1. HYBRID AND VEHICLE SYSTEMS TECHNOLOGIES

Vehicle and system research provides an overarching vehicle systems perspective to the technology research and development (R&D) activities of the U.S. Department of Energy's (DOE's) vehicle research programs, and identifies major opportunities for improving vehicle efficiencies. The effort evaluates and validates the integration of technologies, provides component and vehicle benchmarking, develops and validates heavy hybrid propulsion technologies, and develops technologies to reduce the parasitic losses from heavy vehicle systems. Analytic and empirical tools are used to model and simulate potential vehicle systems, validate component performance in a systems context, benchmark emerging technology, and validate computer models. Extensive collaboration with the technology development activities is required for success. The results of hybrid and vehicle systems activities are used to estimate the national benefits and impacts of DOE-sponsored technology development, and successfully transfer developed technology to industry.

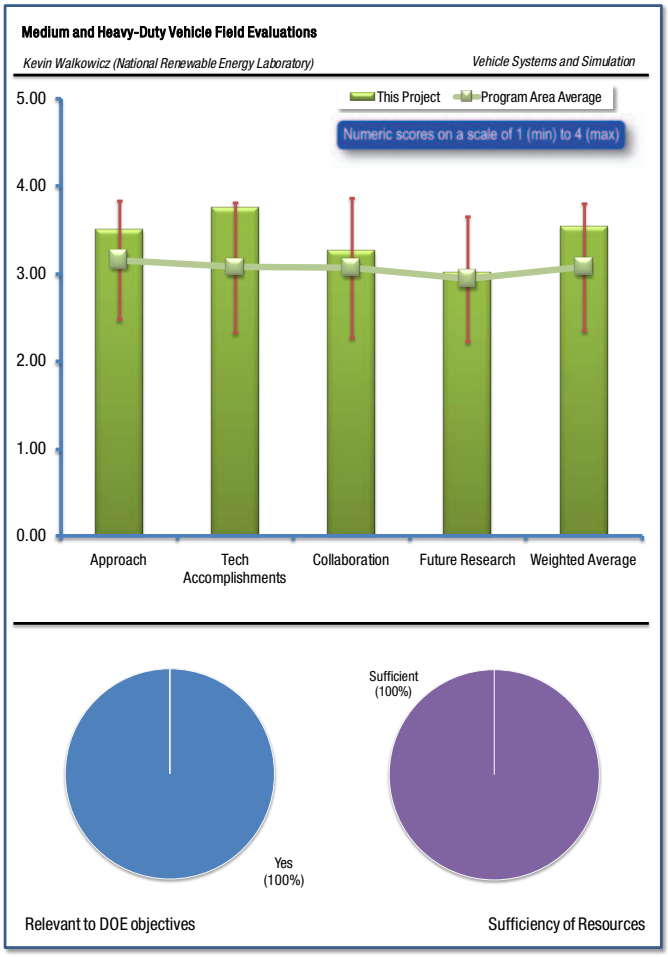
In this merit review activity, each reviewer was asked to respond to a series of questions, involving multiple-choice responses, expository responses where text comments were requested, and numeric score responses *(on a scale of 1 to 4)*. In the pages that follow, the reviewer responses to each question 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
Medium and Heavy-Duty Vehicle Field Evaluations	Kevin Walkowicz (National Renewable Energy Laboratory)	1-3	3.50	3.75	3.25	3.00	3.53
Truck Duty Cycle and Performance Data Collection and Analysis Program	Helmut E. Knee (Oak Ridge National Laboratory)	1-6	3.00	3.00	3.40	2.40	2.98
Boundary Layer Lubrication Mechanisms	George Fenske (Argonne National Laboratory)	1-10	3.67	2.67	3.00	3.33	3.04
DOE/DOD Parasitic Energy Loss Collaboration	George Fenske (Argonne National Laboratory)	1-12	3.00	3.00	3.25	2.75	3.00
DOE's Effort to Reduce Truck Aerodynamic Drag through Joint Experiments and Computations	Kambiz Salari (Lawrence Livermore National Laboratory)	1-15	3.67	4.00	3.33	3.67	3.79
Emissions and Fuel Consumption Test Results from a Plug-In Hybrid Electric School Bus	Jeffrey Gonder (National Renewable Energy Laboratory)	1-18	3.33	3.67	3.33	3.67	3.54
PHEV Engine and Aftertreatment Model Development	Stuart Daw (Oak Ridge National Laboratory)	1-20	3.50	3.25	3.00	3.25	3.28
Autonomie Plug & Play Software Architecture	Aymeric Rousseau (Argonne National Laboratory)	1-22	3.33	3.50	3.50	3.33	3.44
Tradeoff Between Powertrain Complexity and Fuel Efficiency	Aymeric Rousseau (Argonne National Laboratory)	1-25	2.75	3.00	2.13	2.50	2.77
Impact of Driving Behavior on PHEV Fuel Consumption for Different Powertrain, Component Sizes and Control	Aymeric Rousseau (Argonne National Laboratory)	1-28	2.88	3.00	2.88	2.88	2.94
Tradeoff between Fuel Consumption and Emissions for PHEV's	Neeraj Shidore (Argonne National Laboratory)	1-30	3.33	3.00	3.17	2.83	3.08
PHEV Engine Control and Energy Management Strategy	Paul Chambon (Oak Ridge National Laboratory)	1-32	2.17	1.67	2.17	2.00	1.90
Energy Management Strategies for Fast Battery Temperature Rise and Engine Efficiency Improvement at Very Cold Conditions	Neeraj Shidore (Argonne National Laboratory)	1-34	3.40	2.40	2.60	3.00	2.75

Presentation Title	Principal Investigator and Organization	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
AVTA – PHEV Demonstrations and Testing	James Francfort (Idaho National Laboratory)	1-36	3.50	3.75	3.75	3.25	3.63
Advanced Technology Vehicle Benchmark and Assessment	Henning Lohse-Busch (Argonne National Laboratory)	1-38	3.33	3.67	3.33	3.50	3.52
Light-Duty Lean GDI Vehicle Technology Benchmark	Robert Wagner (Oak Ridge National Laboratory)	1-41	3.00	3.00	2.75	2.75	2.94
Plug-in Hybrid (PHEV) Vehicle Technology Advancement and Demonstration Activity	Greg Cesiel (General Motors)	1-43	3.33	3.00	2.67	3.00	3.04
Ford Plug-In Project: Bringing PHEVs to Market	Greg Fenette (Ford Motor Company)	1-45	3.67	3.33	3.67	2.67	3.38
Heavy Duty Vehicle Modeling and Simulation	Aymeric Rousseau (Argonne National Laboratory)	1-47	4.00	3.50	4.00	3.50	3.69
AVTA HEV, NEV, BEV and HICEV Demonstrations and Testing	James Francfort (Idaho National Laboratory)	1-49	3.67	3.67	3.67	3.33	3.63
CoolCab Thermal Load Reduction Project: CoolCalc HVAC Tool Development	John Rugh (National Renewable Energy Laboratory)	1-51	3.00	3.17	3.17	2.83	3.08
Plug IN Hybrid Vehicle Bus	Jan Friesner (Navistar International Corp.)	1-54	2.75	2.50	2.25	2.25	2.50
Standards for PHEV/EV Communications Protocol	Michael Kinter-Meyer (Pacific Northwest National Laboratory)	1-56	2.50	2.75	3.25	3.33	2.82
Integration Technology for PHEV-Grid-Connectivity, with Support for SAE Electrical Standards	Theodore Bohn (Argonne National Laboratory)	1-58	3.00	3.00	3.67	3.00	3.08
SAE Standards Development (J1711 PHEV, J2841 Utility Factor Definition, J1715 HEV Terminology)	Michael Duoba (Argonne National Laboratory)	1-60	3.60	3.60	4.00	3.00	3.58
J1634 SAE BEV Test Procedures	Michael Duoba (Argonne National Laboratory)	1-62	3.25	3.00	3.25	3.25	3.13
Integrated Vehicle Thermal Management	Matthew Thornton (National Renewable Energy Laboratory)	1-64	2.50	3.00	2.50	2.00	2.69
Geographic Information System for Visualization of PHEV Fleet Data	*Sera White (Idaho National Laboratory)*	*1-66*	*3.33*	*3.33*	*3.33*	*3.67*	*3.38*
Advanced Powertrain Research Facility Vehicle Test Cell Thermal Upgrade	*Glenn Keller (Argonne National Laboratory)*	*1-68*	*3.50*	*3.00*	*3.50*	*3.50*	*3.25*
AVTA Vehicle Component Cost Model	*Scott Ellsworth (Ricardo)*	*1-69*	*3.00*	*2.33*	*2.00*	*2.67*	*2.50*
OVERALL AVERAGE			**3.15**	**3.07**	**3.07**	**2.94**	**3.08**

NOTE: Italics denote poster presentations.

Medium and Heavy-Duty Vehicle Field Evaluations: Kevin Walkowicz (National Renewable Energy Laboratory)



Reviewer Sample Size

This project had a total of 4 reviewers.

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

The first reviewer felt that field evaluations are essential to verify system performance (efficiency). Some systems are marketed using data from "favorable" applications, therefore unbiased testing is important. Medium and heavy-duty vehicles represent an important sector. Another reviewer agreed that the data generated from this project provides real world usage data that will help the OEMs and Tier 1 suppliers understand the benefit and potential penalties (e.g. negative fuel economy improvement on FedEx trucks) of the new technology. The development and deployment of new systems and technology requires a good understanding of how the technology performs in the field under real world usage conditions.

Another reviewer stated that independent test and evaluation of new technologies that improve fuel economy and emissions provides critical information to those involved in the spec'ing and purchase of commercial vehicles. Fleet and operations in the commercial vehicle segment are rapid adopters of technology that can improve their bottom line, so the data being generated by NREL can be very effective to moving the industry to cleaner, more fuel efficient vehicles expeditiously. It was also added that improved efficiency in medium- and heavy-duty trucks offers the potential for significant petroleum displacement. Medium-duty vehicles, which have largely been untapped, especially offer potential advances through the use of hybrid and plug-in hybrid technologies. It was broadly agreed that data obtained from duty cycles provide invaluable assistance to OEMs and system suppliers in determining required sizing of components and expected duty cycle. Availability of such detailed data facilitates accelerates the development and industrialization of these technologies.

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?

It was felt that the technical approach was solid. Reviewers stated that data being collected is what fleets need to make informed decisions on new technologies. The team also provided detailed, quantified feedback to OEMs and system suppliers concerning the effectiveness of their systems, allowing for continuous improvement of products. Also within the scope of the program are efforts to quantify and define duty cycles and provide OEMs and system suppliers with information critical to the design and development process (example: defining school bus duty cycles to assist Navistar in development of next generation PHEV school buses). One of the questions is how new technologies are selected for evaluation. Recognizing that resources might be limited, a process for selecting the most appropriate technologies for evaluation could improve the overall process. (It is recognized that such a selection process might be in place, but was not mentioned in the slides or the verbal presentation). Another reviewer also noted that the team captures, processes, and presents the data to DOE and customers and where appropriate provides baseline comparisons. The inclusion of performance, maintenance and operational costs presents the complete picture for analysis and subsequent presentation of the technology payback. The approach also captures any issues associated with deployment of the technology.

It was also stated that after noting program cost, it was important to log as much data as possible, since it will have value in understanding transient operation. This data could be used for system optimization but presumably OEM confidentiality is a concern in pursuing / showcasing this.

Some final points that were made by a reviewer state that this project has a conventional approach for field and dyno testing of vehicular applications and follows a relatively time honored process of testing/evaluation (field and dyno), analysis, and publication. It appears to be evaluating a relatively broad slice of the medium and heavy duty vehicular market (medium-duty, heavy-duty day cabs, and school buses) with HEV, PHEV, and advanced battery technologies. It appears gradients have not been extensively studied; this is area for future work. Additionally, it is not clear if fully wireless data logging systems have been established. If not, this may be an area for future exploration. A more mechanized means (such as a database website) of publications may be in order when distributing testing/project results. Additionally, there has been a significant amount of information collected over the last decade on drive cycles and advanced technologies for medium and heavy duty vehicles. There should be a way to compile all this information into very user friendly formats for easy comparison, cross referencing, and tagging by interested parties.

QUESTION 3: CHARACTERIZE YOUR UNDERSTANDING OF THE TECHNICAL ACCOMPLISHMENTS AND PROGRESS TOWARD OVERALL PROJECT AND DOE GOALS.

Overall, it was felt by the reviewers that since data is available, there seem to be no major technical barriers. It was also agreed that the project appears to be making progress to schedule and it is good to see the extension of the UPS project beyond year 1 into years 2 and 3, which will add valuable durability data.

Another reviewer noted that the fuel economy improvements in real world use compare favorably with chassis testing. The FedEx gHEV conversion to diesel equivalent FE is a useful factor. However a negative fuel economy improvement figure is always hard to accept, however low. The comparison of KI with real world field data and chassis dyno derived data is a good correlation tool that will help the vehicle / system developers optimize the system for greatest benefit.

The third reviewer felt that a substantial amount of detailed data has been collected to date, analyzed and disseminated to concerned parties. Activity has been completed or is progressing on five key vehicle and drivetrain technologies, with detailed results concerning fuel economy, maintenance costs, and driving patterns. Correlation testing is now being done with most test fleets that include: (1) measure data in vehicle; (2) Chassis dyno test; and (3) Ongoing fleet test. Predicted results from chassis dyno test have fairly consistently fallen within the actual range of results from fleet testing, providing increasing confidence in chassis dyno results.

Other reviewers felt that funding for FY09 was relatively modest at $300K and that results based on this funding level are reasonable. Several of the projects are new starts for FY10 while a couple of follow-ons to previous year's activities and they are now looking beyond fuel economy to durability and costs. Results clearly show that fuel economy improvements are often very cycle dependent. One concern is whether information gathered on maintenance costs is broken down to show costs specific to technologies under evaluation. In one case, operating cost of test unit was higher than baseline vehicle, but it was reported that maintenance issues were unrelated to hybrid components under evaluation.

QUESTION 4: WHAT IS YOUR ASSESSMENT OF THE LEVEL OF COLLABORATION AND COORDINATION WITH OTHER INSTITUTIONS?

The first reviewer stated that there is clearly a strong liaison with industry partners, and that collaboration with fleets and OEMs appears to be strong and diverse. Participants appear fully engaged and their comments reflect collaboration with other agencies/departments in DOE but none were highlighted. It was also noted that there is significant involvement with fleets, OEMs and key suppliers, which is critical to the success of the overall program. NREL seems to be working close with first adopters of the new technology being evaluated and cooperation in setting up the test programs is excellent. It also appears that NREL is doing a good job of sharing collected data with other National Labs, OEMs and industry organizations.

Some reviewers were concerned with how fleets can easily access this information in order to assist in purchasing decisions. There may be a straightforward mechanism in place for fleets to obtain results, but it was not specifically discussed during the presentation. An opportunity for improvement is for NREL to collaborate with ORNL on their data collection activities. Historically, NREL has evaluated vehicles with new technologies, while ORNL has focused on capturing duty cycle information for conventional

vehicles. There appears to be some overlap and some opportunity for synergies between the two efforts. The final reviewer stated that the project coordinates/collaborates with a number of industrial entities including OEMs and fleets. It is not clear, however, how well this project collaborates with other DOE laboratories, including INL and ORNL which have extensive vehicular (light and heavy-duty) testing experience. Improved collaboration with these labs could identify areas to fine-tune the NREL medium and heavy-duty vehicular field evaluations, reduce redundancies, and improve cost-effectiveness across the labs. Specifically, INL could provide insights how to improve wireless data collection and industry/fleet cost share, while ORNL could provide insights on emissions testing components for heavy vehicles. Additionally, it is not clearly stated what the level of industrial cost share is for each 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 first reviewer noted that there will need to be an effort with large fleets to sift through data & remove erroneous points. An overall error/confidence analysis is needed because some differences between baseline vehicles and hybrids are small. The second felt that the class 8 truck project with Coke vs. conventional project should yield some very interesting results. The hybrid trucks are believed to be 2010 emissions compliant with SCR. The amount of SCR consumed during the study period should also be measured and factored into the FE, maintenance and performance costs.

Another reviewer stated that an outline exists for expected 2011 activity, although it appears that some of the details concerning what fleets, OEMs and technologies to focus on are not yet available. A certain amount of the future activity is “carryover”, a continuation of the data collection efforts initiated previously. Time limits may have prevented a more detailed discussion of future plans, but more information about some of the newer activities, such as the formation of the “voluntary user groups” to assemble and analyze vocational data would have been beneficial. The final reviewer felt that the proposed future research activities are reasonable but would benefit from additional clarity and prioritization. In addition, as alluded to above, more transparency and emphasis should be placed on industrial cost share.

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

The reviewers felt that funding appears sufficient, the project scope appears containable, and this activity seems well staffed to implement the identified current and future plans. It is also encouraging that spending for FY2010 was increased significantly over FY2009, and over the 10 year spending ranges. This may reflect more technologies and more vehicle types available for analysis, and a heightened interest in quantifying the benefits of alternative technology vehicles. As the number of fielded vehicles under evaluation grows, it will be interesting to see how NREL handles the projected heavier workload. The final reviewer added that overall, this is a solid task with compelling merits. There clearly is a need to field test prototype and early versions for advanced medium-duty and specialized heavy-duty vehicles. There is respectable industry collaboration and the appearance of some cost sharing typically via in-kind contributions. The task should explore expanding its scope to the next level in working very closely with fleets (including small guys) to help them overcome business barriers to widespread commercialization. It would be useful to see compelling information showing this that this task's activities are instrumental to fleets broadly adopting advanced technologies.

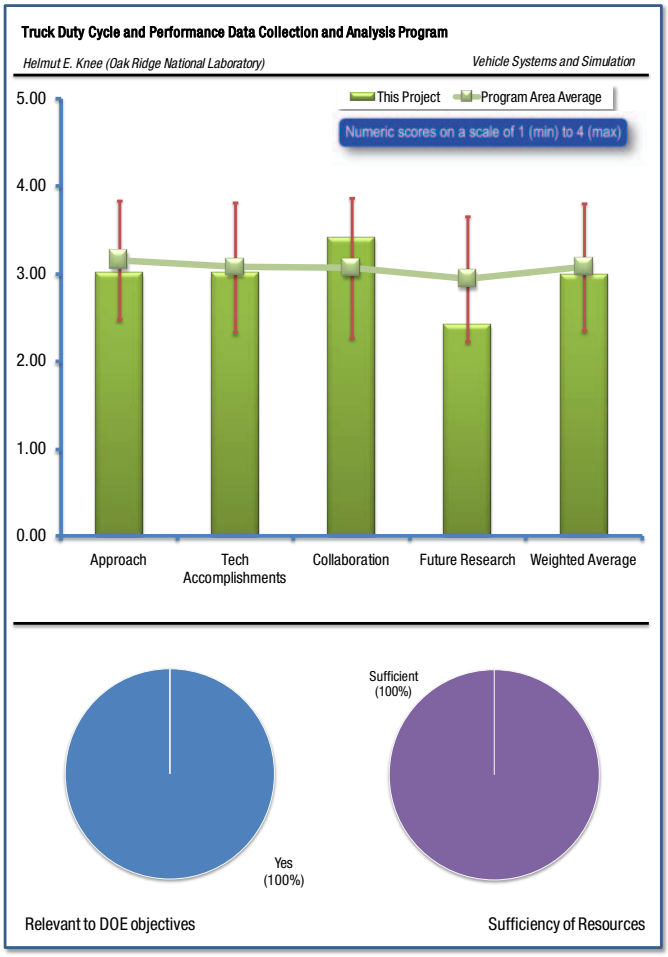
Truck Duty Cycle and Performance Data Collection and Analysis Program: Helmut E. Knee (Oak Ridge National Laboratory)

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?

The first commenter stated that understanding the details of vehicle activity is important for optimized design and for real-world evaluation. This program will also have benefits to a wider transportation community. It was also noted that the capturing real world data for traditional ICE powertrains will help the OEMs and Tier 1 suppliers optimize their system designs for maximum benefit and reduction in hydrocarbon usage. The use of the data to fine tune modeling tools such as Autonomie is an excellent way of sharing knowledge and improving system designs. Another reviewer agreed that the ORNL data collection effort facilitates modeling and simulation of commercial vehicles that allows up front analysis of new technologies offering improved fuel economy and reduced emissions. This data is expensive and time consuming to collect for private companies, so availability of this data will be very helpful to OEMs and component suppliers. This duty cycle data will help OEMs and suppliers accelerate the development or refinement of new technologies that directly address fuel usage. In addition, a better understanding of duty cycles by OEMs and fleets may allow modification of component spec'ing practices or driver techniques.



Overall, it was agreed that the first step in reducing petroleum displacement would seem to be understanding where and how the petroleum is used. This project supports that goal and is a necessary step. It was also stated that ORNL's activities are relevant in that considerable petroleum savings are achievable through efficiency advances in medium and heavy duty vehicles and development of rich data pools provide value across multiple areas. A number of areas are being addressed including quantification of efficiency benefits from advanced wide-based tires and brakes, development of medium and heavy vehicle duty cycles, and real world heavy-vehicle operational data for incorporation into PSAT/Autonomie.

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?

The first reviewer stated that both high density data from a few vehicles and low density data from many vehicles are contemplated. This is a good balance and a wide variety of vehicles is important. It was also felt that the range and types of data collected are impressive, and offer a rich source of information for OEMs and suppliers of many vehicle component types. It was also favorably noted that rather than focusing on a relatively few vehicles, with multiple channels of data collected, ORNL is engaging in a program to collect data on a much larger group of vehicles, but with an order of magnitude fewer channels. This should help improve the statistical significance of the data and also likely allow for data collection in a broader range of operating conditions. In general this is seen as a positive step, particularly in view of the fact that much of the data collected to date (though not all) has been from the general vicinity of Knoxville. This is certainly understandable from a logistics and cost perspective, but the new approach will presumably gather data literally from all parts of the country.

The reviewers noted that an opportunity for improvement is to make this data readily available to OEMs, suppliers, and fleet users. Currently, it is likely that the existence of such comprehensive data is largely unknown throughout the industry. A question arises concerning how candidate vehicle duty cycles are selected and prioritized. Some of the applications to be studied (wreckers, for example) are niche, and less "mainstream" than other applications. It would be interesting to understand the basis for vehicle/application selection. Another concern that was noted is that it is not clear that grade measurement is completely reliable and it needs evaluation of accuracy (perhaps using engine load data). The effect of auxiliary loads also needs to be understood. Another reviewer felt that it was disappointing to hear that there are only a limited number of units under test–six platforms, three transit bus and three Class 7 regional haul. However, it was good to see the proposed increase in number of units under test with the LSDC project. Working with voluntary fleets does mean that having to go with what can be obtained, which does result in some unusual vocations such as wreckers. This is a very small portion of the national Class 8 fleet and it is not clear if a more appropriate vocation could have been chosen (e.g. refuse).

Another commenter felt that there is a definite a lack of available data regarding how vehicles are used (and thus the project addresses a real need). Much of the current work is useful, but a broader view is strongly needed. Researchers have done a good job in trying to get a broad range of applications, but there might be some further gains from a more rigorous design of experiments approach to selection of applications/regions/vehicles. However, it is recognized that a major obstacle is probably one that is non-technical; many companies might be unwilling to share data about their fleet operations. The final reviewer felt that the approach of this task suffers from an apparent lack of overall focus and unification. Many of the activities seem to be relatively dispersed and disconnected, almost unrelated. The approach does cover areas of value though with the potential for broad real world application, a notable example being single wide-based tires. Appropriate, real world performance measures are being collected as part of the project.

QUESTION 3: CHARACTERIZE YOUR UNDERSTANDING OF THE TECHNICAL ACCOMPLISHMENTS AND PROGRESS TOWARD OVERALL PROJECT AND DOE GOALS.

Reviewers agreed that a substantial database has already been assembled and that data points are at a high frequency, both of which are very useful. Reviewers also felt that given relatively modest funding levels, this project has collected a significant amount of real world data, established a number of partnerships, generated several reports, and provided significant support to PSAT/Autonomie development through heavy truck duty cycle data. ORNL has had success in addressing the first two identified barriers including "Obtaining voluntary fleets for data collection" and "Obtaining inter-agency cooperation for leveraged funding." The third barrier identified by ORNL, "Getting data into industry," has not been clearly addressed and it is difficult to assess whether progress has really been made.

A reviewer stated that understanding auxiliary loads for some vehicle types and data on advanced vehicle types (such as hybrids) are required. While this is slated for the future, it could have been obtained already. The limited scope of the data set was also a concern and it was felt that it is unfortunate that the data captured is limited to the Knoxville, Tennessee area, although this area does have a reasonable spread of terrain types including some large hills, with grade data coming from GPS. There was no accessory load data recorded so the source of energy usage was not identified. Perhaps this should be included as part of the LSDC project. Milestone progress appears to be to planned with the MTDC phase 1 complete in September and Phase 2 starting in July. Another commenter stated that he would like to see a list of applications and routes for which data exists (apparently 500 GB of data exists). It was reported, for example, that substantial data on Class 8 line haul and regional haul applications has been collected, but the means of accessing such information is not clear. Use of wireless data collection has allowed the accumulation of a substantial amount of data with only limited human resource intervention. This technology was clearly a program enabler. Reviewers also felt that items related to Class 8 data (confirming effectiveness of super singles) seem to be on point. More than a bullet or two discussing this, if this one of the major outcomes for this year, would have been beneficial. The class 7 data (which seemed to represent the majority of this talk) seems to be a little too narrow without much processing completed.

QUESTION 4: WHAT IS YOUR ASSESSMENT OF THE LEVEL OF COLLABORATION AND COORDINATION WITH OTHER INSTITUTIONS?

The reviewers felt that it was beneficial to be working with DOT FMCSA and supplying data to ANL with numerous fleet partners. They also felt that there were good connections with Argonne and Autonomie. Improving the modeling capability of this new tool will have a positive effect on the development of new vehicle technologies. Reviewers were also pleased to see the piggybacking of the

brake and tire investigations for FMCSA and it was thought to be a good use of funds. It was also stated that considerable success has been demonstrated in working with and obtaining cost share from DOT FMCSA and commercial fleets, and providing heavy vehicle data to ANL's PSAT/Autonomie modeling activities. Efforts are also underway to work with EPA and DOT FHWA.

