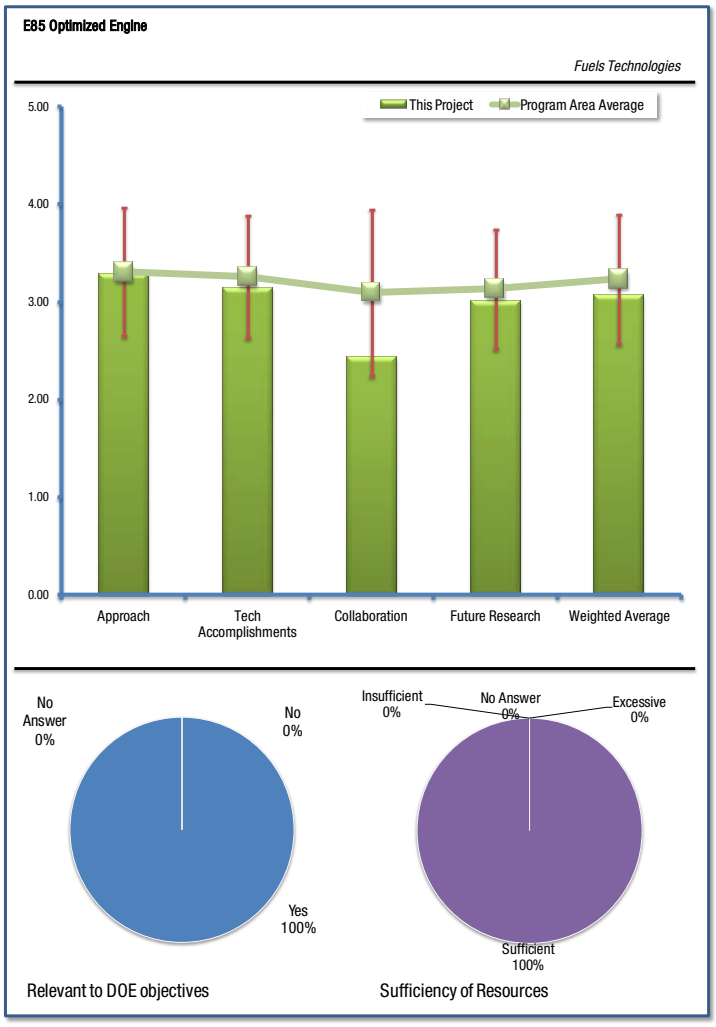
emissions using GREET and showed a 33% reduction via E85 operation. Mich State University is developing a companion optical engine. Baseline engine operation at Argonne was completed on a GM engine for comparison. Finally, detection of ethanol and combustion phasing through ionization detection is a nice accomplishment.

Question 4: What is your assessment of the level of collaboration and coordination with other institutions?
Reviewers found a well coordinated program, with good cooperative relationship with Michigan State University, Visteon and Argonne.

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 identified a few aspects where the project has defined well its future work and some where it fell short. One reviewer would like to see a clearer plan to bring this to commercialization, but another found an excellent research plan for future work–specifically a plan to evaluate optical and metal single cylinder engines, and move to assembly and testing of the prototype engine. Another aspect is to finalize injector design and evaluate performance of single cylinder engine with E85 blends and gasoline.

Question 6: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?
While one reviewer was unsure, two of three with a response found funding sufficient in the program.

E85 Optimized Engine: Apoorv Agarwal (Ford Motor Company)



Reviewer Sample Size

This project had a total of 7 reviewers.

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

Reviewers feel this program supports DOE's goals for displacing petroleum demand. Optimizing E85 operation will provide significant petroleum displacement potential by reducing petroleum demand and permitting efficient use of bio-ethanol. However, it is unclear with the strategy of this project just how much E85 would be consumed. The net ethanol use may be much lower over the duty cycle of the vehicle.