Reviewers did feel that fleet choice seems a little unusual (as previously mentioned), but again with volunteers researchers must take what is available. Other reviewer felt that the program has required close cooperation with candidate fleets and securing their cooperation for instrumentation of their trucks. ORNL has apparently provided data to Argonne National Labs for development and refinement of the Autonomie modeling program. One observation is that these ORNL activities somewhat align with, if not overlap with, NREL vehicle data collection. An opportunity for improvement is for ORNL to collaborate with NREL on their data collection activities. Although NREL focuses on vehicles equipped with new technologies, it would seem that NREL/ORNL cooperation could perhaps streamline the efforts of both groups, especially given potential ORNL future work with hybrid vehicles. Another commenter felt that a good job was being done interacting with ANL and efforts extended outside DOE, namely TRB and FMCSA are very good thoughts. However, it was thought that more could be done here. Researchers from NREL and ORNL definitely need to work together. Some of the projects would seem to be related and as such they should be sharing data and analysis methods. Another area of concern is a perceived lack of coordination is with NREL for the development of heavy- and medium-duty drive cycles and vocations. NREL has done considerable work in this area and it does not appear that ORNL and NREL are sufficiently coordinating. Additionally, there may be synergy with regards to INL's light duty track and field testing activities which should be explored.

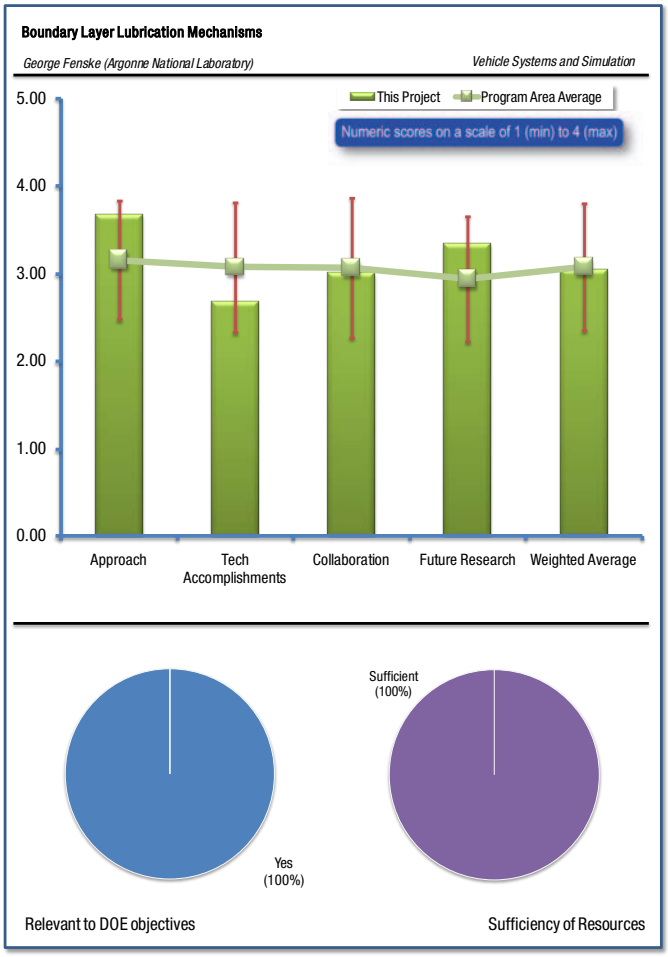
QUESTION 5: HAS THE PROJECT EFFECTIVELY PLANNED ITS FUTURE WORK IN A LOGICAL MANNER BY INCORPORATING APPROPRIATE DECISION POINTS, CONSIDERING BARRIERS TO THE REALIZATION OF THE PROPOSED TECHNOLOGY, AND, WHEN SENSIBLE, MITIGATING RISK BY PROVIDING ALTERNATE DEVELOPMENT PATHWAYS?

The first reviewer noted that hybrids will be contemplated. The acquisition of less intense data from a large fleet will be challenging. The relationship between vehicle speed-time activity and factors such as power/weight ratio should be considered. It is not clear that this level of analysis is proposed (or whether the data are going to be used by others for this purpose). Another commenter stated that the LSDC pilot project dramatically increases the number of vehicles included in the study, which is a good thing. The desire to explore HEVs and PHEVs needs to be planned carefully and aligned with NREL to prevent overlap. The third reviewer restated that the means of determining which applications to focus on for data collection should be reviewed. It appears that some of the applications being considered are very niche or low volume. Future plans to obtain data on several thousand vehicles are perceived as a positive step, and a means of obtaining statistical significance. It was reported that future activity will include data collection of hybrid vehicles. This is perhaps very appropriate, but should be undertaken with collaboration, or at least communication with NREL, who has also been deeply involved in hybrid data acquisition. Future plans should absolutely include a means of making this data, available to OEMs, suppliers, fleets, and the general public. The data can only be useful if appropriate parties know that it exists. Almost as important is to use the technical expertise of the ORNL staff to analyze and summarize this data in way that it is of the most value to users. Making this data and meaningful summaries readily available may be the most significant improvement opportunity in the program. Another commenter noted that the overall results seem in order with funds used thus far. However, looking at original scope (~$9.1M program with MTDC and LSDC phases), much of the work remains (as evidenced by the relatively small budget to date). The large scale data collection seems very appropriate as does the dual thrust–collecting some detailed data in addition to a much broader (albeit limited in depth) collection. Currently, it seems all of the class 7 data is collected in a narrow pool. The difficulties in obtaining a broad spectrum are recognized, but concerns exist about the abilities to use the data in making forecasts regarding national petroleum displacement. Also (especially lacking more large scale data), it is felt that the geographic scope of the class 7 data collection is limited. The final reviewer felt that the future work is fairly well defined and delineated, but suffers from a similar lack of overall focus and unification as current activities. This is especially evident when examining future work activities beyond FY11 which include a plethora of proposed activities including data collection for aerodynamics, parasitic energy losses, rolling resistance measures, and emissions. This project would benefit from a hard examination of which areas really should be addressed from a cost-benefit standpoint. ORNL also should explore means to publish results efficiently for a broad pool of users.

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

The first commenter noted that funding is reasonable to high for the program. Hopefully the researchers will add considerable value through careful analysis of the data, and not just deal with the cycles for the funding. But the resources are sufficient to meet the objectives. Another reviewer stated that transitioning from a $35k cost per platform to a budget target of a $100k per vehicle is a huge leap forward; however, it is unclear if the quality and quantity of data can be recorded with the new budget target. Another reviewer felt that resources appear to be adequate, although the process has previously been somewhat limited by equipment. (Approximately 60 channels of data have been collected, with a per-unit-cost of $35,000). The upcoming approach with limited data collection expands the number of vehicles for which data can be acquired to several thousand. Although the number of data channels is significantly reduced, this approach will be more manageable, and will enable data collection from a much broader cross section of vehicles and applications. The third commenter stated that he agreed with the large scale approach, but think that the sub-100 per vehicle may be optimistic. However, the overall budget seems appropriate. He did not see much summary data from data collection to data. In addition to collecting the data, post-processing and summarizing the data needs to be a part of this. The project does seem to include some research in those directions, but the reviewer interpreted the lack of much summary data to date as a sign that these resources are limited. (He recognizes that “post” processing means it is done after the data is collected, he just did not get a sense that there were enough efforts dedicated here.) Some efforts will be needed to try to “reconcile” the large scale data with the more detailed collection but not much was seen dedicated to this. The final reviewer felt that, overall, this is a solid task with a number of strong attributes including significant non-DOE cost share from several commercial and governmental entities, a broad-based demand for medium- and heavy- duty data for a variety of applications, and extensive intergovernmental collaboration. The project is starting to wring more efficiency out of the system through such means as wireless data downloads and ongoing exploration of new partnerships to assist and leverage funding. This task should continue to be funded at current levels with the option of expanded funding if a more unified focus be identified, continued strong levels of cost sharing are demonstrated, and the project successfully incorporates broad data collection efficiencies across vocations.

Boundary Layer Lubrication Mechanisms: George Fenske (Argonne National Laboratory)



Reviewer Sample Size

This project had a total of 3 reviewers.

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

Overall, the reviewers felt that a better understanding of boundary layer structure and properties can suggest better lubricant formulations and provide guidance for material selection, resulting in better efficiency through reduced friction and reduced component mass. It was noted that, if the presenter's information is correct, a 50% reduction in friction could result in 5-15% energy savings which would yield petroleum displacement.

Another commenter felt that the program to investigate "boundary layer lubrication mechanisms" directly supports the overall mission of the DOE to strengthen America's energy security future. The work performed directly contributes to the DOE's overall objective of petroleum displacement by investigating alternatives for fuels and lubricants that create energy savings. New efficiencies and energy gains may be achieved through the understanding and improved performance of lubricants (and the behavior of their boundary layers). Gaining an understanding of friction reduction in vehicle lubricated components and systems is directly related to improving VSS efficiencies. Lubricants can increase power density which results in size reduction and fuel savings. Lubricants can reduce and/or prevent high friction and high power density failures which can also lead to improved petroleum displacement efforts. This project achieves new information to advance sustainable friction reduction and increase power density in VSS, both critical to the DOE's end goal of displacing petroleum.

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

Reviewers were impressed in particular with the use of the Advanced Photon Source, which provides opportunities to examine the boundary layer composition and structure to a degree not possible with other techniques. It was also noted that the technical barriers are clear and well defined. The methods presented show an appropriate focus on means to attack the problem. The overall objective of the work seeks to achieve sustainable friction reduction and increase power density in lubricated components and vehicle systems. The team uses a clear basic energy science and characterization approach at appropriate and critical boundary interfaces with respect to the appropriate applied R & D problem. The team takes a chemical and materials approach to the basic research, including investigating scuffing, surface coating, film formation, and mechanical and frictional properties. All tests lead clearly to support macroscopic property analysis and improved performance variables based on understanding of boundary lubrication mechanisms. Modeling results are not shown in the presentation; however, the team does an excellent job at detailed characterization and analysis including anisotropic behaviors in tribology, which is often overlooked. Also, the project is nicely coordinated with its commercial partner to demonstrate gain. Overall, it was noted that the approach includes materials and lubricating film studies, new diagnostic techniques, modeling, validation and a reasonable set of collaborations; all of which support a good, well balanced approach.

QUESTION 3: CHARACTERIZE YOUR UNDERSTANDING OF THE TECHNICAL ACCOMPLISHMENTS AND PROGRESS TOWARD OVERALL PROJECT AND DOE GOALS.

It was felt by the reviewers that the project has made significant progress towards its objective to achieve sustainable friction reduction and increase power density in lubricated components and vehicle systems. The project has successfully developed and validated a scuffing model for metallic materials following extensive microstructural characterization, and this model is now being used by industrial partners as a design guide. The project team also evaluated the experimental (and modeling of) scuffing resistance of several materials pairs with high scuffing resistance demonstrated the use of multiple x-ray based surface analytical techniques for in-situ characterization of tribochemical boundary films. This is advanced characterization and should be commended.

However, reviewers did note that while scientific and technical accomplishments were evident, no specific numerical goals for this project were stated, but only a general objective to reduce friction, improve wear-ability, etc. Hence, no metric was provided to evaluate the project's accomplishments in terms of objective measurable milestones and goals. DOE has specific targets for Vehicle Technologies. The PI should quantify his goals and measurable contributions to meeting those targets. It was also felt that while the result showing that friction increases with the crystallinity of the film is intriguing, no information is given on the composition of the films and such information would be necessary to formulate better lubricants. It was also stated that the objectives could be more clearly defined and shown as "met" if more description of the link to new/better/more efficient high power density material were made. However the project is strong in content and demonstrates a continued need to understand better tribochemical boundary film structures, properties and performance for improved vehicle efficiency. Especially noteworthy is the paper produced by O. Ajayi [Ajayi O. O., Erck R. A., Lorenzo-Martin C., and Fenske G. R., "Frictional Anisotropy under Boundary Lubrication: Effect of Surface Texture" Wear 267 (2009), 1214-1219].

QUESTION 4: WHAT IS YOUR ASSESSMENT OF THE LEVEL OF COLLABORATION AND COORDINATION WITH OTHER INSTITUTIONS?

Reviewers agreed that the collaboration on this project includes Caterpillar Inc., Eaton Corporation, Castrol-BP and Oakland University. This collaboration is commendable and appears coordinated, although the presentation does not demonstrate full details on management and coordination of the collaborators. Four relevant collaborations were identified, but only the general area of research was stated. More information on the nature, level of the collaborations, contributions and roles of each party would be useful.

It was noted that team lead George Fenske demonstrates strong leadership and management skills. It would be nice to see another university partner on the team. Some of the links to barriers such as reliability and safety are presented but not discussed. These results may be better coordinated with 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?

Overall, reviewers felt that the project appears well on the way to successful completion. They also agreed that the proposed research includes continued work on advanced characterization (FIB, TEM, GIXS at APS) etc. and continued measurement of nano-mechanical and frictional properties of other structurally different boundary films. Logically, the next year's work will (and should) concentrate as much as possible on the structure-property relationships for boundary layer films. Next characterization steps will include new investigations on contact temperatures and correlations to functional performance. These new results will surely be important findings for the commercial partners. It was also felt that the proposed future research is a continuation of the present direction of work. Targets and goals should be established to measure progress and accomplishments.

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

It was felt that all of the resources for the project appear modest to adequate for the FY 2009 and FY2010 time frame. Much has been accomplished technically on a relatively small amount of funding. Across the full life of the project (beginning in 2004), $2.5 M has been absorbed by the project.

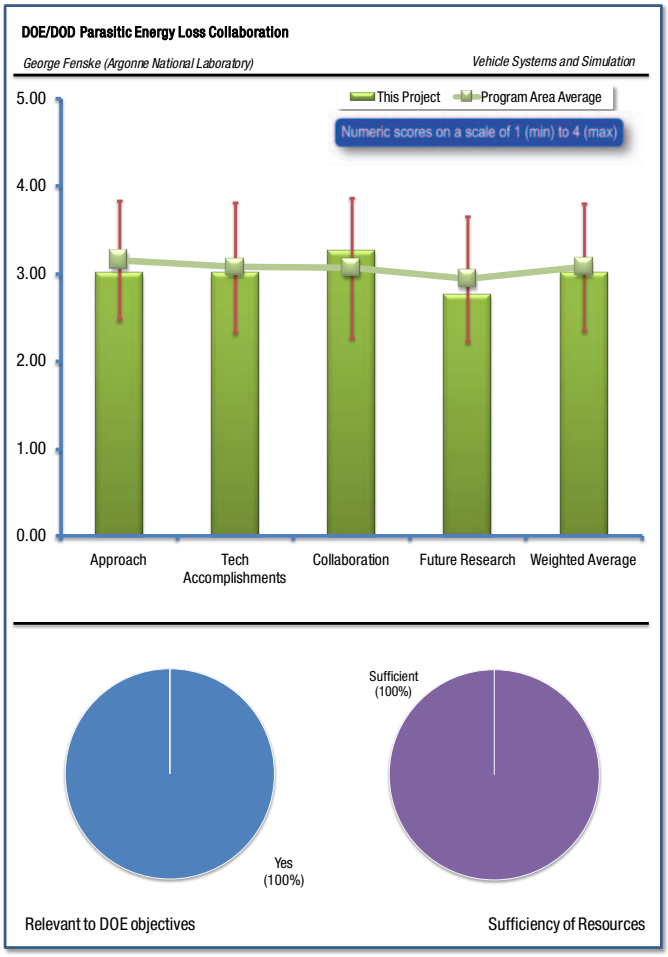
DOE/DOD Parasitic Energy Loss Collaboration: George Fenske (Argonne National Laboratory)

Reviewer Sample Size

This project had a total of 4 reviewers.

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

The reviewers felt that lubrication/tribology studies have the potential to offer small percent reductions in petroleum use, but over a very large fleet. The program is also cognizant of emissions concerns (e.g., sulfur contamination of aftertreatment). This project is particularly relevant to increased use of EGR and impact of lubrication. Another comment made by a reviewer stated that improvements in lubrication and friction reduction have commercial implications beyond just reduction in fuel usage, such as increased durability and component life, reduced warranty costs, etc. Another commenter stated that improving engine and vehicle efficiency obviously will reduce consumption of petroleum and reduce emissions. This program will evaluate opportunities to reduce friction and parasitic losses in the engine and other drivetrain components. The program scope looks at surface finish, coatings, lubricants and lubricant additives. This activity takes on new importance as drivetrain components are downsized to increase power density, which results in a more severe duty cycle at the surface of rolling or sliding parts. This trend potentially increases parasitic losses, but also adversely affects surface life, which may indirectly affect efficiency.



It was also felt that because engine and drivetrain friction account for 10-15% of fuel consumption in commercial vehicles, reduction of friction can lead to significant energy savings across all vehicle classes and vocations (commercial and military). Friction reduction could also be especially attractive for military applications given the high cost of deploying fuel and potential for increasing survivability in a lubricant-starved environment.

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 that the project scope of work appears to be logically laid out with bench testing, analysis and engine validation (with vehicle OEMs, TARDEC, and lubricant suppliers). It was also felt that the technical approach is sound. The use of component or specimen level lab testing under very controlled operating parameters permits evaluation of multiple approaches to reduced parasitic losses (and also improved surface durability). Once a down-select is made of the most promising concepts, testing at the system level can be conducted.

It was observed by the reviewers that the differences between military and civilian vehicles are recognized. However, the discussion was very broad rather than technical but identifying pathways for success (as presented) is a required first step. It was noted that work is being leveraged, which is good, but makes the exact approach hard to define.

The second reviewer also felt that there do not appear to be alternative fuels and lubricity studies (fuel dilution etc) included in the project. The main focus is friction reduction and survivability after loss of lubricant. It was also noted that this is not a new project, but

an extension of a long running tribological activity at ANL with a new facet of military applications. The approach presented is conventional and consistent with past activities. The first two project objectives: 1) identify critical barriers ... and part of 2) "understand fundamental tribological solutions" should already largely be known and compiled. It appears the emphasis of this task should clearly be on objective 3) develop and implement advanced tribological solutions. It was also felt by the third reviewer that missing from the work plan is a discussion of evaluating friction reduction strategies for other drivetrain components, such as transmission and axle gearing. During Q & A, it was implied that such work will be conducted, but does not seem to be part of the current or future work plan. The final reviewer concluded that the approach is focused on the barriers. One thing that would be beneficial is greater clarity on the balance of R&D focus, whether on commercial or military applications.

QUESTION 3: CHARACTERIZE YOUR UNDERSTANDING OF THE TECHNICAL ACCOMPLISHMENTS AND PROGRESS TOWARD OVERALL PROJECT AND DOE GOALS.

It was noted by the reviewers that the project started in FY2010, so progress and results are limited. Thus far, technical collaborations have been set up, partners identified, and teams formed. Preliminary work has focused on reducing the incidence of scuffing and evaluating the benefits of various lubricant additives. Given the short time since project startup, a fair amount of testing has been completed. It was agreed by another commenter that the ANL work with DOD for military applications is in relatively early stages. Some accomplishments have been presented including team building, impact of additives on scuffing in mil-spec mineral oil, identification of two commercial additives that extend scuffing behavior in fully lubricated and lubricant starved conditions. As always, given the evolutionary nature of tribology advancements, it would be of great value to elucidate (based on past experience) a potentially successful pathway to full implementation of advanced tribological systems in military or commercial vehicles.

Other reviewers felt that, so far, progress had been made on testing of oil additives and impact on scuffing loads. The presented data showed an interesting plot of friction loss after oil is drained. Further investigations to understand this phenomenon should be conducted. It was also felt that data is available for scuffing tests, but it is not clear how the additives are selected. It was also felt that the surface examination is forensic more than predictive. It was also mentioned that the study should include impact of additives in used oil vs. fresh.

QUESTION 4: WHAT IS YOUR ASSESSMENT OF THE LEVEL OF COLLABORATION AND COORDINATION WITH OTHER INSTITUTIONS?

It was noted by several reviewers that the collaboration includes DOD, an OEM, a component supplier and representatives from the lubricant industry which covers the complete spectrum well. While the OEM was not named, the Tier 1 supplier, Mahle for pistons, bearings, and liners is a good choice. However, there was no mention of lubricant supplier(s). One reviewer also said that there were several questions and comments from the audience that indicated similar projects had been conducted at other educational institutes and would be worthy of further investigation (Ohio State driveline project as an example)

The program includes DOD/TARDEC as partners, but efforts are being made to address the needs of both military and commercial vehicles. It appears that collaboration with OEMs and lubricant companies is active, although they were not identified. A question that the team should ask (or perhaps already has): how much of this testing could be taken on by the lubricant suppliers themselves? This could be a means of accelerating progress. A major engine supplier has also not been identified as participating. This would seem to be an opportunity for improvement. Engine companies could supplement the testing program with their own evaluations. It was also noted that, although much of the early focus on the program is on engines, other drivetrain systems should not be ignored. In particular, there is a potential collaboration opportunity with transmission and axle manufacturers on efficiency improvements. Overall, it was felt by reviewers that this tribological task is showing improved collaboration and cost sharing which is much to the PI's credit. However, currently only one DOD ground vehicle OEM and one engine component manufacturer (Mahle) have been identified. It would be beneficial to increase this to at least two in each of these areas to stimulate competition and increase the odds of successful implementation of attractive tribological solutions.

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 that future plans outline a continuation of the evaluation of lubricant additives, surface finish, and surface coatings. Based on a response to a question during the Q & A, some work will be done on super-finishing (chemical honing). Another commenter also stated that the results of bench testing will be used to update analytical models that predict parasitic losses in engines and drivetrain components. Following bench testing, complete system tests will be conducted on engines and other drivetrain components. Lacking in the future plans are any specific mention of evaluating transmission and drive axle parasitic losses. This is an area of significance that should be added to the forward plans.

Reviewers did mention that this is a new project, so future work is contained within scope. The reviewer did recommend, though, that this project be aligned with other ANL projects. It was noted that the project is only focused on friction/surface contact, not on viscosity and loss from churning. Perhaps this could be included as part of any further study.

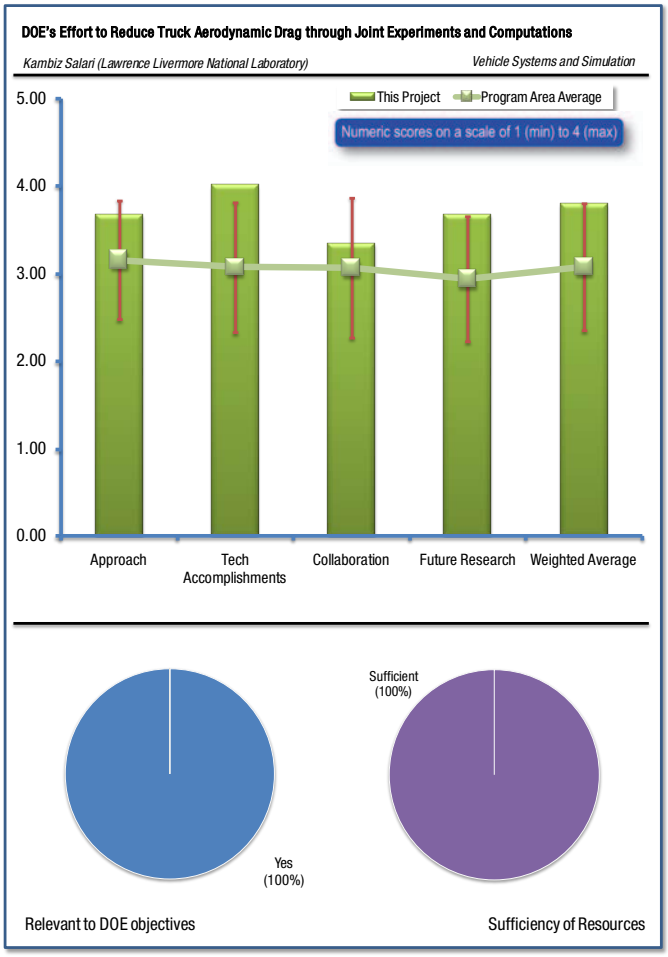
The final reviewer felt that the proposed future work is reasonable, if uninspiring. This project would benefit from some new approaches to advancing tribological solutions whether it be through different relationships with industrial suppliers, aggressive competitive practices, or identification of revolutionary means (in combination with industry) to better validate tribological solutions in real world applications in shorter timeframes. For example, this could potentially be done by even further implementing ANL's advanced diagnostic techniques to improve understanding and confidence in wear and durability characteristics of advanced tribological solutions.

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

Reviewers agreed that overall, this is a good task with solid justification for continuation. Successful reduction of friction without compromising durability is very beneficial for military and commercial applications. In past years the task has demonstrated a number of technical accomplishments and is continuing to progress. However, an area of concern is that the task has been very evolutionary and ongoing for many years, leading to few commercial successes. Perhaps additional efforts should be made to further involve commercial users earlier in the process and demonstrate stronger interest and commitment to commercialization through additional private sector cost sharing.

While the reviewers found the budget and resources apparently sufficient for the project, they would like to see more contribution from the lubricant industry, as ultimately they are the organizations that will be commercializing and retailing the products developed from this study. It was also felt that the extent of resources contributed by the OEM and lubricant suppliers was not discussed in any detail. This appears to be an area, however, that could supplement the testing efforts of ANL, and perhaps accelerate overall progress. Drawing a major engine company, as well as transmission and axle suppliers into the program can also provide additional expertise and resource.

DOE's Effort to Reduce Truck Aerodynamic Drag through Joint Experiments and Computations: Kambiz Salari (Lawrence Livermore National Laboratory)



Reviewer Sample Size

This project had a total of 3 reviewers.

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

The reviewers felt that this area is critical for reduction of diesel use by Class 8 over-the-road trucks in freeway use because realistic reductions of 10% are possible. Above 50 mph, aerodynamic losses account for more than half of the required horsepower for Class 8 tractor and trailers. A significant improvement in aerodynamics of the vehicle can dramatically increase the fuel efficiency of Class 8 vehicles, which account for approximately 12% of the petroleum consumed in the U.S. The output of these efforts could have a dramatic effect on reduction of fuel consumption in the Class 8 market. It was also stated by another reviewer that the primary goal of this project is to improve fuel economy of class 8 tractor-trailers through the use of aerodynamic drag reduction while satisfying regulation and industry operational constraints. Aerodynamic drag reduction is a very attractive area to achieve petroleum displacement due to the feasibility of significant fuel economy improvements (upwards of 10-15%), large and growing number of heavy vehicles on the nation's highways, and the fact that relatively little in-use aerodynamic advancements have been made with trailers which account for one third of the drag of a tractor-trailer combination.

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 agreed that the overall task is well designed, logical, and follows a conventional progression from virtual testing, full-scale testing (NASA Ames Research Center), through on-road testing and evaluation of the most promising aerodynamic device combinations. Subsequently, the approach is to apply the best device combinations for implementation to the team consisting of tractor, trailer and third party device manufacturers; a wide-based single tire manufacturer; and large fleet. In the past year, the focus has been on full-scale wind tunnel testing at NASA Ames. This is a welcome advance from the more strictly modeling-based activities of the past and is an important step towards broad commercialization. This approach is helping to overcome the remaining barriers, winnowing down and fine tuning the most promising technologies, and putting these technologies near the cusp of successful commercialization.

It was also noted that investigators are linking tunnel testing and track testing, and that there is added potential if whole vehicle modeling were incorporated to understand the aerodynamic contribution during the track testing with higher fidelity. With track testing cooling differences may play a role as well as ground effects. It will be important to compare C_dA values from track testing and express those differences as a percentage, rather than using track testing to verify the differences in fuel consumption on the track (sensitivity issues). Reviewers also said that actual wind tunnel testing was preceded by "virtual testing" to sort out relative benefits of each device or configuration to be evaluated. This work utilized the largest wind tunnel facility in the world with minimal wind blocking effects, which affords an excellent opportunity to obtain clean, accurate data. From the presentation, it is obvious there was significant attention to detail in order to achieve the best possible accuracy. Another reviewer also mentioned that, although attempts

were made to reduce the effects of a "non-moving ground plane" and "non-rotating tires," the suggestion was made to repeat testing of underbody components at a track facility, to improve confidence of results.

QUESTION 3: CHARACTERIZE YOUR UNDERSTANDING OF THE TECHNICAL ACCOMPLISHMENTS AND PROGRESS TOWARD OVERALL PROJECT AND DOE GOALS.

Reviewers were very impressed that full-scale wind tunnel testing involving a number of devices has been completed. More evidence of this came from other evaluators, who mentioned that LLNL and Navistar have successfully tested 23 aerodynamic devices using different combinations of two tractors and three trailers in a full scale wind tunnel. Base flaps, underbody and gap devices, and wide-based single tires have been tested and their range of fuel economy improvements quantified. Fuel economy improvements of 5-10% for base flaps, 5-8% for underbody devices, 1-2% for gap devices, and 4-5% for single wide-based tires has been demonstrated. Only a minimum amount of error has been introduced into wind tunnel calculations and which can likely be resolved upon completion of track and field testing. It was also noted that given the industry's focus on efficiency and cost control, these results can help to drive spec'ing and purchasing decisions that will translate into fuel economy benefits. This data should allow relatively quick adoption of the most promising devices.

Reviewers did note that the presentation could have included more detailed results from the testing, although this may have been restricted in order to preserve the confidentiality of the industry partners. Reviewers also mentioned that the presentation would have been improved by at least listing the 23 different tests, and at least providing a rank order of the measured reduction in aerodynamic drag. Data presented in this format would also be particularly meaningful for the fleets and owners that will have to make purchasing decisions on these devices.

QUESTION 4: WHAT IS YOUR ASSESSMENT OF THE LEVEL OF COLLABORATION AND COORDINATION WITH OTHER INSTITUTIONS?

Reviewers felt that this task is working closely with a number of industrial entities including aerodynamic device manufacturers, a tractor and trailer OEM, a fleet, tire manufacturer, and government entities. Good relationships seem to exist and the process is moving forward.

However, a reviewer did mention that there was no mention of collaboration with other National Labs. For example, it is anticipated that improvement results could be integrated into Argonne's Autonomie software for future analysis work. Again, it is unclear if this would have been restricted due to industry partner confidentiality concerns.

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?

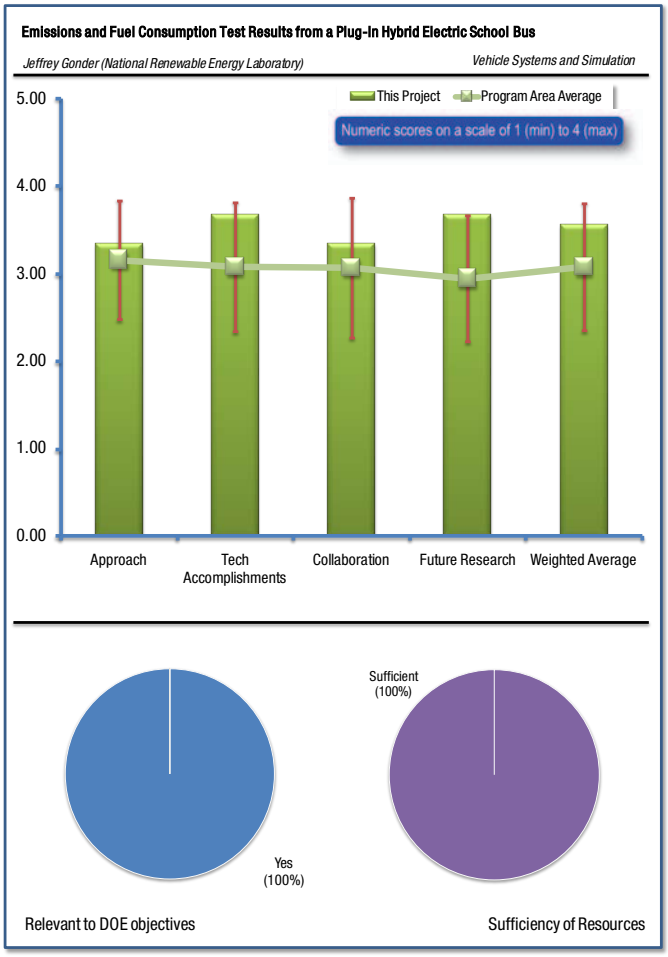
Reviewers agreed that the proposed future research and activities appear to be right on the mark with emphasis on bringing existing aerodynamic devices to commercialization. This is a sea change from some past years which emphasized extensive modeling with less focus on overcoming remaining barriers to commercialization. This is very refreshing. The proposed future research builds on past and current progress and is targeting remaining barriers. It also includes other work to improve aerodynamics of tankers which, while small in number, travel an enormous amount of miles each year. Additionally, the project will look at potential quantum leaps in aerodynamic improvements through integrated tractor/trailers.

Another commenter mentioned that future plans are in place for (1) evaluation of devices for tanker trailers; (2) optimization of various aerodynamic reduction devices; and (3) the aforementioned track testing. Additional aerodynamic devices will be evaluated as they become available. An optimized integrated tractor-trailer concept will be explored. While interesting to determine the absolute minimum aerodynamic drag of the tractor trailer combination, the "optimum" might be difficult to implement given the industry logistics of one tractor pulling a number of different trailers. Several reviewers also stated that while emphasis in the slide presentation was placed on "getting out the word" to the industry concerning benefits of these devices, it was not given much attention in the discussion of future activity. To maximize the impact of this meaningful research, efforts should be focused on how to make this information readily available to fleets and owners. Collaboration with OEMs, supplier, and key fleets is suggested in order to determine the best approaches.

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

Reviewers felt that based on the timely completion of the wind tunnel testing, it is obvious that sufficient resource was on hand to carry out the 23 tests efficiently. As noted in the previous section, it is also suggested that industry partners be brought into the process of determining how best to disseminate this information. Another commenter also stated that consideration should be given to increased funding should the task continue along its currently attractive trajectory. This would be especially true if the track and field testing proves successful and a handful of the aerodynamic devices achieve commercial success in the next year or two.

Emissions and Fuel Consumption Test Results from a Plug-In Hybrid Electric School Bus: Jeffrey Gonder (National Renewable Energy Laboratory)



Reviewer Sample Size

This project had a total of 3 reviewers.

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

The first reviewer felt that testing vehicles which displace gasoline with electricity demonstrates the commercial readiness of alternative technologies. Reviewers also felt that EV and PHEV technology will play a major role in the effort to displace petroleum. The final reviewer was supportive of this project because thousands of school buses are on the roads every day, so technology that improves fuel improve fuel economy can clearly make a meaningful reduction in petroleum usage. It was also agreed that the stop-and-go duty cycle of a school bus, and the relatively short operating interval, make this application an excellent fit for plug-in hybrids. Not only is the operating cost of the school district reduced, but the fuel usage can drop significantly, especially in larger fleets.

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 that the technical approach was sound and that dynamometer testing of specific duty cycles compared the energy consumption of a plug-in hybrid school bus against a diesel baseline. Another reviewer felt that the choice of drive cycles on fuel economy assessment is very important and that the project addresses that issue by looking at different drive cycles and evaluating the impact. However, more work could be conducted to assess how well the cycles studied represented the entire population of vehicles. Another commenter felt that because three standard duty cycles were selected and the hybrid was evaluated in charge sustaining, charge depleting, and "transitional mode," the effect of distance on the net fuel economy was easily discernable from the testing. It was also felt that the test program provided a clean, repeatable, controlled, thorough comparison of the PHEV vs. the standard diesel unit.

Other reviewers felt that this seemed like a good approach overall to testing; however, it did not seem that enough emphasis was put on understanding how electricity contributed to overall energy use. They were also surprised that total energy use seemed higher in the PHEV, and this did not seem to be adequately investigated. It was also felt that it is worth investigating how the usage patterns of the vehicle would change daily energy use, and not just cycle energy use because it is one thing to look at average daily travel, and another to look at the distribution and speed of these different cycles.

It was also noted by a reviewer that the baseline bus was somewhat different than the hybrid. Notably, it was a different OEM (Bluebird vs. Navistar), and a different engine (7.2L Cat vs. 6.4L Navistar Maxxforce) which somewhat affects the comparison. It was noted in the presentation that the smaller engine in and of itself was responsible for a portion of the improvement, so the improvements noted cannot be totally attributed to the hybrid feature. (Some may argue that the hybrid drivetrain is an enabler for smaller engines, since the hybrid can provide torque assist to the vehicle during situations requiring higher torque and power). It would have been interesting, and perhaps a bit cleaner to use the same OEM, and the same engine in both cases.

QUESTION 3: CHARACTERIZE YOUR UNDERSTANDING OF THE TECHNICAL ACCOMPLISHMENTS AND PROGRESS TOWARD OVERALL PROJECT AND DOE GOALS.

Overall, the reviewers felt that this seemed to meet testing goals well. As described above, it would be helpful to perform more analysis, but the data appears to be sound. The reviewers also felt that the results and analysis were very complete and insightful. In addition to providing the test results, this program took several "cuts" at the data to better understand trends, including effect of route distance, charge sustaining vs. charge depleting, and the "net energy" usage (diesel plus electric power).

QUESTION 4: WHAT IS YOUR ASSESSMENT OF THE LEVEL OF COLLABORATION AND COORDINATION WITH OTHER INSTITUTIONS?

The reviewers felt that collaboration was sufficient for this project and including interface with Navistar, Enova, and several school districts. Another reviewer noted that the project has shown collaboration with both OEMs and end users. However, it would have been useful to discuss the actual data received in more detail. Because of the novelty of the technology, connecting the different players is critical to understand all ramifications of the technical choices made.

The final reviewer mentioned that in the supplemental slides, it was implied that this program team will assist other NREL groups if/when they perform a field evaluation of a PHEV school bus. Navistar is already working on a second generation PHEV for school buses and it is anticipated that the team will provide assistance and insight to Navistar in this second generation development.

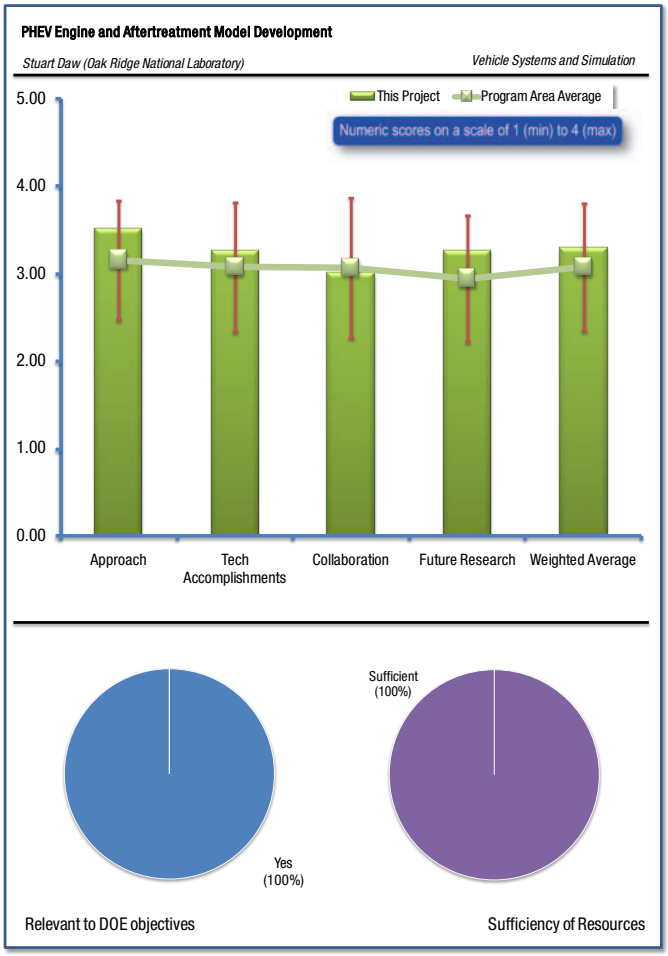
QUESTION 5: HAS THE PROJECT EFFECTIVELY PLANNED ITS FUTURE WORK IN A LOGICAL MANNER BY INCORPORATING APPROPRIATE DECISION POINTS, CONSIDERING BARRIERS TO THE REALIZATION OF THE PROPOSED TECHNOLOGY, AND, WHEN SENSIBLE, MITIGATING RISK BY PROVIDING ALTERNATE DEVELOPMENT PATHWAYS?

The first reviewer stated that the work seems to be on a good trajectory but he would like to see more focus on understanding the why instead of just the what. However, it seems like an excellent starting point. Another reviewer noted that the project is officially complete, although a back up slide itemized some proposed future activity, interfacing with other groups within NREL, and potentially assisting Navistar in their second generation PHEV development. The same reviewer felt that if a similar project is conducted for next-generation PHEV buses, it would be interesting to conduct the testing with a baseline vehicle from the same OEM and with the same engine size. This will provide the cleanest comparison.

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

All reviewers felt that resources were apparently sufficient, as the project has been successfully completed, including not only the data collection, but a meaningful evaluation and presentation of the data.

PHEV Engine and Aftertreatment Model Development: Stuart Daw (Oak Ridge National Laboratory)



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 felt that this project advances the PHEV agenda and analyzes certain parameters pertinent to the fuel use benefits of these systems. They also mentioned that knowledge of engine performance through modeling and trade studies is important for optimizing engine operation and fuel economy.

The final reviewer noted that HEVs and PHEVs offer significant opportunities for petroleum displacement, but potentially pose emissions challenges as a result of multiple engine start and stop cycles. ORNL is working to better understand and quantify the trade-offs between efficiency and emissions for gasoline and diesel hybrid vehicles using different engine and emission control strategies. In order to further their viability and increase their petroleum displacement potential, it is important to accurately assess and identify the most appropriate balance across these areas. This is the crux of ORNL's PHEV engine and aftertreatment model development efforts.

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?

The first reviewer felt that the models should provide for good use in the private marketplace. The second agreed that the objectives are clearly stated with a specific quantifiable list of tasks and that all of the technical barriers are being addressed. New work largely entails fine tuning models and running a lengthy list of possible scenarios.

The final reviewer felt that there has been a noticeable improvement in the approach of this task over the last year. Previously, the task had a scope that was much too broad and was distinctly lacking in focus and priorities. This has been improved in the later part of 2009 and early 2010, to where the effort seems much more manageable and defined. It is evident that the crux currently is on stoichiometric and lean diesel and gasoline HEVs and PHEVs with different strategies and aftertreatment technologies. This is a good approach and it is recommended to continue along this path until resolution is achieved in these areas. The task still has a somewhat broad approach, hinting at exploration of unconventional/bio fuels and exhaust heat recovery systems. It was recommended to keep these efforts to a minimum at this point. The approach could also benefit from a more clear explanation of how the modeling activities and processes are conducted.

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

It was felt by the first reviewer that the PI lists a good number of accomplishments and much past work has been done developing HEV models and performing associated analyses. PHEV engines and HEV engines are mostly the same and the primary goals appear to have now been largely accomplished. He also felt that a list of future milestones and dates would be helpful for evaluating the progress of this project.

Another commenter pointed out that the technical accomplishments over the last year seem to be solid including 1) transient engine simulation methodology, 2) LNT model for lean HEVs and PHEVs, 3) simulations of stoichiometric versus lean HEVs and PHEVs with lean NOx and PM controls, and 4) transfer of TWC model from PSAT to AUTONOMIE, and initiation of other characterization studies. Overall, the reviewers felt that this is a respectable list of accomplishments over the last year based on existing funding levels.

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

One reviewer felt that the task has good coordination and collaboration mechanisms in place via Advanced Combustion MOU, Advanced Combustion and Emission Control (ACED) tech team, Diesel Cross Cut Team, CLEERS collaboration crosscut team and VSATT.

Other reviewers were unsure of what collaborators were contributing vs. what the core team was providing. They also felt that, while a significant number of parties were identified as collaborators through membership in relevant industrial groups, specifics of technical collaborations were not presented. They also pointed out that it would be helpful to explain the nature and role of each collaboration, at least in general terms.

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?

Overall, the reviewers felt that the future proposed research is reasonable and should continue to focus on stoichiometric gasoline hybrids and lean diesel and gasoline hybrids. However, it was also noted that the proposed future scope exceeds the expected budget, but no case was made for the importance and urgency of increasing the annual scope. One reviewer also commented that he would like to see the effect of different performance/towing requirements on results.

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

All reviewers felt that resources are currently sufficient; however, future increases may be required. One reviewer noted that if this task continues to generate models of high value to industry and stays more narrowly scoped and focused, consideration should be given to increased funding levels to accelerate conclusive determinations through simulation in the aforementioned key areas.

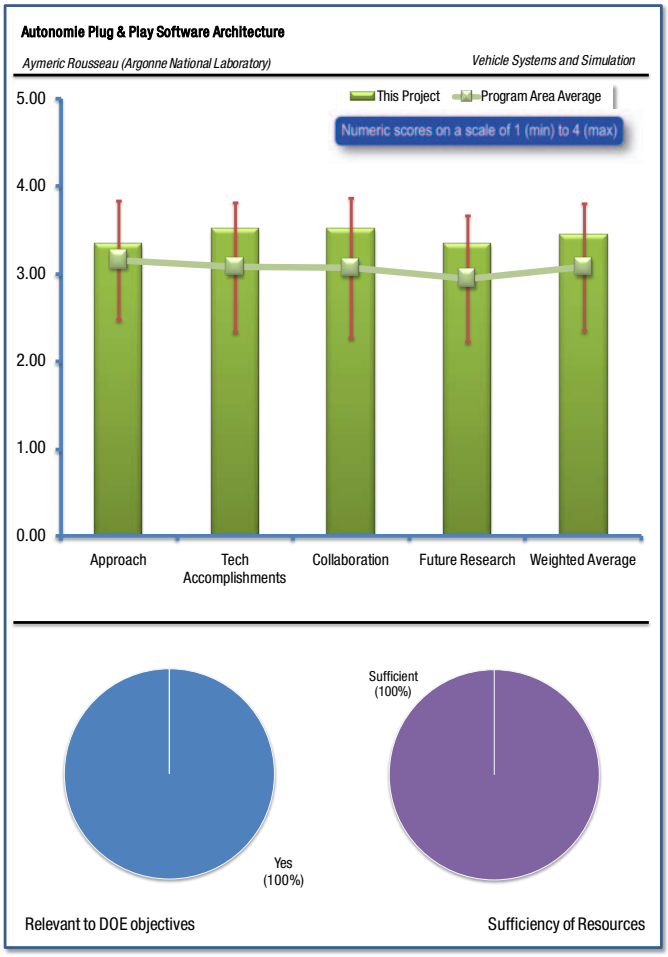
Autonomie Plug & Play Software Architecture: Aymeric Rousseau (Argonne National Laboratory)

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?

All reviewers felt that vehicle modeling and simulation are central to evaluating technologies and developing the next generation of vehicles that use much less petroleum energy. This work is useful to DOE, OEMs, component suppliers, and researchers for advancing vehicle technologies. It was also pointed out that the model-based design support allows for optimization and component selection for efficiency and the flexible modeling architecture allows wider use by more industry participants. It was also agreed that detailed modeling and early simulation can reduce costs and time to market associated with new technology development. A tool like AUTONOMIE can be used on many projects and many technologies and is not limited to only one project. Another commenter felt that speeding the time of decisions by removing redundancies in data exchange and impact analysis will accelerate the deployment of the right advanced technologies. The third reviewer agreed with the presenter's slides and that efforts to facilitate the simulation process and allow studies to be conducted faster will help to identify better components/systems and develop better control strategies. He felt that all of these do lead to petroleum displacement.



The final reviewer pointed out that Autonomie provides a single platform that can be used to perform several different levels of simulation as well as component/hardware in the loop type experiments. The use of a single platform should promote consistency among the various DOE funded projects. This could be seen already in the presentations, where Autonomie was being used in several of the projects. While the intent is for Autonomie to be used in simulation of advanced powertrains, there is nothing to prevent it from being used for conventional powertrains as well. This would also facilitate future comparisons between conventional and new powertrain configurations.

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?

The first reviewer felt that the approach looks very good, and it looks like many of the concerns that a potential user of the software might have, have been addressed. However, it was felt that the 20 minute presentation was insufficient to judge whether all of the approaches are completely effective. Reviewers are looking forward to using the software when it is released in August, and will then be able to provide more valuable feedback that would benefit future development of the tool. The second reviewer feels that this combines the best from Mathworks, Gamma Technologies, LMS and Mechanical simulation in a time efficient and effective single package. Simulink has become the de facto modeling and simulation tool that almost every engineer has access to and with AUTONOMIE all phases of the development and validation processes are tied together in an enterprise wide approach. Another commenter stated that they are open source and working with established software vendors and GM: this takes the work from what would have been a national lab science project to the realm of impactful real results.

One reviewer fears that since it builds around a legacy model, links with components, controllers and simulations of the components, it may prove useful to an entity which is designing or assembling a product, but if corporate models/software are included, it will be limited to that user because of IP issues. He was also concerned that its role in verification of emissions or efficiency is not clear and believes that substantial human intervention will still be needed, rather than just "plug and play."

Another reviewer has some reservations about a tool that claims to be everything to everyone, which may not be completely possible, and feels that perhaps some clear statement of scope would be worthwhile. However, the efforts to pull in other models (e.g. AMESim, CarSim, GTPower) seem to be well placed. Perhaps some additional electrical/electromechanical simulation packages should also be included. (AMESim has this capability, but does not seem to be a common industry tool in electrical/electromechanical modeling. In fairness, Simulink itself is probably a fairly common tool.) Another commenter did point out that the approach and work is focused on development of Autonomie of course, but is not so specifically focused on vehicle technical barriers (so not a criticism of the work).

QUESTION 3: CHARACTERIZE YOUR UNDERSTANDING OF THE TECHNICAL ACCOMPLISHMENTS AND PROGRESS TOWARD OVERALL PROJECT AND DOE GOALS.

The first commenter noted that it appears that the timeline is being adhered to. It was originally given to understand that the software would be released in June, but it appears that the official release has been pushed back to August. However, extensive use of the software for various MIL and CIL studies looks promising. A commenter noted that development has been published and the model has been built (90% complete program), but it would be good to see concrete examples of the simulation compared with realistic data. For it to be successful, each component manufacturer will need to provide a sufficiently accurate model. Another reviewer felt that the co-simulation combined with legacy code and processes results in a powerful, simple, technical solution that is totally customizable, allowing a single tool through the entire development process.

One reviewer stated that their progress seems very good and, as the project is nearly complete, this can be extended to say that overall program seems to have gone very well. Their proven ability to integrate with several commercial software packages is a very good effort. However, some metrics that tied back to original objectives would have been useful. More specifically, the goal was to allow researchers to quickly simulate various powertrains. Reduce cost and time to production by minimizing hardware iterations through Math-Based environment. So, either a summary of "stock" configurations that are available in the software should be provided, or if it is completely free form, perhaps some indication should be given of "typical" time to construct models, as experienced by partners at OEM, would be useful to assess progress towards this goal. Making allowances for previous models and including diverse tools are key to the final software system being widely useful. The flexibility designed into the system seems to work. (Not all software that claims to be able to do these sorts of customizations actually works in practice). It was also noted that the project timeline of three years is long but they have accomplished quite a lot. This reviewer would like to see more vision for the future on next steps, additional modules to hook to, etc.

QUESTION 4: WHAT IS YOUR ASSESSMENT OF THE LEVEL OF COLLABORATION AND COORDINATION WITH OTHER INSTITUTIONS?

The first reviewer stated that it appears that there has been very good collaboration between ANL, GM, and Mathworks. Previous presentations by Mathworks engineers have made extensive use of Autonomie for studies involving HEVs. This seems to indicate good cooperation but it would have been good if the other OEMs (Ford and Chrysler) were more involved. However, credit must be given to the Autonomie team - they had investigated if there was any interest at Chrysler, but efforts to get the right people involved were not at all successful. Based on the information that was presented, it cannot be determined how well the integration of the other software - CarSim and AMESim - has proceeded.

One commenter feels that they need to continue outreach to vehicle OEMs to expand general acceptance. It is not yet clear how widely it will be adopted as an industry standard and many OEMs may have created their own complete modeling systems which will compete, even though Autonomie proposes to incorporate them into a larger package.

Another reviewer felt that the major participants in the project have been able to offer experience and guidance to steer the ANL team to deliver a fully rounded and robust tool. GM, as a major OEM participant, has provided the seal of approval by committing to use

the tool for all future control development activities throughout their company. The forth reviewer pointed out that they seem to be working tightly with industry, but ideally the team would have a few OEM partners and maybe not be so tightly connected to one. However, this is probably a more minor point, in the big picture; researchers are actively working with vehicle OEMs and have tried to interface with other simulation tools. The final reviewer pointed out that there is an obvious collaboration with GM; however, this software will be open to others soon. He also noted that Autonomie development will be on-going, but the Software Architecture will likely be fixed going forward.

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?