This project supports the goals clearly outlined by the Energy Independence and Security Act of 2007. This project focuses on the advanced use of alternative fuels as well as includes improvements to both current and future engine engineering and design for flex fuel vehicles, namely light-duty trucks.

One reviewer did question whether this research should be funded by DOE or if it is competitive technology that should be done by OEMs. Project would use E85 as a local octane boost to an SI engine running on gasoline.

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 mostly found the approach sound and beneficial. One reviewer noted the goal is to obtain diesel-like cylinder pressures and, using an on-demand dual fuel injection approach, to leverage the characteristics of gasoline and E85. Injection of E85 is timed to prevent knock depending upon engine operating conditions.

Another reviewer found the project well defined, even that the industry partnerships developed and utilized here should serve as the example for the DOE programs. The incorporation of new analytical tools, such as the spray pattern mapping, is very interesting and believed to assist in the determination of improved design.

Reviewers also observed that these can be more difficult optimization problems compared to other E85 projects. It is a good approach to addressing these issues by using variety of tools. Finally, one reviewer did find the approach okay, but wanted to know if visual modeling would benefit the understanding of the technology.

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

Reviewers noted a number of technical accomplishments. One mentioned the project has defined the engine system and performed simulations of engine operation and optical and single-cylinder investigations of fuel spray behavior. It has also designed a multi-cylinder engine and procured components for the engine build. The reviewer noted that, due to delays, there was a two month no-cost extension to permit time to complete project objectives–predominantly

Phase 1 is on schedule. And there has been better progress in transitioning to engine-testing compared to competing projects.

Another reviewer noted the incorporation of new analytical tools, such as the spray pattern mapping, is very interesting and believed to assist in the determination of improved design. A greater understanding of engine performance on E85 fuels is needed and this research supports that goal. To another reviewer, it was unclear if the findings of this program could easily be incorporated into the existing Ford engine design. Dual fuel tank systems have been used in Brazil however it's unknown if acceptance would be granted here in the US.

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

Reviewers noted there was good collaboration with other partners, if somewhat limited in national lab or university involvement. And one thought it sounded like competitive research for one company's benefit. Reviewers commented that AVL Powertrain and Ford are partners.

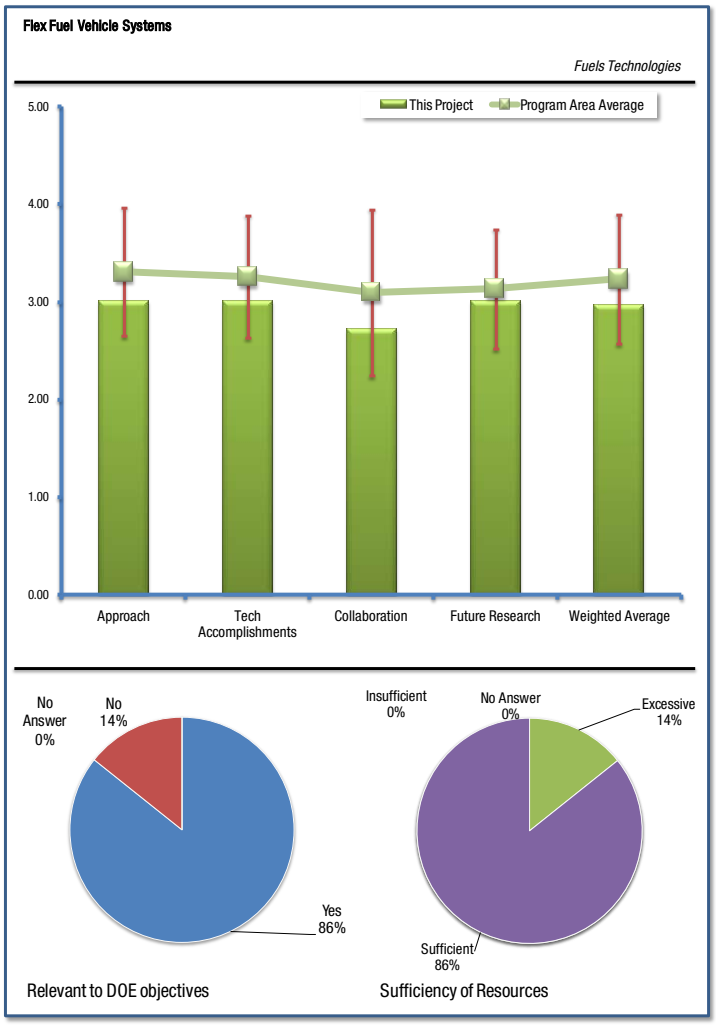
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

Reviewers found the project to be nearing completion, with final steps of the research program certain to be completed. The plan to evaluate engine performance and efficiency using the dual fuel strategy and to evaluate cold start emissions and map a practical engine while considering vehicle level attributes for an optimized engine design should be completed. Reviewers thus found future plans well in line.

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

Reviewers found funds to be sufficient to meet project objectives. One noted they did not see further financial commitment needed as the project's scope is being realized, with targeted completion dates being met, and no problems with resources.

Flex Fuel Vehicle Systems: Hakan Yilmaz (Bosch)



Reviewer Sample Size

This project had a total of 7 reviewers.

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

All reviewers found the project effort to increase the efficiency and attractiveness of E85, while achieving ULEV emissions, to address the DOE objective of petroleum displacement. Wider use of E-85 will reduce amount of petroleum derived gasoline. A reviewer commented that this is conventional research into improving the operation of a FFV. The DOE should not be in the business of doing vehicle research for the OEMs.

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 found the approach to be modest and feasible, with clear, excellent goals for achieving fuel efficiency of an E85 vehicle while targeting SULEV emissions. The approach does a good job of specifying targeted fuel economy improvements. One commented that the improvement in ethanol sensing is good, but needs better accuracy. The engine controls are also attractive with production-like ECU. One reviewer found the approach, with testing in real vehicle platforms, to be good.

A reviewer observed the use of engine controls and injection strategy for E85 in a DISI approach to obtain improved engine efficiency during E85 operation. Tasks include engine optimization using low level adjustments to a base engine, development of a DI fueling strategy to improve emissions, ethanol detection to guide the operation of the engine and model based controls development. The reviewer the approach particularly innovative or ambitious since the efficiency improvement is modest and the strategy is rather conventional. And another felt this project should be stopped and funds diverted to longer term R&D. As the project exists today, this is taxpayer money going toward OEM R&D that should be done by the OEM's, not DOE.

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

Reviewers expressed their understanding of the technical accomplishments. The ethanol measurement method is impressive. Design accomplishments are impressive. One is looking forward to hardware performance results. Another noted the completion of the piston design for increased compression ratio, engine hardware designs for high peak pressure and ethanol operation, and the abd cam design for late intake valve closure.

Reviewers felt there was good progress, especially on developing control strategies and sensors, and in moving to engine tests. However, one reviewer felt accomplishments on a project that should be stopped are not meaningful.

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

Reviewers observed there was collaboration with Ricardo, University of Michigan, and Bosch. It was suggested that collaboration be made with an outside organization to confirm performance. A criticism was raised that this project benefits OEMs on current vehicles.