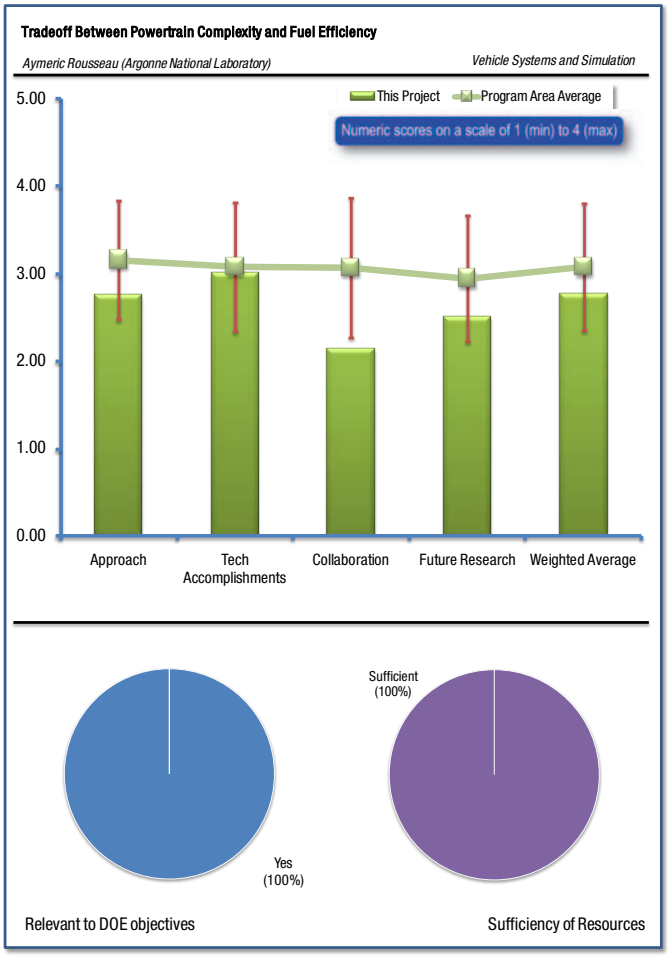
In general, the reviewers felt that overall proposed future research looks good (and perhaps a little ambitious). It was also noted that perhaps one other item that should be included is the linking of other specialty software to Autonomie. There was also a mention of the development of detailed models of batteries and other subsystems at ANL and other national labs. It is not apparent whether the validation and inclusion of these models in Autonomie is slated to happen, but that would be another potential future task. Overall, reviewers noted good forethought to how the tools would be used. Reviewers felt that the project is transitioning from development into a launch and maintenance mode. It was also felt that ANL would do well by exploring the use of Autonomie in the commercial medium and heavy duty truck arena.

One commenter did mention that the task “Define the industry standard for modeling and simulation to be adopted by the entire industry through SAE” is not under the sole control of the ANL investigators. There is a danger that if GM is the lone major first user, it may lose generic capacity.

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

The reviewers agreed that resources appear sufficient for Autonomie launch and maintenance activity because the project is nearly complete and seems to have met all goals. However, they did note that it was hard to evaluate.

Tradeoff Between Powertrain Complexity and Fuel Efficiency: Aymeric Rousseau (Argonne National Laboratory)



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 felt that since complex powertrains are continuously being studied and proposed, the study of the benefit of the added complexity is important to justify the usefulness of the technology. Another noted that making significant gains in fuel economy will require the use of hybrid vehicle technology. This project is looking at different hybrid (electric) vehicle configurations to determine the best return on investment. It offers another perspective on the various hybrid configurations that are being considered (besides the OEM viewpoint).

It was also noted that helping industry partners to understand potential benefits of more complicated systems will reduce overall design time and help industry to select optimal price/performance tradeoff. Designing the best system (that consumers will buy) will increase petroleum displacement. Overall, it was agreed that this knowledge helps in the selection and matching of technologies to their intended use for lowest cost.

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?

The first reviewer felt that in general the approach is valid. While the stated objective of the project is to compare different multi-mode hybrids, the exclusion of other types of hybrids does not appear to support the primary objective of petroleum displacement. Several of the European OEMs are heading towards other hybrid configurations, many of which represent a very viable transition from conventional automatics, and these hybrids are very likely to be marketed in the U.S. Also, the supervisory control for these hybrid configurations will be considerably simpler than those for the multi-mode hybrids. The choice of ratios in the multi-mode hybrids itself could constitute a separate project whose outcome would depend on the vehicle, prime mover, etc. Using the 'default' ratios for these transmissions may mask the true benefits of these multi-mode hybrids.

On a different note, the format of the review (20 + 10) does not allow a thorough understanding of the modeling approach, which is needed to provide meaningful feedback. In the absence of any other reports describing the project, a few more backup slides describing the approach in more detail may be warranted. For instance, it is unclear how the mechanical efficiency of the transmission is evaluated in the models. More information on some of these aspects would be very helpful. It was agreed by another reviewer that they used a fairly standard approach, but also required attention to detail. It would also be difficult to model the secondary issues such as clutch losses, gear losses, etc.

The third commenter noted that this was an interesting and useful program. Ultimately the component sizes and ranges (i.e. constant power ratio of electric machines) have an impact on coverage of transmission and overall results. However, a very clear definition of assumptions regarding performance conditions that govern initial component sizing and assumptions regarding component characteristics is needed to allow industry to properly interpret results. Without this, it is still a nice effort, but there are too many

unknowns to make much sense out of the results. Lacking this up-front structure/organization, the project reduces to coding different architectures in PSAT/Autonomie (which is useful, but probably not a task for more than $500k).

It was also felt by another reviewer that this work forms a good basis for specific component sizing and fuel consumption assessment, but only for the power split class of hybrid powertrains. Please consider defining a sort of an "ideal hybrid" with the minimum-sized components to meet requirements, but with losses included, and an ideal simple control strategy. This idealized hybrid would perhaps never be realized, but it could serve as a benchmark realistic hybrid system to compare other possible (actual) hybrid architectures and component sizes with. This would be similar to a "Carnot efficiency" concept, but with real component sizing and losses. The current work, while perhaps relevant to some specific interests, is too specialized to be of much future general interest. The control complexities and approximations for a simulation require a lot of work, with perhaps not much return. Without any considerations for emissions, this level of control development may not be useful for evaluation of the potential. (The objective given is to size the engine to a minimum, yet get the most from the direct engine path; this may lead to engine loading issues and NOx, but this cannot be assessed.) Real component costs will be assessed by manufacturers for a particular vehicle.

One commenter did point out that there is a danger of oversimplification of models or use of insufficient Vehicle Technical Specifications which may drive erroneous conclusions. It is not a good idea to use material directly from GM/Allison hybrids presentations: at least mention the source on the slides. It was also pointed out that some of this work on transmission configuration has already been done in private industry, along with various transmission designs. One project looked at 20 different transmission configurations.

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

Overall, reviewers felt that good progress had been made so far, but there is much work to be done on the three and four mode hybrid controls before the project can be wrapped up. The main issue, pointed out by the reviewer, is whether the choice of the various supervisory control algorithms does justice to the true potential of these hybrids. It was also felt that modeling of single, 2-, 3- and 4-mode transmissions is a good accomplishment. The reviewer did not see any results (at least not for some of the more complicated transmissions), but the effort to size components and run all needed simulations is far from insignificant. There would still seem to be a lot of work to get to the final objectives. However, the original objectives were very ambitious, given the level of funding, and are as follows: "Evaluate the trade-offs between EVT system efficiency and EVT mechanical loss based on multi-mode powertrain complexity. Select the most promising configuration to support future DOE fuel consumption studies."

Another felt that the objective statement was probably a little too broad; progress is on track with scope that the budget would seem to represent. Some efforts are needed to clearly spell out what this scope really is. It was stated that this was the first time that 3 and 4 modes were seen to be included in such an analysis where controls are also included. Brute force control optimization seems to be inconsistent with what was stated in presentation #9 regarding Autonomie's ability to capture and optimize interactions between systems. It was also asked by a commenter how complexity was measured and if it was one-mode, two-mode, and three-mode and how was it accomplished without taking into account the complexity of controls. The project could use some more work on costs of components and cost of developing the controls.

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

All reviewers state that it is unclear from the presentation how much cooperation there has been with other institutions. It was noted that most collaboration was basically with DOE and GM. The question was also stated by a commenter asking what does GM and the DOE really want to get out of this.

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 generally agreed with the proposed next steps, but noted that the presenter must consider other vehicle classes, different market requirements (luxury vs. standard for example) and their impact on component constraints and assumptions. It was also stated

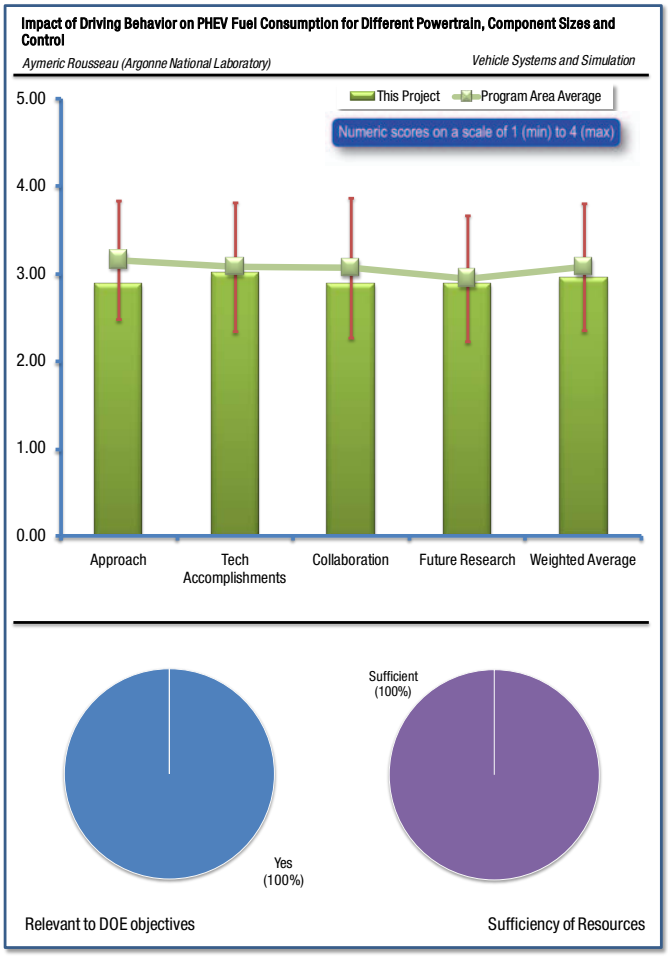
that a reasonable and logical approach to completing the program is proposed. Answers will not be definitive, but will increase awareness of differences between architectures under varied operating conditions. It may not be necessary to go as high as a four mode, but rather refine the loss models for single, double, and three mode. "Expand study" seems like a wish list and lacks focus. Another commenter added that it would be interesting to see where the tipping point would be for the cost vs. benefit of the multi-mode configurations. Mechanical complexity aside, the higher mode hybrids would be a calibration nightmare and a consideration of the effort involved in calibrating the higher mode hybrids would also be instructive.

It was noted that statements about the future work echo those about this project. In principle, it has value and is of interest, however, some clear definition of scope is needed other than the "Future work will address the four selected multi-mode systems to assess their impact on fuel consumption and component sizing" scope that was given. Another commenter pointed out that the project is almost complete, yet there is a list of additional studies to be done including other vehicle classes, more modes, and more configurations. Perhaps focus on a general sort of ideal (not really the right word here) hybrid powertrain to compare to.

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

Reviewers' comments here were basically the same as in earlier stages of the report. They agreed that this seems to be a very good project, but its scope seems almost limitless. It was also thought that some clear statements are needed regarding the desired scope and the assumptions which will underlie the final comparisons.

Impact of Driving Behavior on PHEV Fuel Consumption for Different Powertrain, Component Sizes and Control: Aymeric Rousseau (Argonne National Laboratory)



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?

Overall, it was felt that this project fulfilled the objectives. The first reviewer noted that understanding how PHEVs will be used is of primary importance in determining how much impact they will have in the real world, and how worthwhile continued interest in them is. It was also stated that driver behavior has a significant impact on fuel economy for conventional powertrains and that this effect is even more significant for PHEV. Federal testing procedures currently do not take this parameter into account when evaluating fuel economy. Understanding the impact of driver behavior on fuel economy is hence critical to understand the real world benefit of the technology and hence the amount of petroleum displacement. The final reviewer commented that the assessment of the impact of driving cycle on petroleum displacement is on point since it helps to ensure that the final vehicle designs truly maximize the displacement of petroleum.

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

The main thing reviewers wanted to see is more of the same; more drive traces, more variation, and more days with the same drivers. The only real problem with the work is that by only studying driving in one place on one day, the overall significance of the work is somewhat uncertain. This can only be corrected with more data, which is difficult to obtain, but should be a future focus. Reviewers also found the additional slides are very helpful in understanding the various supervisory control algorithms. However, the structure of the various hybrid powertrains themselves is not clear from the presentation. Perhaps the project would also benefit by using more supervisory control algorithms to evaluate the fuel displacement. It was also noted that using the coefficient of variation instead of the standard deviation to report the impact on fuel consumption displacement may make the results clearer. The final reviewer also positively noted that the analytical approach of utilizing data captured from 110 trips in 1 day in 2007 in Kansas City and the method that the data was analyzed in many ways to determine optimum solution was beneficial.

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

In general, the reviewers felt that this is excellent work towards evaluating the likely value of PHEVs and that the use of several real world driving cycles provides more credibility to the results. They were also pleased that the project appears to have made solid progress towards objectives and accomplished the technical goals set out at the start. It was mentioned that this was a good use of Autonomie to process data and model NPV. In particular, a commenter noted that in addition to the project design, the execution also seems very nice. The charts showing fuel saved (%) vs. distance (with several other elements of the cycle annotated) are exactly the information that the fourth objective would seem to require. (The fourth objective was: “Assess the impact of driving distance and driver aggressiveness on fuel displacement.”)

Another commenter noted that the cross correlation chart would seem to have a lot of interesting information. The reviewer liked the idea/approach, but needed a little more information/ discussion/description. One reviewer stated that many of the results generated are well-known to others in this research space. However, he was concerned with the table in the presentation that shows 2-3% FE benefit of HEV over conventional. An explanation is needed to understand why the benefit is so low, such as the model calibration.

QUESTION 4: WHAT IS YOUR ASSESSMENT OF THE LEVEL OF COLLABORATION AND COORDINATION WITH OTHER INSTITUTIONS?

Reviewers noted some good collaboration with other bodies, EPA, City of Chicago and University Davis. They were also pleased to see that The MathWorks were involved in the data processing and NPV modeling.

It was felt that although it was clear that data was obtained from EPA, the interaction appeared to be limited. It is also not clear what work was done with UC Davis or INL. The interaction seemed to serve the purpose, but likely could be improved. It was also unclear to at least one reviewer why the city of Chicago was a partner because the data is from Kansas City. It was also noted that NREL also seems to do quite a bit of drive cycle analysis and that some collaboration with NREL researchers could be useful. Other reviewer's comments included a perceived narrow collaboration with one software provider and concerns as to whether the results are shared with the right people.

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?

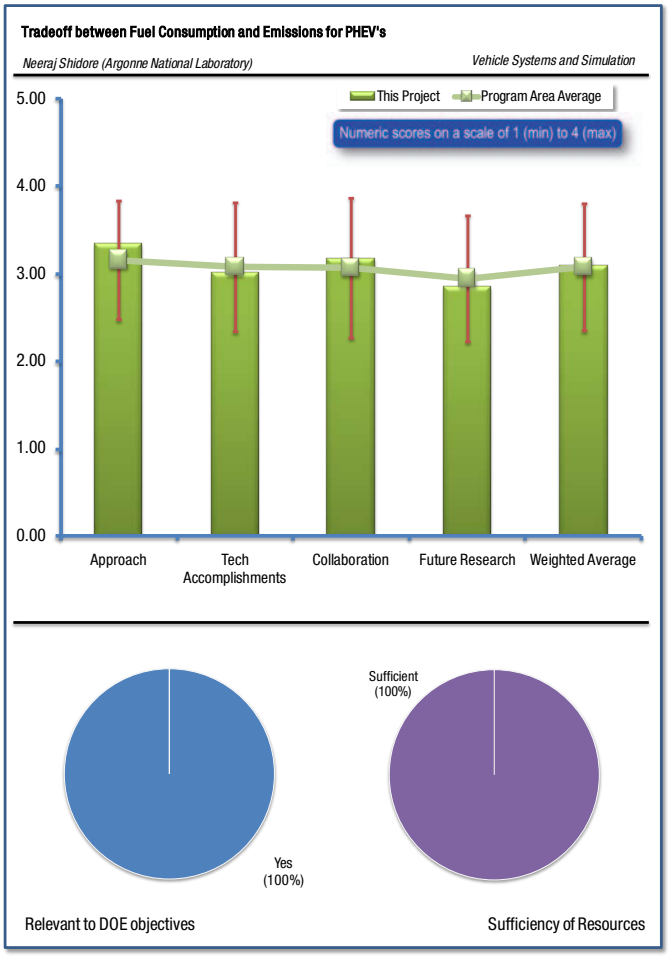
The first reviewer felt the prospects for future work look excellent. However, this particular commenter would prefer to see more focus on increasing the applicability of the work through the incorporation of more traces and vehicle variations rather than the creation of a location-aware control strategy, but this is a rich area of work, so it should all be valuable. In particular, a reviewer felt that the proposed next step of developing a test vehicle with trip recognition to test control strategies would be a good follow-on to this project. Further data analysis aimed at uncertainty would be another interesting avenue. One reviewer did not agree with the discussion that this should not be a DOE project, as the data was of significant benefit to OEMs. If a DOE project yields data for the benefit of all then the project should be regarded as a success, even if it is publicly funded.

Several reviewers also felt that the additional Monte Carlo simulations seem to be a nice extension (further explore sensitivities/variability) and conducting a similar exercise for medium/heavy duty vehicles is also a good thought, but needs some up front work to clarify scope (target vehicles to be studied).

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

Overall, reviewers stated that the project is nearly complete (and seems that it will be completed on schedule) and the results seem consistent with the original scope and budget. They are also looking forward to what should be an interesting report.

Tradeoff between Fuel Consumption and Emissions for PHEV's: Neeraj Shidore (Argonne National Laboratory)



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 felt that by allowing the enhanced simulation of PHEVs, this project can contribute to petroleum displacement. It was also agreed that criteria emissions can significantly worsen when CO_2 emissions improve, making tradeoff studies important to develop a good compromise. Criteria emissions are particularly sensitive to aftertreatment temperature, and techniques that will allow faster temperature rise are of particular interest.

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?

The first commenter stated that although the overall goal is admirable, it was not demonstrated that this work will be generalizable, or what the approach actually was. It was unclear if series, parallel, or a conventional technology was being discussed because at different points in the presentation all were mentioned. It seems that the intent is to prove the model in a simulation of a conventional vehicle, the most difficult application, and then to use this as validation for all other uses. However, it is not believed that this was done. Although it seems plausible that the difference in cold start fuel economy was due to a cold powertrain, it is unclear how this was demonstrated with data. This seems to be more of an assumption than an outcome, which is not a good way to approach validation. There was also no discussion of emissions validation, and although this was touched on in a previous presentation, it was not clear how these efforts would combine to result in a unified approach. Another reviewer remarked that the comment by the presenter that accuracy within 5% of reality is sufficient does not seem to address the needs of end users for more exacting virtual methods.

A reviewer noted that cold-start emissions are a significant issue for PHEVs and the results of this work should be integrated into Autonomie. It was also felt that while the model correlates for one set of points, more may be needed for full correlation (across temperature and other operating condition variables). It was also questioned what fidelity is deemed sufficient.

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

Overall, reviewers felt that very good progress on a complex system to implement engine in the loop and very good validation results had been accomplished. One commenter noted that the integration of the ORNL aftertreatment model into Autonomie was a good achievement. The data showed good correlation between the Autonomie model and Engine in the Loop. The differences on the EIL "preliminary cold start" appear to be understood (lower powertrain efficiency at cold start–not modeled). The simulation studies under way for power thresholds on fuel economy and emissions as well as engine warm up and torque transients should provide some interesting results. However, it was noted that although the progress was good, it's not clear whether the focus is on completing a

tradeoff study or adding a feature to Autonomie. If the study is the focus, the EIL setup should be ready to deliver interesting results now.

QUESTION 4: WHAT IS YOUR ASSESSMENT OF THE LEVEL OF COLLABORATION AND COORDINATION WITH OTHER INSTITUTIONS?

It was agreed that there seemed to be excellent collaboration with Argonne and ORNL on the development of the engine emissions simulation. It was also noted as a very good example of using the strengths of ANL and ORNL integrated on a project. The project was also noted for good sharing of models with ORNL.

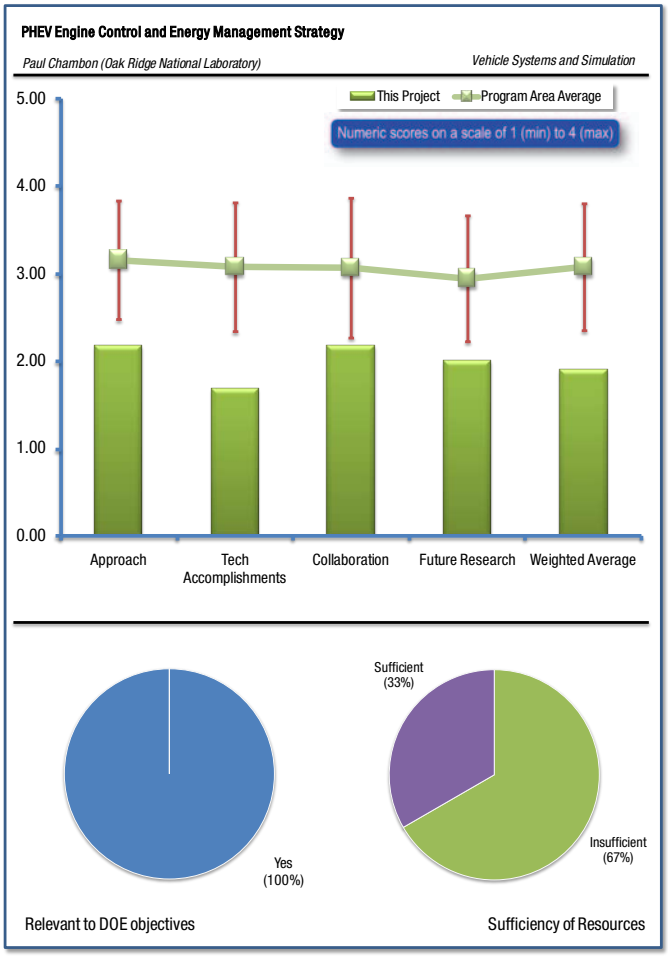
QUESTION 5: HAS THE PROJECT EFFECTIVELY PLANNED ITS FUTURE WORK IN A LOGICAL MANNER BY INCORPORATING APPROPRIATE DECISION POINTS, CONSIDERING BARRIERS TO THE REALIZATION OF THE PROPOSED TECHNOLOGY, AND, WHEN SENSIBLE, MITIGATING RISK BY PROVIDING ALTERNATE DEVELOPMENT PATHWAYS?

One reviewer remarked that future model-based work to evaluate other hybrid configurations and validation of vehicle level control strategies is a logical and valuable next step. Another noted that this work should also be integrated into Autonomie so that basic emissions considerations can be accounted for, including in control strategies that often only consider fuel consumption. It was also felt that there seems to be an excellent path forward for interesting results in a difficult area. Given the complexity of the setup achieved so far and the goals, it would be preferred to see the focus on using this setup to produce test results for one specific powertrain/setup. Although achieving generalizable results is admirable, it is going to be impossible to test a wide array of cases adequately; the approach should be deep instead of wide.

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

It was noted by all reviewers that there seems to be adequate resources for excellent progress.

PHEV Engine Control and Energy Management Strategy: Paul Chambon (Oak Ridge National Laboratory)



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?

It was agreed that the successful completion of this work would help make PHEVs more practical, which would decrease petroleum displacement. It was specifically noted that cold emissions are particularly important for PHEV vehicles because of the potential repeated cold starts. Understanding of the level of criteria emissions and the impact on fuel economy is critical to understand the real impact of PHEV on petroleum displacement. Another commenter remarked that engine-off operation does offer the capability to displace petroleum. However, as the researcher noted, initial emissions transients may not allow vehicle designers to exploit engine-off (it would not allow emissions regulations to be met).

The final reviewer agreed that the project meets the required objectives; however, he noted that the project appears to be chasing the same objective as every other OEM and major Tier 1 Engine Management System supplier, but without the support of either.

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

One commenter noted that exploring the trade-offs between efficiency and emissions is something that can also be done in simulation. There is definitely value in exploring this in real hardware as well; however, there should be a very tight coupling between the simulation exercises and the hardware experiments. Researchers mention that they are working together, but from the presentations it was very hard to see that a fully integrated plan existed between the two projects. This fully integrated plan needs to exist or one of these efforts would seem to be largely wasted.

Another reviewer was concerned that this project does not seem to have a feasible project plan or specific goal and that it appears to be more of an aspiration than a project. The project team seems to be strong, but it is clear that they need to do more work to design a project that is feasible given the lack of OEM support and the need to do useful work within a reasonable amount of time. Some questions to consider include: What new strategies will be tested and how will this work be compared to OEM systems to ensure relevancy? These questions must be answered before the project can proceed in a useful direction. It was also noted that without OEM or Tier 1 support there has to be significant effort to characterize (map) the engine and even then the quality of the response surfaces generated will likely be poor due to the limited ability of proprietary control systems to perform major parameter sweeps. Another obstacle mentioned by a commenter is access to ECM code and control algorithms.

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

The first reviewer noted that while this is a project in its initial stages, as noted above, it is not clear that the plan has been adequately rethought in light of changing circumstances. It was also mentioned that delays due to lack of cooperation by OEM caused a need for a robust back-up plan in place. It is good that graduate students from GATE are involved. Encouraging participation of graduate

students and helping them become the next generation of researchers and (practical) engineers is very essential to the success of the entire DOE initiative. One reviewer noted that the large number of slides dedicated to planning, purchasing and administration would seem to suggest a shortage of doing. Researcher correctly acknowledged that this has started slowly.

One concerned reviewer did note that there are very few knobs/levers to pull and all of these are well understood by the OEMs and Tier 1s. There was no evidence of a "brand new approach" or "silver bullet" that would succeed where all others have not.

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

The first commenter felt that there appears to be good collaboration with relevant partners, given the status of the project. The second noted that while collaboration with UT and ANL appear to be going OK, more cooperation between ORNL and the OEM would contribute to the success of the project. Even though 2009 was a bad year for all the OEMs, it may be worthwhile to pursue that course in parallel once more, for the potential pay-off is significant. The final reviewer mentioned that there seems to be two projects looking at this, one is in simulation and one is on hardware. However, they appear to be progressing independently, which is not OK.