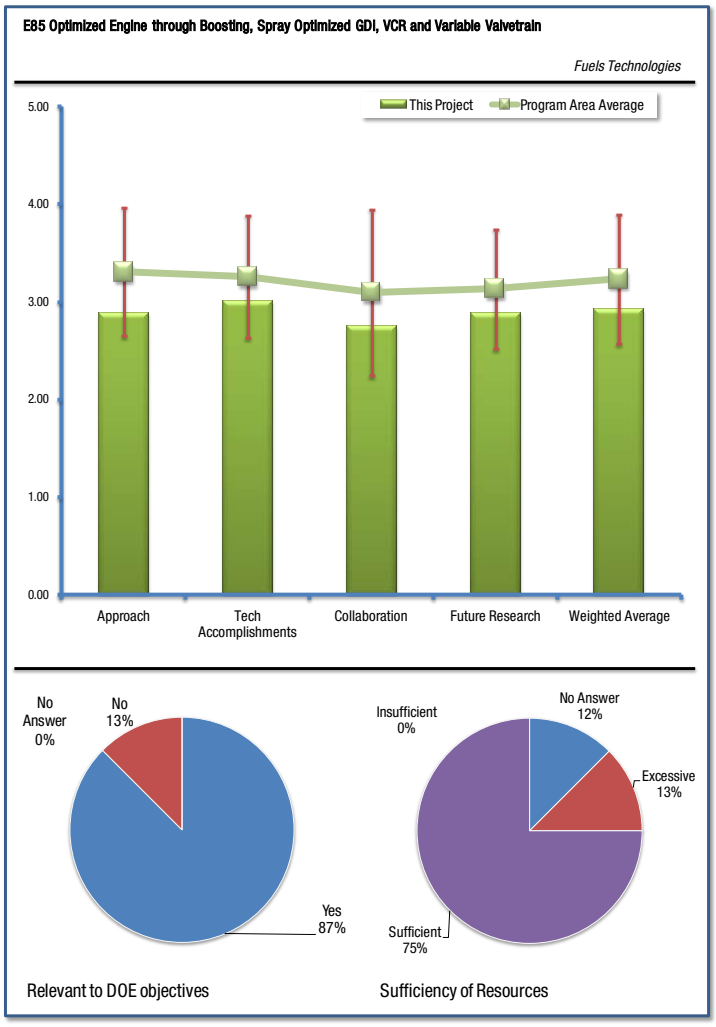
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

Reviewers found that attempting to meet SULEV targets will further increase the attractiveness of this approach, and make FFVs more attractive; however, the project was criticized as being beneficial to current product. Some reviewers found that with the designs in place, the next steps seem reasonable, building on recent progress. Another found, however, that there should be no future work on this project funded by DOE.

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

Reviewers found the project was either adequately funded or over funded. Some found there was no indication that resources are not appropriate. Yet others found funds to be more than ample, perhaps a bit high, for a project with such modest objectives. Another agreed, noting no resources funded by DOE should be used for this project.

E85 Optimized Engine through Boosting, Spray Optimized GDi, VCR and Variable Valvetrain: Keith Confer (Delphi)



Reviewer Sample Size

This project had a total of 7 reviewers.

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

Reviewers found the prospect of increasing fuel efficiency for FFVs and thus the attractiveness of E85 to be consistent with the DOE objective of displacing petroleum. Overall goals, said one reviewer, are closely related to promoting advancement in engine hardware, emissions control systems and fuels technologies. Another noted that wider use of E-85 will ultimately decrease quantity of petroleum derived gasoline, assuming wider availability of E-85 vehicles and fuels. Another found this to be his favorite presentation from a company-sponsored study.

Another reviewer questioned DOE's funding of this project–it is the third of three projects on E85 in the Fuels Technologies group. This project is research and development on conventional FFVs to improve mileage and utilization of E85 fuel–a noble goal for the OEM's but not for DOE to do competitive R&D for the OEM's. This project has no relevance for DOE, but maybe one of the OEM's with their funding.

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 had mixed responses to this project. The project was found to be feasible and it attempts to better utilize the properties of E85 fuel. It was also found to be a well-planned program with detailed program goals and deliverables.

One reviewer found seeking variation of compression ratio combined with DISI in a variable valve train to be an ambitious controls and hardware challenge, with a high potential payoff. The project will use variable valve train to prevent knock on gasoline operation by decreasing effective compression ratio. It does not include high peak cylinder pressure, they noted, which could have provided more power density had it been considered.

While several said it is a good approach, with a good mix of modeling and hardware development testing, one found this project to have the wrong approach for short-term improvement of FFV's mileage using E85, and that OEMs should do this work not tax-payer funded DOE.

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

Reviewers were mixed on the approach taken in this project. Some found it to be making progress where others found it lacking. One noted that progress seems to be going well with the construction of the E85 optimized valve train, ignition, pistons, and injectors, plus preparing for dynamometer testing. But another felt a better focus is needed,

noting researchers need not to try to handle too many variables; they should focus on few and provide depth in technical conclusions.

One reviewer found the project demonstrated optimized injector spray, prepared a single cylinder test engine and performed engine and injector simulations. It also developed high pressure and temperature test chambers for injector verification. The modeling analysis suggested a 12-15% overall improvement in fuel economy. Planned engine tests will help to verify these analyses. Lastly, one reviewer felt the project should not be continued and did not find much accomplished thus far.

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

Most reviewers perceived limited collaboration. The work with Wayne State University and Delphi were mentioned, along with an unnamed OEM, but the number of collaborators was small relative to other programs. A reviewer did find collaborations to be progressing well, yet another saw no collaboration and expressed disapproval, noting this is competitive research and development for the OEMs.

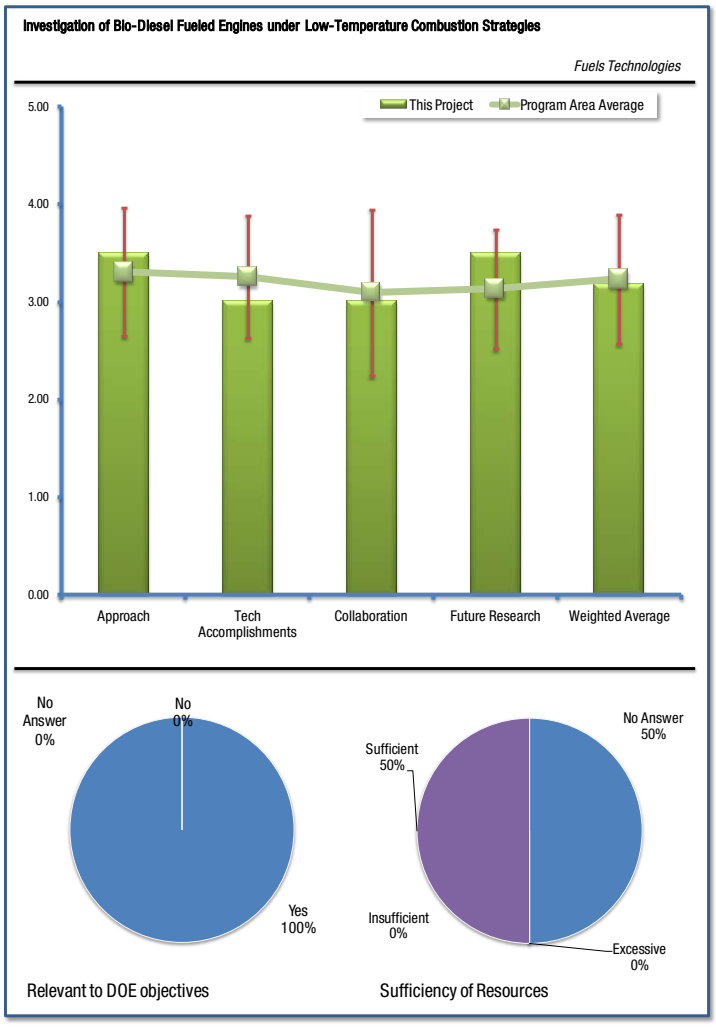
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

Reviewers held mixed assessments of the future plans for this project. One reviewer expressed hope that there are good results from the project. Another noted the project plans to verify engine hardware optimization and implement the engine in a test vehicle. Another noted the planned work seems reasonable and appropriate. The planned engine testing will be critical to verifying modeling results, another noted. Finally, one reviewer felt no future work using tax payer money should be done on this project.