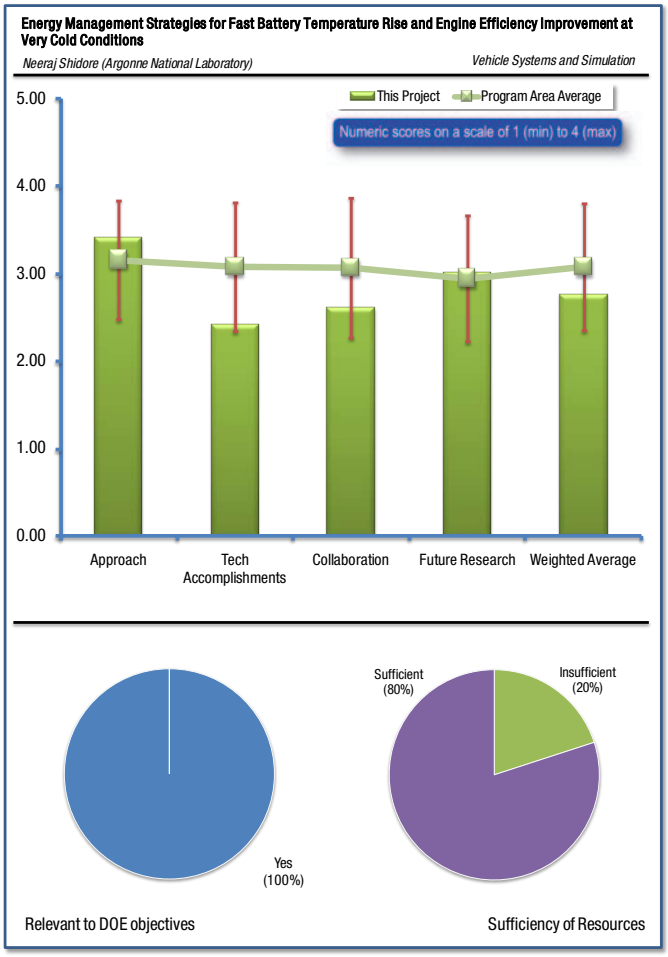
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

The first reviewer noted, as mentioned above, that the project needs a much more well-defined plan. It is not clear what specific things the team hopes to accomplish, aside from getting an engine running with a modified controller. It is also unclear what strategy the team is hoping to try that hasn't been tried before. The comment that the team will not evaluate current hybrid systems because they do not wish to reverse engineer is not acceptable. One cannot advance the state of the art without first understanding the state of the art. Another commenter felt that, while the proposed research plan looks good, the success of much of the plan and preventing budget overruns may depend on cooperation with the OEMs.

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

The reviewers were torn on this topic because they did not want to redeploy what seems to be a well-qualified project team, onto another effort and canceling this one. However, if this project is continued it is under-resourced. Another reviewer agreed that a lot of work was required to actually get to the starting point due to lack of OEM, Tier 1 participation. It was also suggested that as this is a core business for a number of commercial organizations which spend many millions researching this topic, the project budget may be under estimated.

Energy Management Strategies for Fast Battery Temperature Rise and Engine Efficiency Improvement at Very Cold Conditions: Neeraj Shidore (Argonne National Laboratory)



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?

The first commenter agreed that by improving the prospects for PHEVs, and improving the performance of those PHEVs, this project supports petroleum displacement. It was also noted that the quicker batteries and engines reach their optimum operating temperature the greater the fuel economy improvement and emission reductions are to be had. Other reviewers also added that PHEVs have a potential to displace a significant fraction of petroleum fuels and low temperature impacts on battery power and life are important considerations.

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?

The reviewers confirmed that the comparison of different energy management strategies to raise temperatures quickly is a logical approach and is a very good combination of battery-in-the-loop with the engine thermal model to get realistic yet workable ways to address the issues. The use of Autonomie is another example of the power of this development tool.

Another reviewer stated that while this project is interesting overall, it is not clear how much benefit is gained from having a battery in the loop. A battery should be much simpler to model than an engine in this regime, so developing a model instead of doing in-the-loop testing would allow rapid test restart, parallelization, and all of the other benefits of model-based design. It appears that the team does not think that battery makers are doing adequate testing of batteries at cold temperatures. However, it appears that they also want to treat the Battery Management System as a black box. The reviewer asked who developed the BMS, and the reviewer wondered how the team knows so much more about operating the battery in this regime than the battery maker. The reviewer has also consistently found the BMS to be the weakest link in the system. It was also noted that this project would be better if battery manufacturers were collaborators. It was not clear how industry may be addressing this issue which the battery manufacturers would know.

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

Overall, the reviewers felt that this project appears to be showing good progress towards its goal. Specifically, a reviewer commented on the fact that the use of battery in the loop and Autonomie is a well coordinated approach and the integration of the engine thermal model into Autonomie appears to be on track. It was also noted that it seems that base modeling work along the line of the intended outcome is progressing. It was described that more work needs to be performed before a solid outcome can be accomplished. One commenter did mention that the project is well along, but only preliminary results are available; this is due to the complexity of battery-in-the-loop set up time. Now that the system is working, the testing can be executed to generate the main results.

QUESTION 4: WHAT IS YOUR ASSESSMENT OF THE LEVEL OF COLLABORATION AND COORDINATION WITH OTHER INSTITUTIONS?

The first commented noted that he didn't see strong collaboration, but it doesn't seem necessary for this project given the scope and approach. Another reviewer felt that the combining of other DOE projects (Autonomie and development of an engine thermal model) is a good use of existing work and one that builds upon previous funding exercises. The final reviewer stated that getting component suppliers involved should improve the outcome toward a potential use.

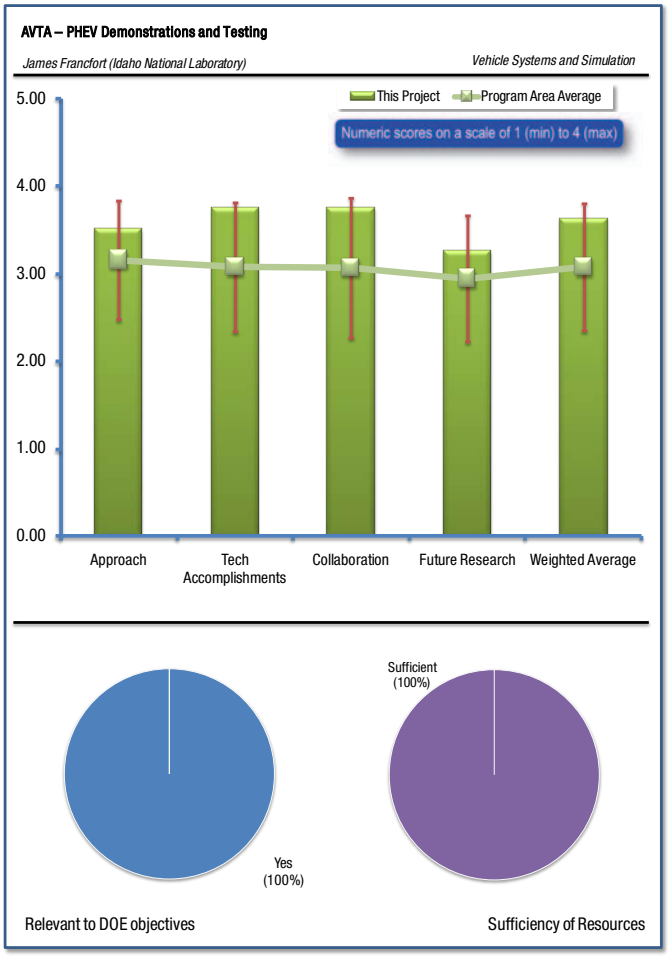
QUESTION 5: HAS THE PROJECT EFFECTIVELY PLANNED ITS FUTURE WORK IN A LOGICAL MANNER BY INCORPORATING APPROPRIATE DECISION POINTS, CONSIDERING BARRIERS TO THE REALIZATION OF THE PROPOSED TECHNOLOGY, AND, WHEN SENSIBLE, MITIGATING RISK BY PROVIDING ALTERNATE DEVELOPMENT PATHWAYS?

Overall, it was felt that this project appears to be well planned. It was advised to focus on understanding the different lithium ion chemistries in more detail or pursuing alternate strategies like battery heating while plugged in before focusing on using ultracapacitors. However, another reviewer felt that ultracapacitors have yet to establish a foothold and challenge batteries in the hybrid electric arena. This reviewer thought that exploring this technology on this project would be a valuable study. It was also noted that there's a lot of variation in “conventional” PHEV systems. The final reviewer pointed out that the project is for a one-year duration and is approximately 60% complete. The inclusion of a cabin temperature model is an interesting and novel extension of the project and one that explores the impact to vehicle driver / passengers.

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

Generally, it was agreed that the resources seem appropriate for the project. However, one commenter did add that the project completion is hampered by funding limits.

AVTA – PHEV Demonstrations and Testing: James Francfort (Idaho National Laboratory)



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 stated that this is the most extensive data collection ever on these new technology vehicles. The data will be critical in evaluating assumptions made in the past and assess the real performance of those technologies. It will also serve to modify and tune the powertrain to address issues raised by the project. It will be beneficial to the OEMs and the general public for the successful introduction of these new technologies to the market place. Reviewers also felt that the development and high volume production of PHEV vehicles will help to achieve the national objective of reducing dependence on foreign oil. This program seeks to accelerate the development process and make available key data necessary to refine and bring PHEVs to market. Providing a consistent approach for evaluating vehicles and systems assists not only the vehicle OEMs, but key system suppliers. The program also provides insight to the general public as to progress and status of these developing technologies.

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?

The reviewers stated that this program conducts testing on a variety of new technology passenger cars, including dynamometer, controlled track, accelerated field, and "unsupervised" fleet testing. The fleet testing relies on wireless data transmission and automated generation of test reports. The approach is highly leveraged, resulting in significant data accumulated with a relatively small staff. The fact that the vehicle testing is fairly well distributed geographically is impressive, so that a cross section of conditions and duty cycles may be obtained. The program includes focused testing to understand temperature effects on the battery and the fuel economy of the vehicle. It was also stated that there is some activity intended to understand PHEV charging strategies in the future. It was also agreed that the structure and specific objectives of this particular effort are not clearly understood, based on information provided in the presentation. There appears to be some good data generated concerning vehicle usage and charging times, but how this will be used by the program or the member utilities is a little vague.

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

It was the general consensus among the reviewers that providing data and results on 1600 vehicles is nothing short of outstanding. As previously noted, this program is very efficient in generating results with a somewhat limited group of resources. It was also noted that the data also appears to be summarized in a meaningful way that provides insight into vehicle usage, fuel economy based on event or operating condition, and when and for how long vehicles are being charged. While it is clear that a variety of reports are generated, the reviewers were left with two questions: Are OEMs provided with reports and briefings on the results in order to maximize the potential benefit and usage of the data? What is the means of disseminating this information to the public? Such data could help individual consumers make wiser purchasing decisions, as well as assisting OEMs and suppliers in refining technology and systems.

QUESTION 4: WHAT IS YOUR ASSESSMENT OF THE LEVEL OF COLLABORATION AND COORDINATION WITH OTHER INSTITUTIONS?

The reviewers all agreed that collaboration and communication with other national labs appears to be effective. In particular, some of the required lab testing is done at Argonne. In addition, vehicle data related to temperature effects is being shared with the battery groups at INL and Argonne to facilitate their battery test and development programs. Other partners include government entities, clean air agencies, universities, and vehicle conversion companies. It is not clear from the presentation the extent to which vehicle OEMs are tied directly into testing, or if they are receiving detailed testing results. This would seem to be an opportunity for improvement. Importantly, a number of utilities are tied into this project, and there appears to be a focus on identifying vehicle to grid issues and helping the utilities to identify potential solutions. It was also noted that having OEMs, other labs and converters all working in a common space is an outstanding result in and of itself.

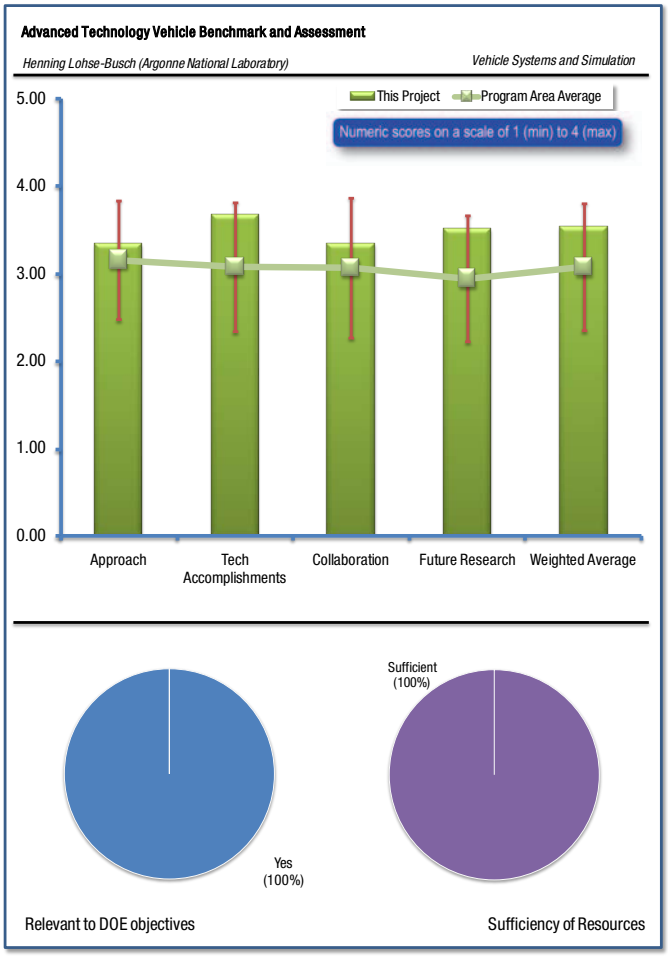
QUESTION 5: HAS THE PROJECT EFFECTIVELY PLANNED ITS FUTURE WORK IN A LOGICAL MANNER BY INCORPORATING APPROPRIATE DECISION POINTS, CONSIDERING BARRIERS TO THE REALIZATION OF THE PROPOSED TECHNOLOGY, AND, WHEN SENSIBLE, MITIGATING RISK BY PROVIDING ALTERNATE DEVELOPMENT PATHWAYS?

The first commenter mentioned that future plans include evaluation of new advanced technology vehicles as they become available. According to the presentation, future focus will be on evaluating OEM hybrid systems. It was noted by the reviewers that this is seen as a very positive move. Data on retrofitted or low volume conversions is interesting, but the future impact to national petroleum usage will be with OEM installed systems. A suggested future activity is continued collaboration with utilities to better refine recharge strategies that will be most cost effective and require the least amount of upgrade to the power grid. This was not specifically mentioned, but may already be part of the plan. Another reviewer also made the comment that flipping through slides that are not presented or explained is not really useful; the team should take the time to pare the presentation down to what can be presented in the time allotted.

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

It was felt by all the reviewers that this program appears to be generating significant, meaningful data with relatively few resources, and is perceived to be very "efficient." Obtaining data on several hundred vehicles and being able to report the results using an automatically generated test report allows for a much larger, statistically significant test program.

Advanced Technology Vehicle Benchmark and Assessment: Henning Lohse-Busch (Argonne National Laboratory)



Reviewer Sample Size

This project had a total of 3 reviewers.

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

The first commented stated that in part, this project provides the baseline testing for the prior project presented, VSS015. The project supports the DOE laboratory and field evaluations of HEVs, PHEVs and EVs, codes and standards development and continued support for model, development and validation (using Autonomie) with test data, EV testing and charging evaluation. All of these activities directly support the DOE VTP mission, and the administration's goals of improved fuel economy (fuel/electricity), reduced emissions, and improved performance in vehicle efficiency. DOE's VTP support of the understanding, improvement, analysis and validation of various EVs, HEVs and PHEV is directly supporting the overall DOE objective of petroleum displacement with new vehicles that will be using alternative forms fuel (electricity). The project objective includes the overarching goal of establishing the state-of-the-art automotive technology baseline for powertrain systems and components through data generation and analysis to displace petroleum.

Another reviewer pointed out that the benefits of new vehicle technology are hard to assess, as many varying factors can significantly impact the results. Having a third party doing a non-biased assessment of product delivered to the market by an OEM is a good way to first check on the claims done by OEMs and second on the real impact of the technologies.

It was also noted that clearly, the development and high volume production of PHEV vehicles will help to achieve the national objective of reducing dependence on foreign oil. This program can facilitate and accelerate the development of PHEV, HEV, and BEV vehicles through data collection and analysis. This effort is invaluable to move the technology to a production-ready state. Work performed under this program provides a consistent means for evaluating competing technologies and systems, and generates data necessary for development and continuous improvement.

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?

It was noted by the first reviewer that the project team leverages a 10 year testing and validation approach working with INL collaborators. The project highlights use of the Advanced Powertrain Research Facility at ANL that carries the ultimate mission to benchmark advanced technology vehicles and disseminate that information to U.S. OEMs, National Labs, and universities. A set of standard test plans is being developed, adjusted for individual vehicles.

Reviewers also pointed out that the project performs laboratory (APRF) and field evaluations (INL,OEM) of HEVs, PHEVs and EVs affecting codes and standards development, development and validation (Autonomie), EV testing and charging evaluation with a set of strong partners including DOE, INL and eTec, USCAR, a variety or OEMs and vehicle components and suppliers.

Reviewers were wondering how coordination of individual systems development includes modeling and simulations is actually implemented. While Automonie is used for modeling and simulation, it seemed like an enormous task requiring extensive dialog and data. Unfortunately, the presentation at the review was cut short, but reviewers would have liked to see more information on battery options, addition of cost effective, and life-cycle analysis may be helpful to improve the projects and analyses.

It was noted that testing approaches are well documented and rigorous (as noted in the presentation, "refined over a decade"). They provide for a consistent, objective means of evaluating hybrid and BEV technologies and systems. This initiative has access to state of the art instrumentation and test methodology. The Argonne facility is the "center of excellence" for controlled laboratory evaluations of hybrids and alternative powertrains. Two levels of dynamometer testing are available, depending upon whether the objective is basic characterization of the vehicle powertrain, or a more detailed data collection exercise to understand vehicle drivetrain efficiency and/or to evaluate operating parameters of specific system components. Data generated is used by other groups within Argonne and by other national labs. For example, data is used to help validate Autonomie analyses and simulations. Dynamometer data is used to compare with actual fielded vehicle data collected by Idaho National Laboratory. Procedures provide insight to industry organizations such as SAE for the purpose of writing test standards and procedures.

QUESTION 3: CHARACTERIZE YOUR UNDERSTANDING OF THE TECHNICAL ACCOMPLISHMENTS AND PROGRESS TOWARD OVERALL PROJECT AND DOE GOALS.

The first reviewer noted that the technical accomplishment of the work and use of DOE funding is outstanding. The first accomplishment includes a comprehensive testing overview of various 2010 vehicle models from a range of OEMs, energy consumption and NEDC. The comparative presentation of the data and results is very effective. The selection of vehicles and point of interest for evaluation are complete, logical and appropriate. Value of the state of art hybrid, technology evolution, thermal recovery systems for example are studied in the Prius and Insight: fuel economy, and high speed EV operation are investigated in the Ford Fusion, and the Mercedes is used as the "modern" EV system benchmark, as it uses OEM lithium ion battery packs and associated SAE J1634 development. Fuel economy and energy consumption in label/conventional systems are demonstrated. The second accomplishment includes tracking power splits in hybrid vehicles (Fusion and Prius) and the third accomplishment investigates component life in more moderate hybrids. The accomplishments are met with detailed and appropriate variables for testing and modeling analysis, including details like driver aggressiveness and battery cycling. Another accomplishment of the work at the APRF included analysis of alternative fuels (hydrogen and liquid to coal).

Other reviewers mentioned that this project has completed the evaluation of 14 PHEV vehicles, as well as alternative fuel vehicles. Other accomplishments cited include a detailed evaluation of split power vehicles, understanding tradeoffs of mild hybrids, testing of alternative fuel vehicles, understanding effect of driver technique on fuel economy, and effect of accessories on efficiency (air conditioning). Results obtained in the lab are instrumental in establishing or modifying industry test procedures or standards. Test results have also provided invaluable assistance to vehicle OEMs. To show this, two examples were cited: an unnamed electric vehicle OEMs vehicle development, and Ford's latest PHEV vehicle under development.

QUESTION 4: WHAT IS YOUR ASSESSMENT OF THE LEVEL OF COLLABORATION AND COORDINATION WITH OTHER INSTITUTIONS?

The first commenter felt that the collaborative team appears outstanding and comprehensive, led by INL, and including USCAR, eTec, OEMs, suppliers, Labs, etc. The only reason the rating is "good" is because access to data has been criticized, and d-cubed commented on difficulty in accessing the INL data. While this is not a show stopper, it has been observed by others and should be noted.

Other reviewers pointed out that this team worked closely with Magna and Ford in the development and refinement of their hybrid systems. As previously noted, collaboration with INL is readily apparent, with ANL performing lab testing on the vehicles subsequently field tested by INL. Some direct feedback is provided to OEMs that may improve system efficiency and/or robustness. This is viewed as a positive in terms of accelerating development and high volume production of these systems and providing a means for continuous improvement. This team has also contributed to the industry as a whole, through development or refinement of SAE test standards.

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?

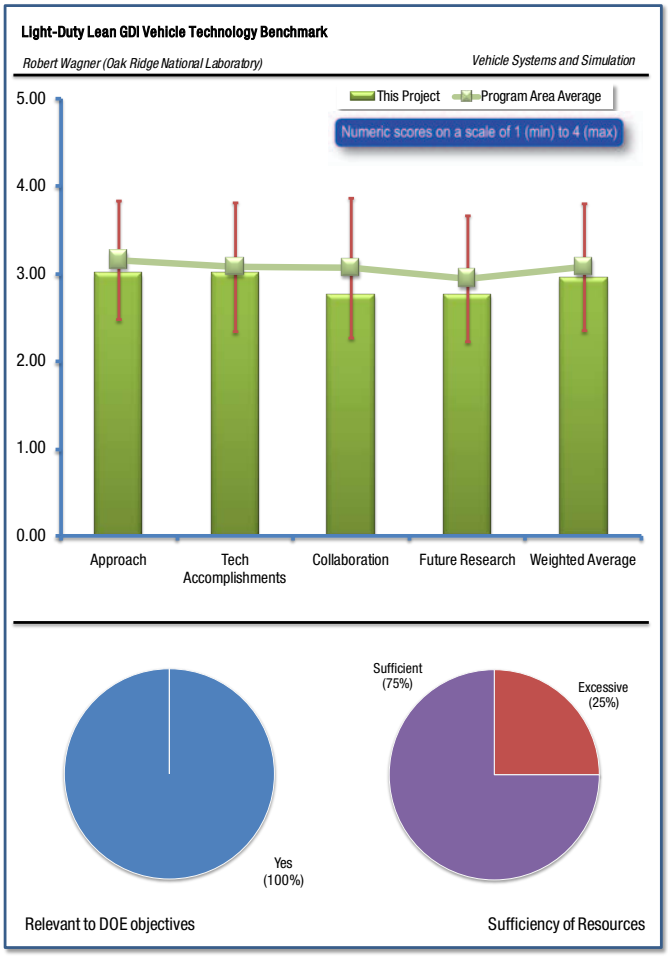
It was felt by the reviewers that the proposed future work is logical and appropriate and will no doubt be effective based on past year results. The proposed new work will extend and continue the benchmarking of Vehicles and Components in System Context, and include: possible EVs (Nissan Leaf, Mitsubishi iMiEV, Ford Focus, Ford Transit Connect, BMW, and Think); possible PHEVs (Toyota Prius, Chevy Volt); and possible HEVs (Honda CRZ, Chinese HEV). The future project would also include some APRF facility upgrades that will improve the analysis and testing capabilities, including adding a climate test cell upgrade and 5 cycle fuel consumption testing.

It was also advised that future plans include continued lab evaluation of new or developmental hybrid vehicles, refinement of Level 1 and 2 test procedures, and an upgrade to the climate controlled test cell. Some specific focus areas include a better understanding of temperature effects on vehicle performance and the impact of accessories (heating and air conditioning) on overall vehicle performance. It was also added that future plans should include, where appropriate, increased communication and collaboration with vehicle OEMs to hasten technology development and industrialization.

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

All reviewers felt that the budget is strong and appropriate and recommended continued level of funding support for the work. The resources used in the past have been used successfully to achieve detailed and timely results.

Light-Duty Lean GDI Vehicle Technology Benchmark: Robert Wagner (Oak Ridge National Laboratory)



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?

Each reviewer had slightly different comments on this particular question. The first stated that stop-start systems have the potential to improve city fuel economy significantly. Benchmarking competitive stop-start systems would help in developing systems that offer a better return on investment. The second pointed out that the project presented appears to support the overall DOE mission of petroleum displacement by providing benchmark and validation data on performance and emissions of advanced lean GDI vehicles. This technology is not sold in the U.S. at the present time. This work, as presented, may or may not lead to a better understanding of if this technology will actually penetrate the U.S. market space if the technology becomes available here. Regardless, it provides useful benchmarking data for future analysis of performance and emissions of engines relevant to the U.S., and the ultimate displacement of petroleum. Another noted that it met the objectives by showing that lean GDI's benefits must be compared with fuel supply challenges, emissions impacts, and potential usage as lean GDI as a defeat device when users don't fuel with ultra low sulfur fuel. The final commenter stated that lean gasoline direct injection engines offer potential fuel economy benefits but pose emissions challenges in the U.S. This is a one-year characterization task to better understand advanced GDI technology from Europe and use this knowledge for development of simulations, augment dynamometer experiments, and advise future work in this technology area.

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?

The first commenter felt that he was not well qualified to comment on the lean GDI benchmarking. However, he was qualified to comment on the stop-start aspect of the benchmarking. He felt that in general the approach is good. However, there is a significant effort underway in the USCAR-TWG (Transmission Working Group) to evaluate stop start in at least two different vehicles. There has been extensive input from all the OEMs regarding the various driving state (and several other variables) under which the stop-start behavior would be studied. Even though the project is well underway, it would make sense to work with the TWG to maximize the potential benefits realized from this effort.

It was also mentioned that the approach to the work is logical and generally effective. The team negotiated and acquired a BMW on loan from GM and performed comprehensive instrumentation and full system vehicle testing. The characterizations and results were used to update PSAT/Autonomie models. The team will combine vehicle benchmark data with engine dynamometer experiments to develop and validate emissions control models for use with lean GDI advanced powertrain vehicle simulations. The approach to the work and process is sound, and will likely help understanding of barriers to widespread use of the lean GDI technology in US market. More discussion and focus of project activities to address barriers to be overcome if lean GDI is to adopted would enhance this work. Another reviewer pointed out that this is a standard advanced vehicle benchmarking task following conventional testing protocols looking at fuel efficiency and emissions. The focus and procedure for the activity is clear with little task creep.

QUESTION 3: CHARACTERIZE YOUR UNDERSTANDING OF THE TECHNICAL ACCOMPLISHMENTS AND PROGRESS TOWARD OVERALL PROJECT AND DOE GOALS.

Many reviewers felt that the comprehensive testing performed is impressive. However, it was questioned if the approach to the testing and data is repeatable, so that the accomplishment can have full impact. The reviewer also questioned how one gets from one mode to another mode, and override to stop/start. It is still not clear whether this will make it to the U.S. market at this point in the project. It was also asked if more vehicles should be studied.

It was also pointed out that technical accomplishments are in line with standard vehicular benchmarking activities. Engine, aftertreatment, and hybrid features were instrumented; three iterations of three drive cycles were conducted; and fuel economy, emissions, and engine operation were characterized. Three different operating conditions were tested: stoichiometric, lean, and lean with stop-start. Lean NOx trap, start-stop, and intelligent alternator were also characterized. There are really no specific technical barriers to the continuation of this task.