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

Reviewers found funding levels either sufficient or wrongly allocated. Two reviewers noted funding level appears to be appropriate to meet the project objectives. One found assessing all fuels technologies projects difficult to evaluate. And one felt no DOE resources should be used for this work.

Investigation of Bio-Diesel Fueled Engines under Low-Temperature Combustion Strategies: Chia-Fon Lee (University of Illinois at Urbana-Champaign) - 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?

The two reviewers found that the project aims to enable and improve biodiesel combustion, which can displace petroleum directly and lower fuel demand–a primary DOE objective. It was noted this investigation is key toward understanding the effects of biodiesel and biodiesel blends on low temperature combustion.

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 found a combination of modeling, optical engine studies and firing engine studies in the project–an ambitious research plan. Also, it was found to be fundamental experimental work and modeling of the LTC combustion process.

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

A number of papers have been produced from this work and a variety of interesting results have been generated. Many of these measurements have previously been performed elsewhere, such as at Sandia, NREL and various universities, with regard to in-cylinder visualization on biodiesel combustion, spray luminosity and NOx emissions. They found it to be novel work, with good progress made in the injector studies and difficult combustion measurements.

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

The reviewers found the project had a good mix of industrial partners in the test plan.

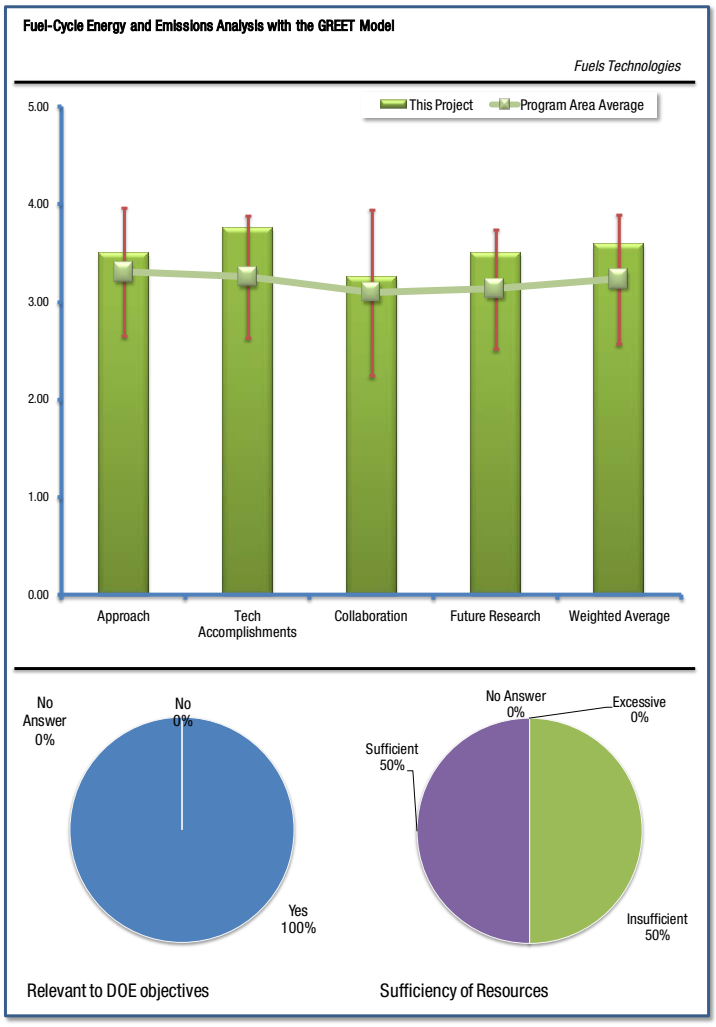
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

Reviewers found a good future work plan to further the base of understanding on biodiesel low temperature combustion.

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

Reviewers found ample funds for this work.

Fuel-Cycle Energy and Emissions Analysis with the GREET Model: Michael Wang (Argonne National Laboratory (ANL)) - 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?