QUESTION 4: WHAT IS YOUR ASSESSMENT OF THE LEVEL OF COLLABORATION AND COORDINATION WITH OTHER INSTITUTIONS?

The first reviewer felt that the fundamental collaborations for this work are strong. The team collaborates also with INL testing facilities and ANL PSAT/Autonomie teams. Nicely, the VSATT-Data is available for use by the Vehicle Systems Analysis technical team and was already presented in other project presentations. The Lean NOx after-treatment data will be used in support of the CLEERS modeling activity. There is good coordination between experimental and modeling teams. Another reviewer also thought that the project team presents an interesting collaboration proposed on health effects, but it appears that the comprehensive study is not included in this project. However, it is thought that this might be a nice extension of this work. The third reviewer felt that the access to the data may be significantly improved. It is not clear whether there is a significant overlap with U.S. OEMs and feedback on data (besides the loan from GM). It may be important to consider more collaboration with the U.S. OEMs on data / findings.

Overall, it was felt that the coordination and collaboration seem reasonable with data available to the Vehicle Systems Analysis Tech Team, CLEERS modeling activity, and ORNL Advanced Combustion Engines Programs. INL provided advanced powertrain/vehicle testing support and data will be processed for use in ANL's PSAT/Autonomie simulation models. The project will publish results upon completion in September 2010.

QUESTION 5: HAS THE PROJECT EFFECTIVELY PLANNED ITS FUTURE WORK IN A LOGICAL MANNER BY INCORPORATING APPROPRIATE DECISION POINTS, CONSIDERING BARRIERS TO THE REALIZATION OF THE PROPOSED TECHNOLOGY, AND, WHEN SENSIBLE, MITIGATING RISK BY PROVIDING ALTERNATE DEVELOPMENT PATHWAYS?

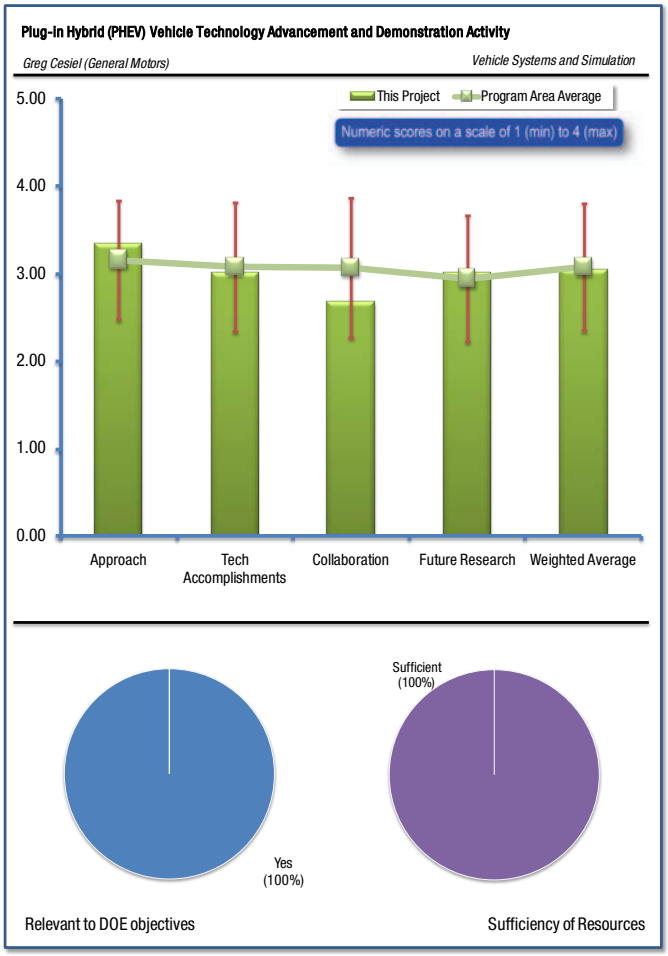
A reviewer felt that future work seems logical and focused, targeting: 1) helping evaluate the potential of lean GDI engine operation and aftertreatment systems with advanced hybrid powertrains, 2) supplementing dynamometer experiments to develop and validate emission control models for lean GDI powertrains, and 3) exploring opportunities of ethanol use in lean combustion engines.

It was noted by another reviewer that the future work, as presented, was not very clear. However, the team proposes to combine vehicle benchmark data with engine dynamometer experiments to develop and validate emissions control models for use with lean GDI advanced powertrain vehicle simulation, and to focus on ethanol blends and potential opportunities presented by ethanol for lean combustion and emission control.

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

Overall, the reviewers felt that cost resources appear sufficient or perhaps slightly under-resourced. That said, the vision and impact of the project could be strengthened at which point a stronger budget could be recommended. With a stronger testing and coordination/collaboration plan, the project could potentially grow. Another commenter thought that the $300K seems a little high for characterization of a single vehicle.

Plug-in Hybrid (PHEV) Vehicle Technology Advancement and Demonstration Activity: Greg Cesiel (General Motors)



Reviewer Sample Size

This project had a total of 3 reviewers.

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

The first reviewer felt that the use of gasoline and E85 in combination with HEV technology definitely addresses the DOE objective of petroleum displacement. It was also felt by other reviewers that PHEVs have the potential to significantly reduce petroleum consumption in light duty vehicles. However, they face commercialization barriers including higher costs, consumer risk aversion, and electric infrastructure challenges. This task aims to address these barriers through development and deployment of 60 PHEVs in geographically dispersed areas with the goal of collecting fleet demonstration data. Information gleaned from demonstration will hopefully lay the foundation for broader penetration of PHEVs into the commercial market. The task incorporates lithium-ion battery technology and E85 flex fuel capable engine 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?

Reviewers pointed out that the project makes maximum reuse of Chevy Volt and Dual Mode technology and components. The inclusion of E85 technology appears to be carried across from other GM programs. The transition from NiMH battery technology to the Volt Li-Ion is a natural evolution. It was also noted that General Motors is following a well-proven early introduction strategy for new advanced vehicles. This activity is proceeding from development of mule vehicles, to integration, through validation, and demonstration fleet data collection. Every six months, deep dive demonstration reviews are being conducted with DOE. This PHEV demonstration activity builds upon GM's successful 2-mode hybrid vehicle family. An aggressive implementation schedule is being conducted with appropriate safety testing and user feedback mechanisms. The final commenter felt that this approach is straight-forward OE. However, what we don't see in this presentation is any of the details and targets of the vehicles being met.

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

The first commenter did notice that the presentation contains very little technical and timing detail. Only events completed were discussed, and no future dates were included. Initial progress appeared to be on track until the issues associated with the dropping of the Saturn brand and the shift to a new platform introduced additional work to the project scope. Another reviewer felt that, currently, this task is significantly ahead of schedule. It appears all major development activities are so far on track or completed and have met or exceeded technical targets. Cold weather testing exceeded specs using both gasoline and alcohol fuels and the plug-in charging system has proven effective in both cold and hot temperatures. OnStar data collection has been customized to meet DOE reporting requirements and virtual modeling and simulation of vehicle hardware has been completed. It was also mentioned that reviewers would have liked to have seen more data on engines, fuels, fuel economy, and emissions.

QUESTION 4: WHAT IS YOUR ASSESSMENT OF THE LEVEL OF COLLABORATION AND COORDINATION WITH OTHER INSTITUTIONS?

The first commenter pointed out that, clearly, this project is commercially sensitive and GM has kept the majority of the details of this project in house. The only collaborations are with University of Michigan-UMTRI for fleet feedback and ABCD for advanced research. The DOE 60 vehicle demonstration fleet was discussed during the Q&A session, but no timing or location details were provided. ANL was identified for future collaboration, although this looks like two weeks of testing rather than partner participation. It was also mentioned by a reviewer that they really liked the collaboration with U of M, and ANL.

It was also noted that this task has 80+ percent non-governmental cost share–no additional funds have been requested of DOE. The effort is coordinating with the Michigan Economic Development Corporation (MEDC) for funding, University of Michigan Advanced Battery Coalition for Drivetrains for research, and University of Michigan Transportation Research Institute (UMTRI) for consumer behavior research. The project is also coordinating with ANL for fuel economy and emissions testing in the fall of 2010. The final reviewer did point out that as a critical barrier has been identified as the interface and interaction with electric grid, an additional project partner such as an electric utility or EPRI may be of benefit.

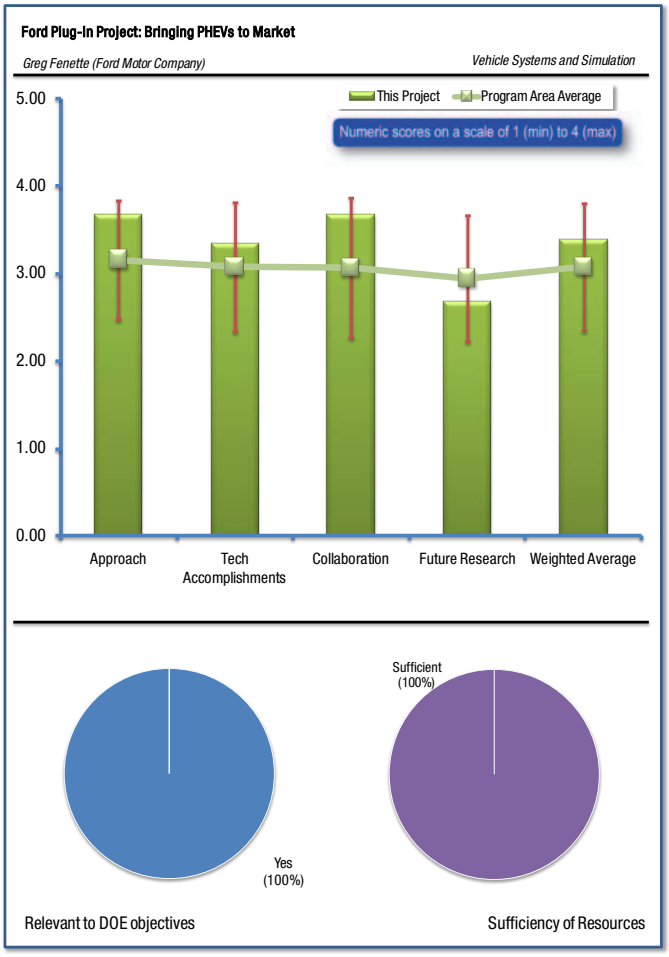
QUESTION 5: HAS THE PROJECT EFFECTIVELY PLANNED ITS FUTURE WORK IN A LOGICAL MANNER BY INCORPORATING APPROPRIATE DECISION POINTS, CONSIDERING BARRIERS TO THE REALIZATION OF THE PROPOSED TECHNOLOGY, AND, WHEN SENSIBLE, MITIGATING RISK BY PROVIDING ALTERNATE DEVELOPMENT PATHWAYS?

The first commenter mentioned that the change in platform was identified as an additional challenge; otherwise, future work is contained within the program scope. It was also noted that, unfortunately, the elimination of the Saturn nameplate will require GM to rework a number of the activities under this task which has the potential to erase the schedule progress achieved to date. On the surface though, given that the task has been way ahead of schedule, it appears likely to meet the original schedule requirements using a different model as the vehicular platform. It was also mentioned that this program is continuing to move forward, but it would be nice to see some baselining compared to what DOE is collecting on competitive vehicles. It was expected to see 60 vehicles in test, but the reviewers were surprised not to have the additional details on expectations of consumer behavior and final placement of vehicles.

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

Reviewers agreed that it was difficult to determine how much funding was needed; it was assumed that it was contained within GM program resource commitments.

Ford Plug-In Project: Bringing PHEVs to Market: Greg Fenette (Ford Motor Company)



Reviewer Sample Size

This project had a total of 3 reviewers.

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

Reviewers stated that plug-in hybrid vehicles offer a significant opportunity for reducing fuel consumption, with a corresponding reduction in emissions. This project incorporates lithium-based battery technologies and flex-fuel engine capabilities in which a large percentage of the vehicle's energy consumption would come from domestically produced fuels. This program also supplemented Ford internal efforts to bring a plug-in hybrid car to market at an accelerated pace.

It was also noted that this project identifies a sustainable pathway toward accelerated and successful mass production of PHEVs to get to the 2012 launch. However, the reviewers would like to see how much petroleum this would displace at various volumes of vehicles and over what time period of expectation to sell into the marketplace.

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 agreed that the technical approach appears to be sound, with the program working through a number of technical challenges in a very expeditious manner. The scope of effort included design of propulsion system, hybrid control system, development of vehicle to grid communications, selection of a battery supplier and subsequent development of battery control systems, laboratory testing to quantify fuel economy benefits, and finally, a fleet evaluation program, consisting of 21 vehicles released throughout the U.S.

Another commenter pointed out that Ford is following a logical, technical progression in developing and deploying their fleet of 21 PHEVs. The project's strong interest and coupling via deployment with various utilities is especially attractive. The active emphasis upon Smart Meter and two-way V2G and G2V communications as part of the deployment is excellent. Additionally, the human machine interface is very appropriate. Ford is also using their well-developed base of utility partners to conduct extensive public education. Ford recognizes that in many ways the successful development and commercialization of PHEVs is as much a consumer perception and marketing challenge as a technical challenge.

It was also stated that the first 10 vehicles were built with Ford built battery packs while the rest of the fleet has JCS batteries. Ford has also increased the Escape engine size from 2.3L to 2.5L, seemingly the opposite direction of what expected. The reviewer also had some questions including: How many different combinations of updates are you currently fielding? What was the increase in the weight of the vehicle that is PHEV vs Base vehicle? What are the metrics that are being monitored wirelessly? (that are also provided to DOE and what is DOE doing with this?) It would also be helpful to note how much it costs to field a vehicle.

QUESTION 3: CHARACTERIZE YOUR UNDERSTANDING OF THE TECHNICAL ACCOMPLISHMENTS AND PROGRESS TOWARD OVERALL PROJECT AND DOE GOALS.

The first reviewer noted that it appears that excellent progress has been made to date, assuming that this activity began in 2008. Completing vehicle design, prototyping, lab performance testing, along with field testing of 21 units indicates that the efforts have been focused and well managed. The list of accomplishments aligns well with stated project objectives, and it appears that the project is tracking to an on-time completion.

Another commenter included that Ford is demonstrating a steady stream of technical and programmatic accomplishments including vehicle design and build, implementation of two-way communication on all vehicles, implementation of flex fuel calibration and strategy, and improved vehicle/battery robustness at cold temperatures. Broadband wireless data collection has been implemented. Additionally, the human machine interface displays are very appropriate. All 21 fleet vehicles are on the road racking up miles and have not demonstrated any battery problems. The feedback received from utility partners to date has been very impressive with regards to all electric range and drivability. The project is under budget and on schedule for completion in June 2012 and preparation for commencement of mass production that year. The detail included in this presentation was appreciated.

QUESTION 4: WHAT IS YOUR ASSESSMENT OF THE LEVEL OF COLLABORATION AND COORDINATION WITH OTHER INSTITUTIONS?

Reviewers noted that Ford has worked with DOE on aspects of development, although the specific areas of collaboration are not clear. Understandably, much of the development work has been conducted in-house. The only government activity specifically noted was the fuel economy testing conducted at Argonne Labs. It was also pointed out that Ford had identified battery cost and charge time as technical barriers. To address these barriers, Ford brought on Johnson Controls - Saft as their battery supplier during Phase 2 of the program and approximately half of the 21 vehicle fleet uses the Johnson-Saft batteries. A number of electrical utility companies are also listed as partners, presumably for the V2G and G2V development activities. Another commenter also mentioned that Ford's network of utility partners is especially impressive and is being leveraged appropriately. A strong outreach effort is being made with agreements reached with 10 partners for demonstration. Ford has also been working closely with Johnson-Controls / SAFT early on to improve and implement their lithium-ion based battery technology into the second half of the demonstration vehicles. The final reviewer reported really liking the fleet location map and mix of customers. What he didn't report seeing is the interaction with DOE on this project and what it means. He also had questions about what type of costs the fleets are taking on.

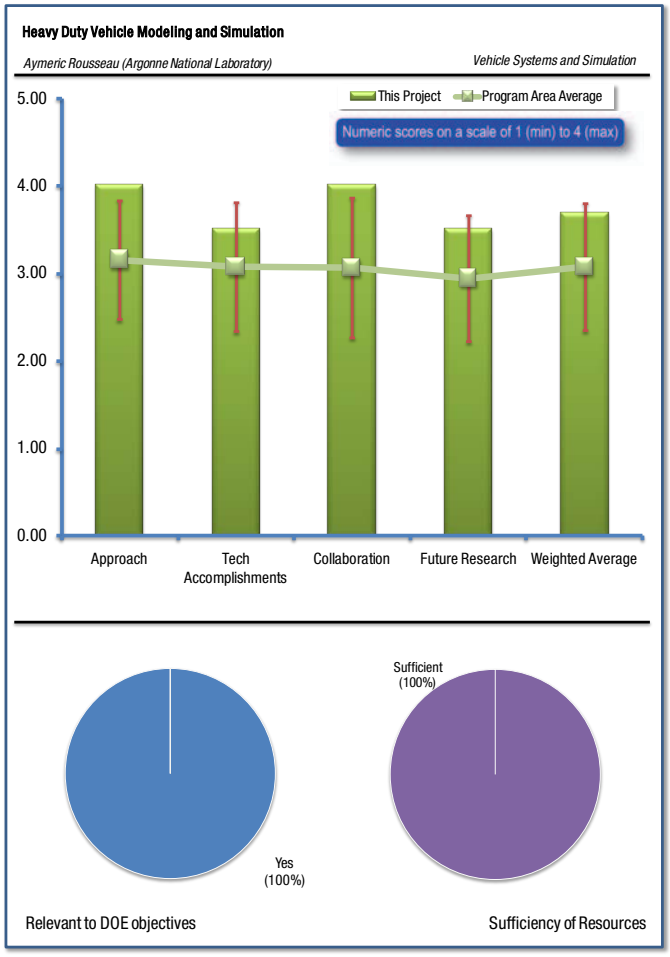
QUESTION 5: HAS THE PROJECT EFFECTIVELY PLANNED ITS FUTURE WORK IN A LOGICAL MANNER BY INCORPORATING APPROPRIATE DECISION POINTS, CONSIDERING BARRIERS TO THE REALIZATION OF THE PROPOSED TECHNOLOGY, AND, WHEN SENSIBLE, MITIGATING RISK BY PROVIDING ALTERNATE DEVELOPMENT PATHWAYS?

Future activities included additional fleet vehicle deployments, improvements to system and battery controls, continuation of V2G and G2V communications evaluations, collection of data from fielded vehicles, usage of data to guide design of production configuration. The program finish is noted as 2012; however, it is unclear if this equates to production implementation or completion of design phase. It would seem that a much greater number of field vehicles should be deployed to gain sufficient confidence in system reliability. It was also stated that lessons learned from this project will serve the next stage of PHEV mass production/marketing and feed Ford's full battery EV program. The final commenter pointed out that in 2012, the product vehicle design needs to be frozen to move into production. However, he had questions about whether it is the end game or if there are additional items that are for Future Research.

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

It was noted by the reviewers that, apparently, significant resources have been devoted to this critical program from Ford. That said, funding amounts seems rather low, unless technology developed for other programs is being leveraged here. As previously noted, given the early-on production date, it would seem that the fleet testing must be significantly expanded. It was stated that the availability of DOE funding was a significant enabler for (or at least accelerated) the development of this vehicle. Another reviewer felt that resources for this task are sufficient and that overall, this is a well designed and implemented PHEV development and demonstration activity. The final reviewer did mentioned and a very good job was done on the presentation.

Heavy Duty Vehicle Modeling and Simulation: Aymeric Rousseau (Argonne National Laboratory)



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 first reviewer felt that modeling and performance analysis of heavy vehicles provides insights into improving designs and operations leading to fuel savings. The second pointed out that a significant fraction of petroleum based fuels are consumed in HD vehicles, so technologies to enable lower fuel consumption directly support this DOE program objective.

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

Reviewers felt that the modeling and analysis scenarios seem to be right on, tasks and milestones are clear, and accomplishments are specific and are aimed at addressing the barriers. It was also noted that collaborations are appropriate and both sides are providing value. There was also mention of a very good approach to integrate data, models, simulation, and validation to improve vehicle design and guide R&D efforts. However, it was requested that the project team identify the potential for fuel consumption reduction for each class of vehicle and each technology applied, including control strategies.

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

Reviewers felt that the team has made very good progress toward the end of this project on achieving objectives. Some early results are already identifying operational methods leading to fuel savings. Accomplishments are clear and measurable and provide value to DOE and the project's partners. Assessing the potential improvements in efficiency in terms of meeting the basic function/mission of the vehicle, air conditioning loads, hybrid component losses versus other improvements, and the impact of basic versus advanced control strategies would also be useful. Drive cycle and driver behavior are also areas of interest (as noted in future research).

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

It was felt that excellent use of partnerships for access to vehicles, component data, and validation data was executed. The list of collaborators is very reasonable, they appear to be working well with the PI to provide necessary modeling and operational data, and the project is providing useful information back to the collaborators. Reviewers also mentioned that, perhaps, the project team should consider more coordination with EPA to at least begin to assess impact of these technologies and control strategies on in-use emissions.

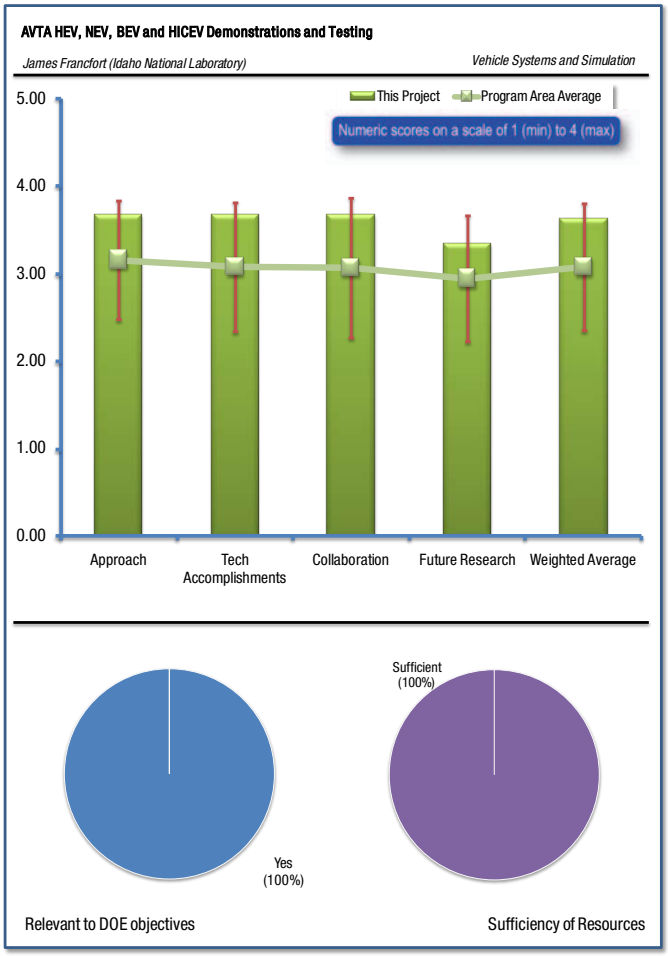
QUESTION 5: HAS THE PROJECT EFFECTIVELY PLANNED ITS FUTURE WORK IN A LOGICAL MANNER BY INCORPORATING APPROPRIATE DECISION POINTS, CONSIDERING BARRIERS TO THE REALIZATION OF THE PROPOSED TECHNOLOGY, AND, WHEN SENSIBLE, MITIGATING RISK BY PROVIDING ALTERNATE DEVELOPMENT PATHWAYS?

Reviewers felt that future work is expected to provide more of the same good work with specific accomplishments and milestones, overall very good work. Even though exhaust emissions are not part of the scope of modeling, it was requested that the project team consider partnerships that can address this issue, and include emissions where possible in any validation data effort.

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

Reviewers felt that the funding appears to be sufficient but at the same time somewhat modest for the new modeling and analysis area. Heavy vehicles are complex and cover a wide array of configurations. It was also mentioned that maybe this effort should be expanded.

AVTA HEV, NEV, BEV and HICEV Demonstrations and Testing: James Francfort (Idaho National Laboratory)



Reviewer Sample Size

This project had a total of 3 reviewers.

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

Reviewers felt that by providing accurate and timely test data, the project promotes the use of petroleum reducing alternatives. This project also provides the public with invaluable information to educate them on the performance and reliability of these new technologies.

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?

The first commenter noted that this project does not work on "reach" technology, so it is not particularly focused on technical barriers. However, the data warehousing and processing required to test this many vehicles is an under-appreciated challenge, and the project team is doing a good job of scaling with the needs. It was also stated that this is not a technically intensive project; the test protocols and how to manage the program are the greatest management challenges. Consistent application of the protocols seems to be the well done. Another reviewer has a concern when the answer is, "I don't have enough money to do the project."

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

All reviewers agreed that the testing appears to be on target. Again, the focus is not on ambition but on execution, and the team appears to be doing an excellent job of keeping a diverse activity under control. The consistency of the information and its relevance are how the barrier of public confidence is being overcome to the use of these new vehicle systems. Again, the number of vehicles and the mileage accumulation is useful. It will be nice to see how the Leaf project progresses and if this can be compared to Nissan's project in Israel.

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

Reviewers felt that there is excellent collaboration with partners within DOE and with external partners. It was also noted that significant collaborations for funding and equipment exist here that leverages massive capability to generate the information that is being provided to the public. It was also felt that this information is useful as it gets disseminated. One reviewer would also like to learn more about the work that is being done with Canada, due to past experience there.

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 first commenter mentioned that there appears to be a good plan in place to continue testing. Another reviewer also felt that the project team should look at a study that will show how real world driving may change battery system reliability and durability vs this

accelerated drive schedules. Accelerated mileage accumulation is a benefit to battery life and it would be of great interest to see if actual usage is in any way different from this accelerated mileage method. It was also stated that another commenter did not like to hear the complaint of being "budget constrained."