Reviewers found this project positively supportive of the DOE objective of displacing petroleum–the GREET model is an outstanding analysis tool essential for evaluation of options of interest to DOE and U.S. economy. A reviewer noted, the GREET model is an internationally recognized tool for examining vehicle and fuel impacts on emissions of pollutants and greenhouse gases and on energy efficiency. It permits making informed choices between fuel and vehicle technology paths.

A reviewer cited the Energy Independence and Security Act (EISA) of 2007 which included a directive for life cycle analysis for transportation fuels. The GREET model is the most widely accepted, peer reviewed model for determining the green house gas impact of individual fuel production processes and logistics schemes. This is the only publicly available tool for industry to evaluate their individual production process. Continued support and update of the GREET model are critical to the advancing environmental goals established by the EISA, the reviewer stated. Another agreed, noting the GREET model is the standard for LCA and emissions evaluation.

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 unanimously found the project to be wholly worthwhile. The GREET model approach is time proven and internationally recognized. Reviewers noted the GREET model continues to serve to provide guidance on technology pathways that can be adopted to solve fuel supply and utilization challenges. A reviewer commended Argonne for being open for discussion of and education on the various intricacies of the model.

Reviewers continued, noting the approach of adding more pathways and features to the GREET model has been thoughtful and organized. A concern was raised about criteria pollutant estimates since these are regional effects and not global (e.g. greenhouse gas emissions). But this issue is minor compared to the overwhelming utility of GREET.

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

Reviewers found the effort has a long history of productive research. Various WTW and vehicle technology implementations have been analyzed and numerous publications produced. One reviewer remarked that the continuous improvement of the GREET model is critical for industry utilization of this evaluation tool. The dynamic structure of the model shows not only its relevance but also continues to add to its already established credibility. Maintaining the relevance and credibility must be a priority. The technical support of the model given by M. Wang

and M. Wu by participating in the life cycle analysis discussions and policy development taking place in the US and abroad is greatly needed and strongly encouraged to continue. One reviewer continued, noting as experts in this field of growing popularity, the experience and knowledge of the scientists supporting the GREET model must continue. Another reviewer noted that progress on the GREET model has been steady.

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

All reviewers found extensive collaboration on an international basis among many government agencies and industries. A broad network of users and partners exist. GREET is used by students and professionals and has penetrated broadly in the technical community. Its further development benefits from its broad use and acceptance.

A reviewer also said, as the GREET model is developed and maintained by ANL, the partnerships and collaboration for this project come into play with the implementation and usage of the model. Good collaboration exists with industry and government. The recognition of new technologies and continued expansion of the model's ability are to be commended and strongly encouraged to continue. Lastly, one reviewer personally had worked with Mr. Wang and the GREET model on alternative fuel studies and found him to work well with others offering input to the model.

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 found the future research plans to be valuable. They noted consideration of advanced vehicles and XTL pathways is essential to help judge the many pathways available to try to solve the fuel supply and greenhouse gas emissions problems.

A reviewer further noted the additional fuel production pathways added both recently and future production pathways identified are both relevant and necessary. They encouraged the evaluation and inclusion of developing technologies and improvements for existing petroleum and non petroleum processes.

One reviewer noted the future work for GREET has often been driven by the demand of the government looking toward policy decisions and impacts. This reviewer suspects with RFS#2 with LCA included, this will become more intense.

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

Reviewers generally found that this project is in need of additional funds, for its importance. There are many uncertainties remaining on LCA, it was said. Certainly more support would benefit this important program, and it would be a wise investment.

Continued support and updates of the GREET model are critical to the advancing environmental goals established by the EISA 2007, according to another reviewer. This model will continue to undergo in-depth evaluation and scrutiny; the robustness of the model will continue to be challenged and additional resources may be needed to maintain the respect and transparency already inherent in this modeling tool.

One reviewer found resources seem to be adequate.