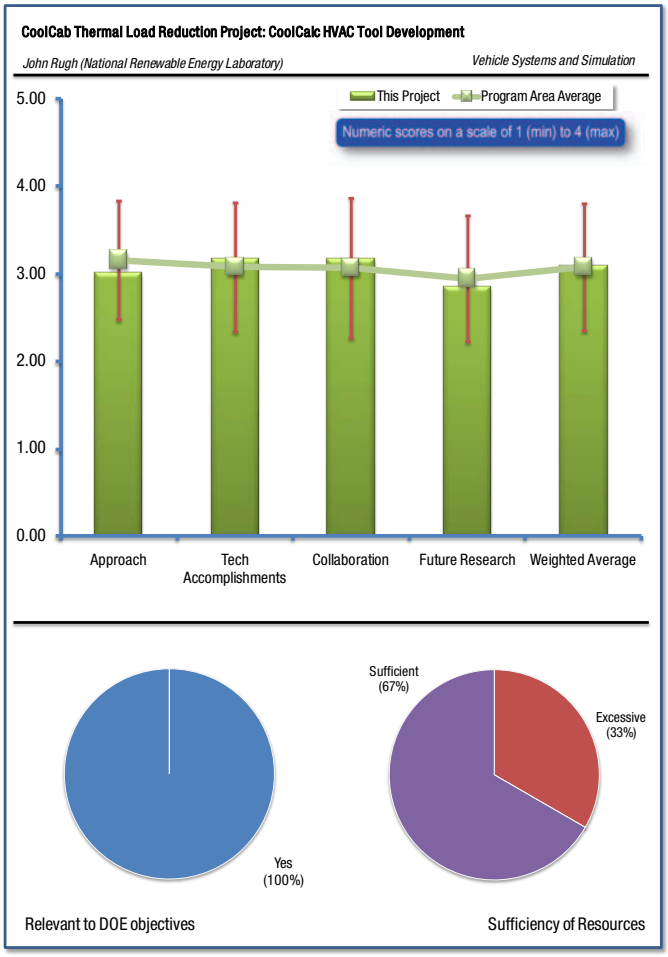
QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

Reviewers felt that funding appears to be good and management seems to be adequate for funding increases already in the pipeline. It was added that it would also be nice to see the actual manpower on these projects.

CoolCab Thermal Load Reduction Project: CoolCalc HVAC Tool Development: John Rugh (National Renewable Energy Laboratory)

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?

All reviewers felt that this project fulfilled the objectives and that CoolCalc may prove to be a useful tool for evaluating thermal conditions in the truck cab leading to better thermal designs aimed at reducing fuel consumption by reducing truck idling periods. It was also stated that the main effort is to develop test methods rather than actually reduce load, so that it is a support effort.

Another commenter mentioned that reducing idling of heavy duty trucks can save millions of gallons of diesel fuel per year. One of the biggest barriers to reduced idling is the inability of some idle reduction technologies to meet performance requirements over widely varying temperature ranges. Especially challenging is the need to keep the truck cab cool in high temperatures over extended time periods. If the load can be reduced, via any of a number of thermal management strategies, the capacity and cost of idle reduction systems can be reduced thereby greatly increasing their market viability.

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, the reviewers agreed that the development of an easy to use tool with standard available software (freeware) is a great approach. One reviewer noted that this project makes use of existing code and tools resulting in an economical approach. However, it is not clear that the truck sketch is best approach; instead, the user could just be given an option of typical truck designs. The model does consider heat transfer coefficient and infiltration, but the user must "guess" at some values. It is evident that the presenter is aware of ways to expand the approach using more fundamental methods, but it is not clear how deeply the project will consider these. Another felt that the approach to this task is reasonable and methodical starting with the need to reduce the thermal load on the cab, identifying a modeling pathway, validating the model through field testing of actual truck cabs under varying thermal loads, integration of an air conditioning model, and sharing of the model with industry partners. The final reviewer pointed out that the project uses the top down approach, combining analyses and testing. The modeling system is physics based, no mesh modeling, with convenient input/output and the results are compared with experiments for validation. This modeling system allows modifications to designs to accomplish the thermal goal and it is linked to DOE database of weather for thermal boundary determinations.

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

The first commenter noted that the importance of a user friendly interface to running the program tends to be underestimated in many of the research programs; however, it is quite the contrary here. The overall package looks very good. He also noted that he is looking forward to trying out the CoolCalc tool in the near future. Another noted that the project is on schedule.

The third reviewer felt that a real A/C model will be very complex, particularly when the heat rejection couples with the engine heat rejection & aerodynamic factors. Several test projects have been completed, and these are accomplishments, but a holistic model (as opposed to a vision of many options) is needed. However, the work done is still very valuable. It is good that CRADAS are executed.

The final reviewer pointed out that overall; the task has progressed but has taken a long time. The project was initiated in 2006 and only now a beta version of the tool is becoming available. For the length of time the task been active and funding expended to date (nearly $2M), technical accomplishments have been somewhat sparse. Technical accomplishments surround CoolCalc tool development and heavy duty truck cab instrumentation and testing with results used to validate CoolCalc.

QUESTION 4: WHAT IS YOUR ASSESSMENT OF THE LEVEL OF COLLABORATION AND COORDINATION WITH OTHER INSTITUTIONS?

Reviewers felt that the project has a nice collaboration network with industries for testing and feedback. It was also noted that the partners have provided access to truck cabs enabling the project to measure thermal conditions and validate modeling efforts. One commenter did point out that the cooperation has been with trucking companies only. This tool is a general purpose tool that could be used for other applications as well. It may be worthwhile to consider involvement of the automotive OEMs as well. The final reviewer noted that the task has been coordinating with several heavy duty truck OEMs (PACCAR, Volvo, Freightliner, and International) and a fleet and idle reduction technology equipment manufacturer. It is disappointing that after five years it appears no industrial cost sharing has been procured, which lends doubt to how badly the truck industry is really interested in this tool. Primarily the truck OEMs are lending a couple of their vehicles to be instrumented in order to help validate CoolCalc. The project indicates that a primary barrier is the industry lacks key performance data on HVAC loads and truck cab thermal load reduction technologies, which may not be completely true.

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 first commenter noted again that if some cooperation with automotive OEMs could be achieved, it would be worthwhile to use some of the passenger car/SUV information to validate the model as well. It was also mentioned that there is a need to define confidence of predictions, perhaps with a parametric study.

Another reviewer felt that the proposed work is appropriate to bring the development of CoolCalc to a relatively mature, validated and usable state. Other than any additional generic and essential improvements that may be identified, application of CoolCalc should be turned over to the OEMs and/or HVAC vendors for their use. NREL's long term scope should be to develop new essential models (if any more are really needed) and code validation. Specific evaluation and designing of truck cabs should be left to the OEMs. The extent to which the OEMs utilize and/or provide financial support for CoolCalc will substantiate its value to DOE and the OEMs for thermal load reductions leading to reduced fuel consumption.

The final reviewer stated that proposed future research includes applying CoolCalc tools to testing, and working with industry to improve idle reduction technology. The DOE is no longer in the idle reduction technology business as primary responsibility for this was transferred several years ago to EPA. As a force multiplier, thoughts should be given to transferring the technology to other vehicular applications such as transit and school buses. Efforts should be made to obtain cost sharing from non-DOE sources, to comprehensively identify (with truck OEMs) the universe of barriers to widespread commercialization of thermally enhanced tractors, and a task end game established bringing the task to conclusion no later than 2011.

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

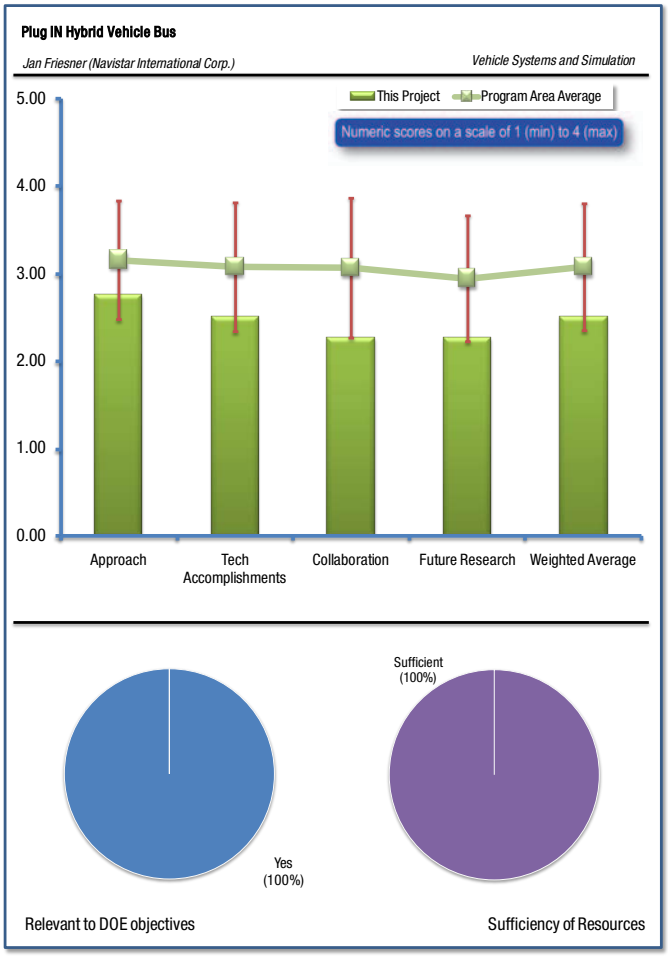
The first commenter mentioned that the budget is sufficient to large and that NREL has the ability to address driver comfort more precisely (model, spatial variation), and if this is done, resources are well matched.

Another reviewer felt that the project has produced reasonable results through its fifth year of an eight year schedule. The budget appears reasonable and adequate and the project should be looking for additional OEM support as CoolCalc matures and becomes a viable design tool. The project had a big increase from its FY09 budget of $300K to its FY2010 budget of $900K. Given CoolCalc's

apparent near-maturity, DOE should consider reducing the budget back to about $300K to support additional essential model development and validation. It was also noted by another that this task is overfunded and should be scaled back significantly.

The final commenter pointed out that concerns surrounding this task include the lack of cost sharing from non-DOE entities, no definitive project end game, and questions as to what is really needed for industry to broadly implement thermal enhancements in heavy duty truck cabs. For example, even if a highly accurate tool (say CoolCalc) is available for determining HVAC loads and appropriate mitigation strategies–will this lead truck OEMs to broadly implement improved insulation strategies, glazings, IR reflective materials, and so forth? Or are there other business barriers such as cost and return on investment, weight, driver preferences, etc. which are the real show stoppers? A very frank dialogue with truck OEMs is necessary if it hasn't already been conducted in depth to truly understand the business barriers to widespread commercialization of thermally advanced truck tractors.

Plug IN Hybrid Vehicle Bus: Jan Friesner (Navistar International Corp.)



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?

It was noted by a reviewer that school buses are potentially attractive vehicles for electrification, given their start-and-stop duty cycle, consistent and centralized refueling pattern, and ability to accommodate hybrid-electric systems equipment. While school buses don't account for a significant fraction of the country's petroleum use, they offer the opportunity to clean up the air around some of the country's most vulnerable citizens (children) and provide a visible platform to promote awareness and acceptance of advanced vehicular technologies.

Another noted that if the claims made by Navistar of 1400 gallons per annum of fuel use reduction are realized, then it would meet the objectives; however, no info on how that may happen was provided.

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 that since the project has only been ongoing for the past few months, reasonable progress has been made. However, one reviewer did feel that not enough information was provided to evaluate it and the program has too much proprietary information to evaluate it to any degree of depth.

Another commenter noted that the overall approach of looking at both parallel and series configurations, constructing two buses of each, and testing at least two battery types in each configuration makes sense. Also, focusing on 30 miles electric range, from 0 - 45 mph, is appropriate to maximize the potential benefits for the majority of bus routes while minimizing storage requirements. The approach of publishing cost targets to promote competition from suppliers is especially attractive.

The final reviewer stated that the presentation listed the technical barriers but did not elucidate exact plans to address them and there was absolutely no discussion about addressing the cost barrier. PHEV battery packs for automobiles are estimated to add $20,000 to the cost of an vehicle, so a much larger battery pack for a school bus will most likely cost a lot more. Not much was said about availability, integrations, and potential reliability problems that were identified, but no real plans were presented to address reliability. The reviewer also noted that it's not clear how many PHEV buses will actually be constructed and tested. Parallel- and series-hybrid configurations were stated and “at least two [unspecified] battery types.” So this could be two buses, four buses, or maybe more.

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

While the reviewers all agreed it may be a little too early to tell, accomplishments seem roughly in line with the current early stage of the project. However, it was noted that it does appear that the project may be slightly behind schedule.

QUESTION 4: WHAT IS YOUR ASSESSMENT OF THE LEVEL OF COLLABORATION AND COORDINATION WITH OTHER INSTITUTIONS?

Reviewers did note that other than stating that bids were received to test the batteries and perform emission testing and some uses of DOE lab simulation elements, no collaborations were cited. Another commenter pointed out that outside of battery and fuel economy and emissions testing, it is not clear who other project participants are. It may be appropriate to include another manufacturer experienced with hybrid/electric systems for medium-heavy vehicular applications, NREL for their intimate knowledge of duty cycles and recent PHEV school bus project with Enova, and possibly make exploratory inquiries with bus manufacturers about innovative bus construction designs that may facilitate application of advanced PHEV systems. A holistic approach examining not just application of hybrid electric systems but the entire bus structure could lead to advances or breakthroughs from a cost or functionality perspective.

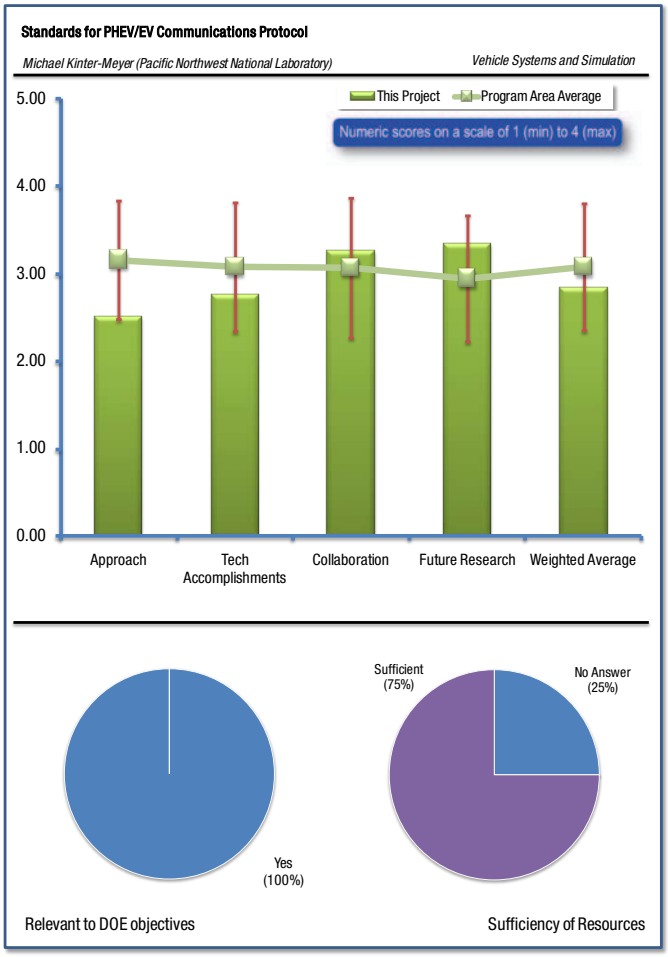
QUESTION 5: HAS THE PROJECT EFFECTIVELY PLANNED ITS FUTURE WORK IN A LOGICAL MANNER BY INCORPORATING APPROPRIATE DECISION POINTS, CONSIDERING BARRIERS TO THE REALIZATION OF THE PROPOSED TECHNOLOGY, AND, WHEN SENSIBLE, MITIGATING RISK BY PROVIDING ALTERNATE DEVELOPMENT PATHWAYS?

Reviewers felt that the time frame for a point solution-based demonstrator program seems to be practical according to industry standards. It was also noted that the short-term planning for the next few months seems OK, but the long term planning was short on details. The final reviewer agreed by adding that the proposed future research is somewhat generic focusing on fuel economy, emissions, and durability testing as well as public awareness events, including ride and drives.

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

Reviewers had only limited information on the funds available for this project and as such were limited on their input. However, one reviewer noted that in the presentation it was never stated how many PHEV buses would actually be constructed (2? 4? More?). He also noted that the resources were not really discussed, but one would assume that Navistar should be able to convert a few buses into PHEVs and evaluate them for nearly $20M. Another reviewer felt that the task is sufficiently funded and 50% industry cost-shared.

Standards for PHEV/EV Communications Protocol: Michael Kinter-Meyer (Pacific Northwest National Laboratory)



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?

It was widely agreed, by the reviewers, that the project as proposed will support the overall DOE objective to reduce petroleum displacement by proposing to improve standards and communications protocols for PHEV/EV vehicles. Such data on PHEV/EV could indirectly support the use and acceleration of new/more PHEV/EV into the US market space. Another added that greater integration and standardization of grid connectivity is essential as the number of vehicles increases.

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?

The first reviewer commented that there does not seem to be a clear goal or approach. Although contributing to the standard development is useful in itself, it is not clear what unique work PNNL is doing, and why this work is critical to the overall effort.

The second reviewer felt that the project attempts to make an important impact on the proposed project: developing standards for PHEV/EV communications and protocol. This could be important work including validation of standards, multiple data variables, and states of charge. Effectively communicating this data would also be critical and linking IEC with SAE activities. However, at present, while these important project objectives are stated, the approach to the work may not be as effective as necessary to achieve the planned results. The approach to the work presents a methodology but lacks a demonstration of the implementation of the approach. The project promises to build a "VGC Virtual Testbed" to test validation procedures for VGC. This requires collaboration with industry partners and it is not clear as presented that this will be accomplished.

Other commentators noted that it is a good approach but only focuses on the passenger car industry and has not given any consideration to commercial EVs. It was also mentioned that the project appears to understand the status quo and its short comings and has identified plans to correct them.

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

It was noted that, given the early state of the project, it is difficult to evaluate progress, but it seems that adequate progress is being made. Another reviewer noted that, as stated above, while the methodology of the work proposed is fundamental, implementation strategies for the work appear weakly coordinated. This lack of implementation does appear to demonstrate and realize the potential impact of the work. There does not appear to be much data to support results yet in the project. Equipment is being purchased for the work. Perhaps it is still too soon in the project for comprehensive results. The work is certainly potentially important to document limitations and visions in EV distribution, and data would also be useful for medium-duty vehicles for SAE.

The final reviewer added that the project appears to have only considered individual vehicle charge situations and should be expanded to include multiple vehicle charge stations operating at same time, such as parking structures etc. Interesting use of ZigBee (something the reviewer had not come across previously). Subsequent research suggests that this technology is a good fit for this application.

QUESTION 4: WHAT IS YOUR ASSESSMENT OF THE LEVEL OF COLLABORATION AND COORDINATION WITH OTHER INSTITUTIONS?

Reviewers felt that the project team has put together a good collaborative team including a standards body, an OEM, a utility company an EVSE supplier, and a national lab. However, it was mentioned that collaboration and coordination is the core of this project, but it's not clear what the specific plan is to achieve this.

Another commentator noted that the collaborators on the work appear to be strong and include the Society of Automobile Engineers, Argonne National Lab, Ford, Echelon, Coulomb, and DTE Energy. However, as stated above the coordination and implementation of the project remains weak. The effectiveness and potential value of the collaborations is not realized.

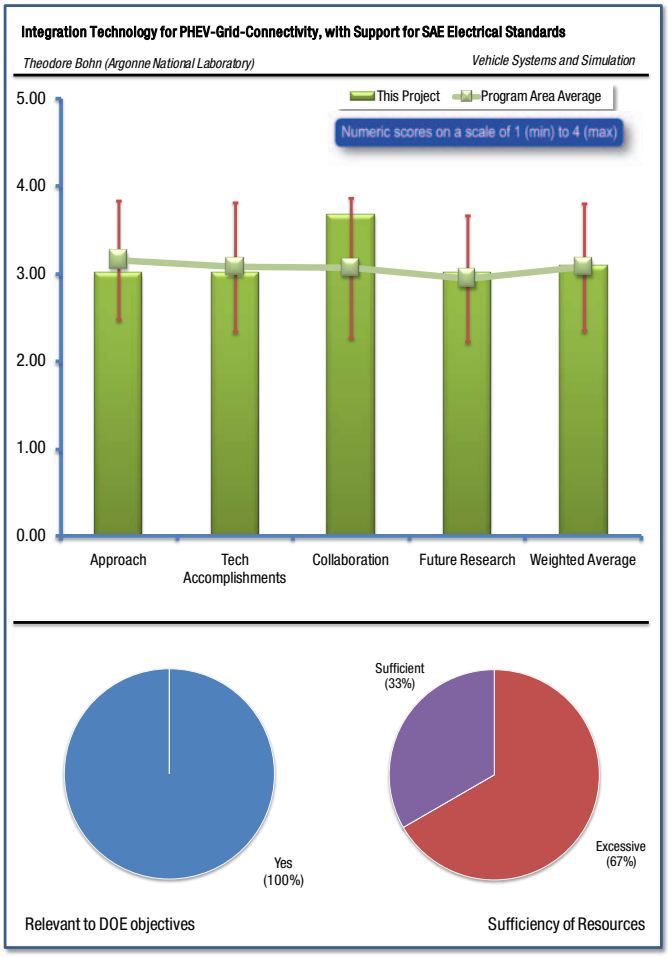
QUESTION 5: HAS THE PROJECT EFFECTIVELY PLANNED ITS FUTURE WORK IN A LOGICAL MANNER BY INCORPORATING APPROPRIATE DECISION POINTS, CONSIDERING BARRIERS TO THE REALIZATION OF THE PROPOSED TECHNOLOGY, AND, WHEN SENSIBLE, MITIGATING RISK BY PROVIDING ALTERNATE DEVELOPMENT PATHWAYS?

Reviewers felt that the lack of a coherent plan is again a problem in evaluating this. It seems that there is a plan to create the test bench; however, reviewers were unsure how critical this is to the overall effort, and how the other partners will be incorporated into this process. It was also added that the project's stated future work ends at the end of this fiscal year with the expectations that it will all be completed.

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

It was generally accepted by the reviewers that the resources seem to be adequate for the proposed work. One commentator did mention that it is difficult to determine; however, it is assumed as project duration is so short that resources are appropriate. Another reviewer agreed by adding that the budget and collaborations should be sufficient to complete the stated work scope as long as the collaborators all participate in a timely manner.

Integration Technology for PHEV-Grid-Connectivity, with Support for SAE Electrical Standards: Theodore Bohn (Argonne National Laboratory)



Reviewer Sample Size

This project had a total of 3 reviewers.

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

Overall, the reviewers felt that by assisting the deployment of PHEVs, this work supports the objective of reducing petroleum use. It was also stated that adequate infrastructure, vehicle-to-grid integration and standards are important for success in PHEV acceptance and commercialization which leads to reduced petroleum usage.

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

A reviewer mentioned that this is a collection of projects and tasks that appear to be making good progress although it was difficult to evaluate because of the diverse nature and number of activities. However, the second identified barrier in part states "Alternative approaches exist…" If it is truly the case that alternative approaches exist, it is difficult to understand how this is a barrier. It was also noted that the development of clear industry standards is a must if the DOE is to manage the future power requirements for an increasingly electric national fleet.

It was also stated by another commentator that this seems like a diffuse grab-bag of work. Some of the different parts seem interesting, but there is not a clear overall plan or defined goals. At some point, though, advanced research needs to happen this way, so it is trusted that the project funders are keeping track of the overall direction.

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

Reviewers felt that it is difficult to assess actual progress with the information given, but the different subparts appear to be on track. It was also added that the potpourri of projects appear to be making good progress. Another reviewer noted that the project has taken on many challenges: in fact, too many for a single presentation. However, the approach of defining electrical connector requirements, motor ratings, and charger efficiency metrics has resulted in some good consistent standards that will help manage the future growth. The reviewer was, however, disappointed that in this day and age we still find EU, US and Japan doing things differently. When will we see a global standard?

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

Reviewers felt that it appears that there is good collaboration. Another added that the project had compiled a vast list of collaborators from national labs, to OEMs, to utility companies and EVSE suppliers, an exhaustive list.

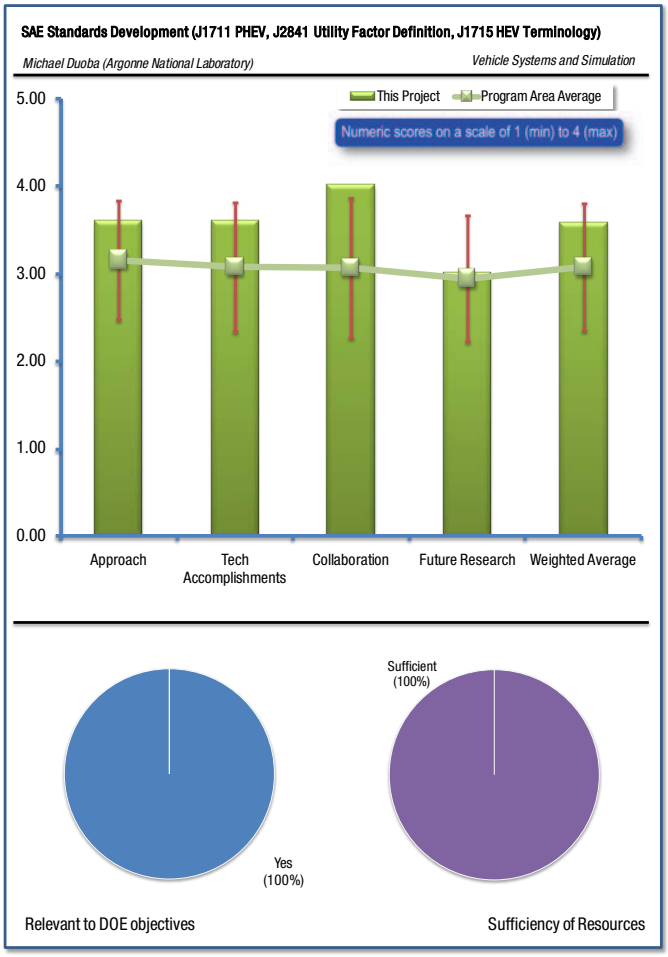
QUESTION 5: HAS THE PROJECT EFFECTIVELY PLANNED ITS FUTURE WORK IN A LOGICAL MANNER BY INCORPORATING APPROPRIATE DECISION POINTS, CONSIDERING BARRIERS TO THE REALIZATION OF THE PROPOSED TECHNOLOGY, AND, WHEN SENSIBLE, MITIGATING RISK BY PROVIDING ALTERNATE DEVELOPMENT PATHWAYS?

The first commentator felt that it seems that there are interesting ideas, but there is not a coherent plan with clear milestones. The second reviewer was pleased to see the proposed work for next fiscal year to include investigations on vehicle to grid communications technologies that emphasizes operations between countries as well as regions. The development of rating standards for Power Electronics and Energy Storage Systems are also a long time overdue. It was also noted that the stated future scope and general approach appear reasonable.

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

The first reviewer pointed out that this work seems to be going in too many directions at once, which is an indication that funding exceeds the needs of the core research questions. It seems that more appropriate funding could improve focus. Another reviewer agreed by adding that the use of the second portion of the FY2010 budget was not adequately detailed nor adequately justified. Also, the second slide shows that $470k is pending for new projects. There is concern that this funding may be excessive given the lack of a clearly identified scope. This is not a good way to utilize taxpayer funds.

SAE Standards Development (J1711 PHEV, J2841 Utility Factor Definition, J1715 HEV Terminology): Michael Duoba (Argonne National Laboratory)



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 felt that this project supported the overall objectives and that a fair and consistent measure of fuel economy is essential to consumer confidence in the published figures when selecting a vehicle. Another commentator agreed that this project enables the market penetration of electric vehicles which leads to displaced petroleum use. It was also added that the establishment of robust, flexible, technology neutral, and broadly accepted test procedures and standards are essential to the successful market introduction of PHEVs and other electrified vehicles. The development of test procedures and standards is an arduous, time consuming task that requires participation and cooperation from a broad spectrum of interested parties.

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 that the goals of the project have been achieved on a very tight timeline, in time for implementation. It was also agreed that the approach used was very good, and about the only way to get this work done in the time frame needed. The final reviewer added that the approach followed by this task is very robust, comprehensive, and inclusive. ANL chaired the J1711 Task Force and served as arbiter of competing interests. In the development of test procedures and utility factors, deep analysis has been conducted which has been augmented with the testing of many different PHEVs. This overall approach has led the finalization in a timely manner of the J1711 concept document which was sent to ballot in March 2010.

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

Commentators stated that the project is essentially complete, with all objectives met, and the J1711 process is near completion. It was stated that the standards are rigorous, and have now been published. Reviewers also felt that the project team did a great job of addressing the many issues that came up.

The final reviewer added that this task has demonstrated a number of new technical accomplishments including the completion of 1) multi-day individual utility factor (MDIUF), 2) rewrite of J2841 with MDIUF, 3) Definition of SOC corrections, 4) harmonized charge depleting range and end of test criterion, 5) alternative results calculations, and 6) updating of J1715 HEV terminology document. The knowledge gained through development of J1711 will be a key enabler in the development of the electric vehicle (J1634) standard.

QUESTION 4: WHAT IS YOUR ASSESSMENT OF THE LEVEL OF COLLABORATION AND COORDINATION WITH OTHER INSTITUTIONS?

Each of the reviewers agreed that the right participants were chosen and involved in getting an end product that addressed the needs of the industry. It was added that EPA, CARB, vehicle manufacturers are included and the involvement of JARI and Environment Canada is important. The final reviewer added that the collaboration for this task has been outstanding with input and participation from CARB, ISO, JARI, EPA, and DOT. Especially impressive is the harmonization and success in keeping J1711 compatible with CARB and ISO. Additionally, EPA and DOT will reference SAE standard J1711 for fuel economy labeling and CAFE. Furthermore, ANL is working with Idaho National Laboratory to investigate how J1711 test results compare to actual in-use fleet PHEV data. Additionally, CARB, Environment Canada, and Chrysler have provided early test data in support of J1711. ANL should be commended for all their efforts to draw in interested parties and bring nearly everyone to the table in the development of J1711.

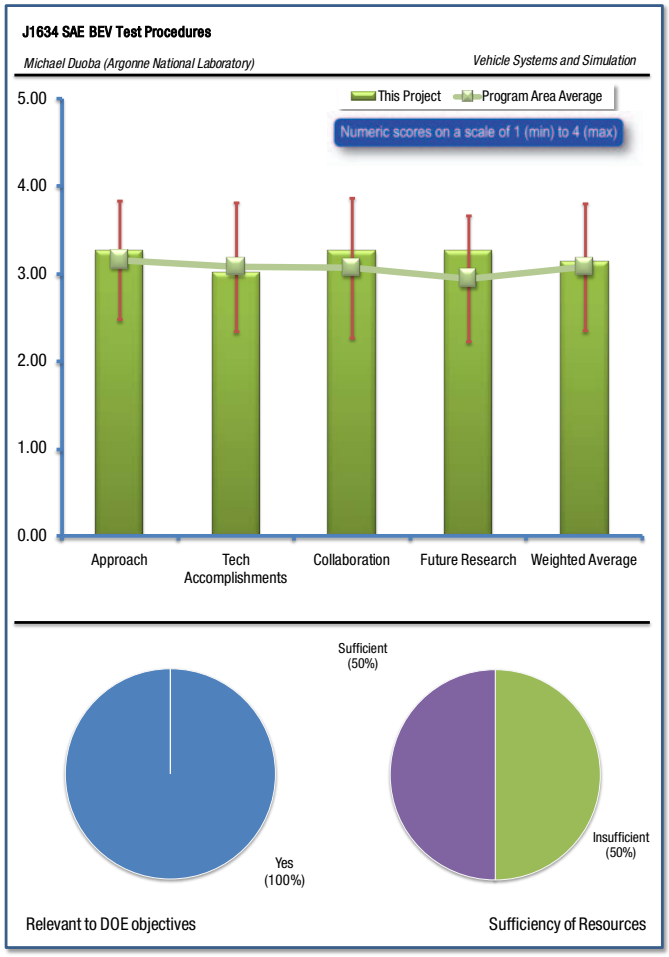
QUESTION 5: HAS THE PROJECT EFFECTIVELY PLANNED ITS FUTURE WORK IN A LOGICAL MANNER BY INCORPORATING APPROPRIATE DECISION POINTS, CONSIDERING BARRIERS TO THE REALIZATION OF THE PROPOSED TECHNOLOGY, AND, WHEN SENSIBLE, MITIGATING RISK BY PROVIDING ALTERNATE DEVELOPMENT PATHWAYS?

Reviewers acknowledged that the J1711 standard program is near completion. It was also added that the proposed future activities are appropriate in substance and scope. A journal article will tie up the J1711 rationale and provide a learning tool for test engineers. Possible short cuts may be revisited and better understanding of PHEV in-use performance will be explored.

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

Reviewers felt that the end product appears well suited to the stated objectives and since the task ends in 2010, it has been appropriately funded. It was also felt that there was good sharing of resources from related activities.

J1634 SAE BEV Test Procedures: Michael Duoba (Argonne National Laboratory)



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 felt that this project supports penetration of electric vehicles. It was also noted by a reviewer that although this does not represent applied research, it is essential to develop uniform procedures to characterize new technology and to evaluate system design and control improvements. It was also added that the development of a BEV test procedure is a necessity to ensure an efficient and consistent approach across the entire space and prevent mis-selling or misrepresentation of the truth regarding range, power etc. BEVs are a significant component of fleet electrification plans.

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 of the reviewers felt that this project took a nice solid approach to the standard, with opportunity for comment and feedback included. It was also added that although BEV testing may appear straightforward, there are details which complicate the process and which ANL is addressing. This builds on SAE J1711 development, led by ANL.

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

It is felt that even though vehicles have been tested and data is available, this still requires further development. It was also noted that the short cut approach and use of "Battery in the Loop" to test the viability of these ideas, is an efficient and quick method of getting some early results. Further "real" vehicle tests serve to validate the initial findings. Unfortunately no consideration appears to have been given to commercial EVs.

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

The first reviewer noted that the SAE process assures wide participation resulting in major "traditional" auto manufacturers, plus JARI and Tesla are involved. It was also stated that as mentioned during the presentation, collaboration is essential as consensus must be achieved. There appears to be a good selection of collaborators including both US legislation bodies (EPA and ARB), overseas industry bodies from Japan, and many OEMs domestic and foreign.

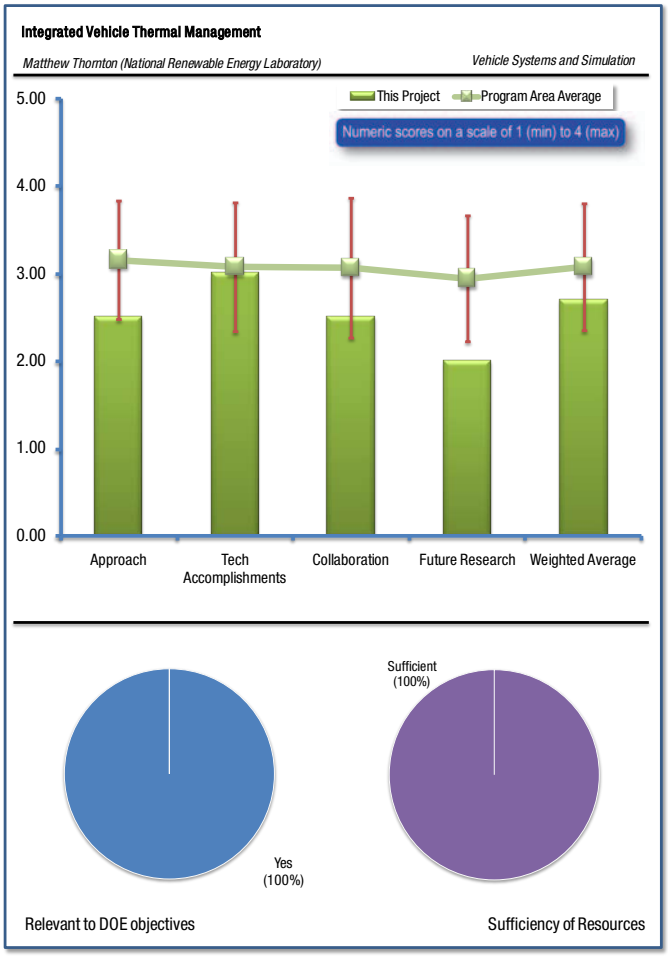
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

The first reviewer noted that the project team recognizes that the method must work for all BEVs. It is important that new technology is anticipated in the best way possible. Pursuing short-cut methods is important, and this has been recognized. It was also mentioned that a reviewer would like to see the use of cabin heaters included as this will also have a significant impact on range.

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

Commentators felt that, for the most part, funding was sufficient for this project. The first reviewer felt that $150K appears reasonable to formulate the standard, but it will limit high volumes of testing. However, the final reviewer would like to see this work accelerated and given high priority.

Integrated Vehicle Thermal Management: Matthew Thornton (National Renewable Energy Laboratory)



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 first reviewer felt that reducing the complexity of thermal systems when adding vehicle electrification complexity is a goal that requires research. Reducing mass and complexity will improve fuel efficiency. It was also noted that it is possible that by integrating thermal management functions throughout the vehicle, cost/energy consumption parameters and space utilization could be improved. One difficulty of this is accurately quantifying and synergistically lining up the heat and cooling load requirements for key components including energy storage, power electronics and electric machines, etc. under various transient operating conditions.

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

A reviewer felt that this is a start and a good one where additional modeling and complex systems evaluation would be of great benefit. However, another pointed out that the principal weakness of the project approach is the lack of industry partners and early input into the task. It would seem that industry would be looking at options to integrate thermal management functions under their HEV/PHEV development programs, yet little mention is made of discussions with industry nor literature research as to what is going in the commercial world.

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

The first commenter stated that the two approaches being investigated are clearly understood and seem valid. Continued effort should bring positive results. The other reviewer felt that the task has made progress quantifying heat loads over transient operating conditions of individual components and integrated systems under real world in-use driving conditions. Some challenges as well as potential opportunities have been identified with regards to integrated thermal management for HEVs/PHEVs.

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

The first reviewer noted that this project, if extended, needs a number of partners to join the effort in the thermal systems supply base. Bringing these results to industry would increase effectiveness. Another reviewer agreed by adding that this task would have benefited from increased and more transparent collaboration with other industrial and government entities. The task has not received any industrial cost share throughout its life.

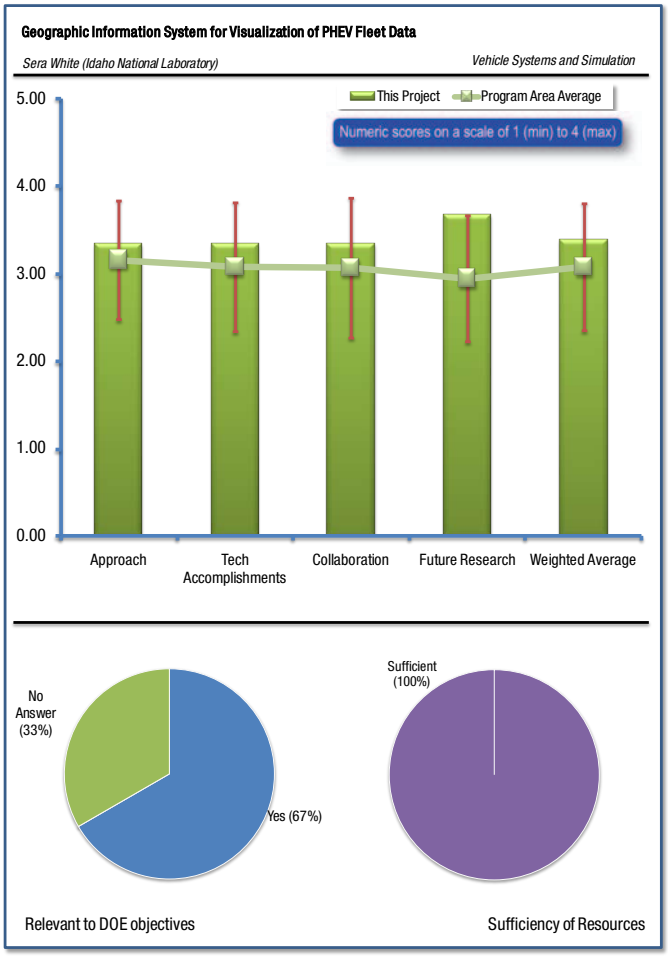
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

Reviewers stated that no future work planned beyond this fiscal year. This may inhibit potential use of the outcomes.

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

It was felt that this project has been sufficiently resourced throughout its life.

Geographic Information System for Visualization of PHEV Fleet Data: Sera White (Idaho National Laboratory)



Reviewer Sample Size

This project had a total of 3 reviewers.

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

Reviewers felt that the project supports the DOE's goal of petroleum displacement by attempting to improve PHEV fleet performance using advanced GIS and visualization tools. The project looks at barriers in present GPS systems and looks for avenues to improve GIS tracking.

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?

The first reviewer felt that the project appears to have clear goals, and appears to be feasible. The project is well-integrated with the overall testing project. It was also added that the project appears appropriately defined for a student. The approach as presented appears sound and generally effective but might be improved. The project notes that GPS data from vehicles is not always transmitted, and therefore proposed targeted lab and field tests in large-scale demos to enhance the INL PHEV test fleet and improve INL QA. Another reviewer also noted that the overlay of fleet data onto the Internet map server provides readable graphical trip data.

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

Overall reviewers stated that it appears that progress is being made, and that the project is on track to being a useful tool. Another reviewer also felt that the project team has made good progress on the work, and met numerous milestones including; (1) completion of development of web based map used to visualize PHEV fleet data (2) completion of a Digital Elevation Model (DEM) slope calculation (3) and integration of the new slope calculation into current aggressiveness algorithms. Future work will include complete city vs. highway trip type determination and a comparison of the results to current trip type determination and evaluate the new algorithms effectiveness. Next steps will include integration of map interface into current QA processes and a beta test and documentation. This approach is a very logical sequential process to achieve a path toward enhancement of the technology. It was also added that the ability to view the route graphically and zoom into different sections with selected parameters identified (e.g. speed) is a useful function.

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

A commenter felt that it is great to see a student lead project with strong leadership from INL. The collaboration with ISU and INL is strong and the relationship with eTec is not only important to achieve the project objectives but good exposure for the student.

Another added that it appears that there is a good coordination with the current project partners, but was concerned that the tool's focus is too narrow. It appears to be useful only to partners who have access to the full, detailed project data. Almost all partners will not be allowed to access this data due to privacy concerns. It will be very valuable to INL, valuable to individual project partners within the limitations, but it is difficult to see the value to organizations that are less tightly coupled.

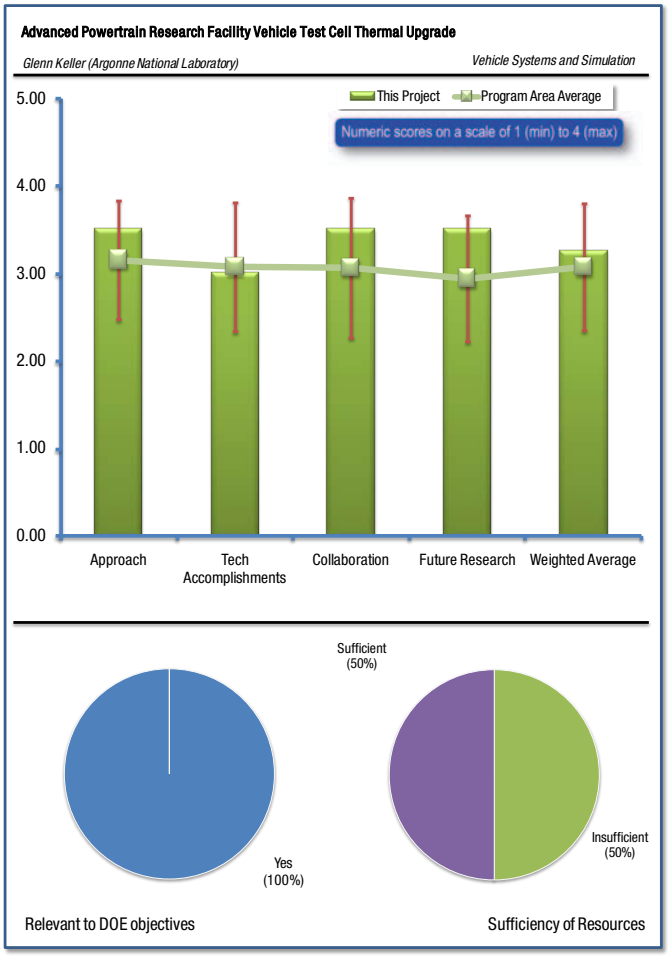
QUESTION 5: HAS THE PROJECT EFFECTIVELY PLANNED ITS FUTURE WORK IN A LOGICAL MANNER BY INCORPORATING APPROPRIATE DECISION POINTS, CONSIDERING BARRIERS TO THE REALIZATION OF THE PROPOSED TECHNOLOGY, AND, WHEN SENSIBLE, MITIGATING RISK BY PROVIDING ALTERNATE DEVELOPMENT PATHWAYS?

The first reviewer stated that the project appears to have a good plan for future development. It was noted that it does not seem to have defined decision points, but given the nature of the project it seems that flexibility is more valuable. Another added that future work is strong, logical, and sound but may be improved by consideration of extended deployment. The final reviewer felt that the inclusion of slope/grade data is a very useful enhancement of the tool.

QUESTION 6: HOW SUFFICIENT ARE THE RESOURCES FOR THE PROJECT TO ACHIEVE THE STATED MILESTONES IN A TIMELY FASHION?

The reviewers agreed that resources seem sufficient for the given project goals. One reviewer added that the resources are excellent and matched to support a student project.

Advanced Powertrain Research Facility Vehicle Test Cell Thermal Upgrade: Glenn Keller (Argonne National Laboratory)



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 first reviewer felt that this project promotes development of an experimental facility for very accurate efficiency determinations & efficiency research. The facility deals with powertrain configurations and provides for "real-world" thermal loads. Another reviewer also liked how this project ties into ANL's other DOE projects.

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

A commenter stated that this is a construction project based on design requirements and the requirements are either clear or standardized in each regard. A timeline is presented but the end date does seem ambitious. It was also added that the project may be tight on budget.

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

Reviewers agreed that it is hard to evaluate since program has only recently started, but poster shows that general contractor will be chosen this month.

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

The first reviewer noted that ANL has many industry partners (generically), but the poster highlights collaborations only with INL, NREL, and ORNL. Another liked how this is tying into ANL's projects and EPA's as well.

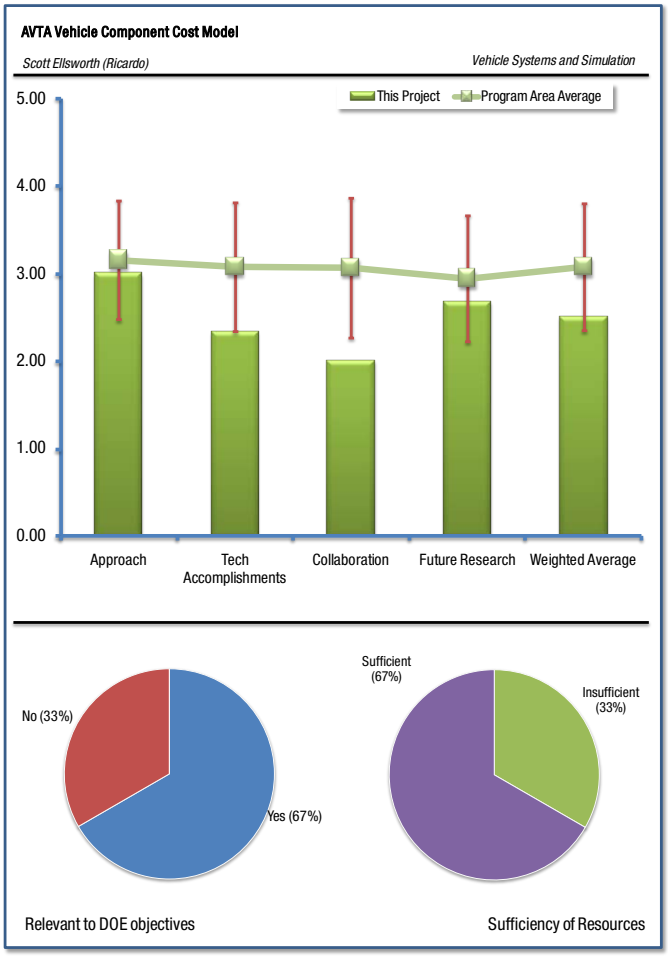
Question 5: Has the project effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways?

The first reviewer noted that this is a research tool and ANL has identified cold effects on powertrain, accessory / air conditioning loads, and other areas for further study. These areas are important for vehicle design optimization and characterization. It was also felt that this can only lead to even better projects and understanding.

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

One commenter felt that resources will permit the stated development; however, future add-on improvements would require additional funds. Another commenter thinks that the budget will be short by 20%, based on experience of building a similar facility many years ago in the auto industry, including shoe-horning the design.

AVTA Vehicle Component Cost Model: Scott Ellsworth (Ricardo)



Reviewer Sample Size

This project had a total of 3 reviewers.

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

The first commenter noted that in response to more stringent federal fuel economy regulations, a number of technologies are being considered for implementation. Currently, tools exist to predict fuel economy improvements, but determination of the "cost versus benefit" has been somewhat of an ad hoc process. This program seeks to provide a consistent approach to estimating costs of candidate technologies and providing a means of technology evaluation that considers not just performance but cost and commercial viability. Such a tool will facilitate and accelerate efforts to down-select the most promising technologies that can reduce petroleum usage.

Another reviewer stated that this one seems to be very borderline. Fundamentally, system cost absolutely matters, OEMs cannot produce systems that are not ultimately cost competitive (thus "yes" was checked). However, the reviewer reported having a hard time understanding the scope of this particular program. It seems to be focused on the current cost (with perhaps some assumed technology curves), instead of looking at how current research dollars could impact future costs. It is not thought that Ricardo intends to provide their cost data to other OEMs (they would have to pay, just as the government has), so it is not positive how this model is intended to be used. It almost seems that the government wants to independently verify cost estimates that OEMs provide. (Perhaps this is a needed step). It was also noted that while this project may be useful for policy making, it does not directly impact costs, or petroleum displacement.

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?

The first commenter noted that the tool to be delivered by this project takes a data-based, pragmatic approach to evaluating costs. Rather than basing estimates strictly on industry rules of thumb or more theoretical analyses to predict cost, this project provides a library containing actual cost data (where available), or refined estimates based on supplier input and well accepted means of cost estimating. The data used for analysis will be reviewed with key industry suppliers to validate its accuracy and appropriateness. This program will be a "post processor" of sorts to Autonomie analyses conducted to evaluate fuel savings potential of various methodologies.

The second reviewer is not completely sure what technical barriers this seeks to address. (Focus seems to be more on current cost of existing components as opposed to expected costs after government R&D investment.) The costing model seems reasonable—Ricardo does have some purchasing experience and the various assumptions regarding technology development and its impact on cost seem to be appropriate. He was also surprised to hear that the "cost" of lighter designs/materials is not included in this specific study. Ricardo indicated they had developed such models in the past (assisting with CAFE standards), but were not planning on incorporating the approach into the current project. In addition to more efficient components or alternate fuels, one way to decrease transportation fuel

use is to decrease the energy originally required to move the vehicle and reducing the vehicle's weight is a typical way to attempt to reduce the energy required.

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

The first reviewer noted that this project just began in earnest a little over a month ago, so results are very limited at this point. It is expected, however, that the technical approach used here will yield a very useful tool for timely evaluation of candidate fuel economy technologies. Another commenter felt that the project seems to be on track, but difficult to tell from the poster.

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

The first commenter felt that there has been significant interface with the analysis and simulation group at Argonne National Laboratories to ensure that this cost estimating program dovetails with the Autonomie analysis tool. He also noted that the program investigators envision significant interface with industry suppliers to obtain validation of the cost data included in the program. It appears once the tool is "test driven," the predicted cost results will be compared with estimates generated by industry suppliers or technology users, in order to validate the approach.

Another reviewer noted that cost information is certainly useful to OEMs–but if they are not involved in this program, it is unclear how they will use the data. The final reviewer stated that the poster and discussions did not make it clear how coordinated the work is with partners, either for input to the process, or using the output.

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 that a very clear plan has been laid out for implementation of the program. It does appear that the timeline has slipped just a bit due to a delayed project start. The program steps and projected timing are well defined. He also noted that discussions are already underway for the next phase of this program (funding for next phase not included in this program). Future plans include creating a similar database and program for medium and heavy duty truck technologies. In addition, there is a vision to incorporate the cost analysis tool directly into Autonomie, which will provide a seamless approach to evaluating both the technical benefits and commercial viability of candidate technologies.

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

The first commenter noted that resources appear to be adequate for the program as defined. Several groups within Ricardo, including both the Strategic Analysis group and the technical group are engaged in this process. Support from Argonne appears to be adequate for the first phase of the program. He also stated that this is a relatively short duration program limited in scope, but the timing and resource requirements have been well laid out to ensure successful attainment of project deliverables.

Another reviewer felt that the time and cost do not seem to be consistent. (Relative to most of the modeling/simulation efforts, $750K in 4 months is an aggressive spend rate.) His assumption is that the majority of this cost is to acquire rights/access to Ricardo's existing knowledge as opposed to funding additional work by Ricardo. However the rushed nature of the project would suggest that it will be hard to get a software tool that integrates well with the rest of modeling suite. (He does not doubt that Ricardo will fulfill their obligations, but cannot see how the end result will fit into the bigger picture.)