1. Vehicle Systems

Vehicle Systems (VS) is concerned with advancing light (LD)-, medium (MD)-, and heavy-duty (HD) vehicle systems to support the U.S. Department of Energy's (DOE) goals of reducing petroleum consumption, and reducing greenhouse gas (GHG) emissions in the U.S. transportation sector.

To help reach these goals, VTO conducts research and development (R&D) programs implementing strategies to help maximize the number of electric vehicle (EV) miles driven, and increase the energy efficiency of transportation vehicles. VS's mission is to accelerate the market introduction and penetration of advanced vehicles and systems with R&D that have a significant impact on petroleum displacement, GHG reduction, and DOE electrification goals.

The following outlines the outcome objectives that VS had identified as important to fulfilling its missio

- Enable superior outcomes for VTO R&D programs by evaluating technology targets.
- Accelerate the design, development, and market introduction through advanced design tools, analysis, and procedures.
- Provide stakeholders with data and analysis to support decision making.
- Accelerate codes & standards development for EVs.
- Develop technology for auxiliary systems that improve vehicle efficiency and promote market acceptance.

Primary processes include the following.

- Develop, distribute, and use advanced modeling and simulation tools to evaluate efficiency potential of technologies.
- Conduct vehicle evaluations to guide future R&D and validate component and system models.
- Support development and adoption of codes and standards for EVs.
- Support industry development, demonstration, and market introduction of advanced vehicle efficiency technologies.
- Investigate systems optimization strategies and enabling technologies to enhance vehicle efficienc , robustness, and effectiveness.

The following details sample project objectives.

- Provide updated Autonomie simulation tool to original equipment manufacturers (OEMs).
- Develop algorithms for proper transmission selection and shift parameter optimization.
- Benchmark the BMW i3 EV battery on a laboratory dynamometer.
- Organize and chair a Society of Automotive Engineers (SAE) task force to define methods for testing and validating the powertrain power rating for hybrid electric vehicles.
- Improve freight efficiency of HD trucks by 50% compared with a model year 2009 highway truck.
- Integrate 6.5 kW wireless power transfer (WPT) technology into demonstration vehicles and validate in an independent testing laboratory.
- Increase electric range by 20% during operation of the climate control system through improved thermal management while maintaining or improving occupant thermal comfort.

The following details outcome objectives.

- Enable superior outcomes for VTO R&D programs by evaluating technology targets.
- Accelerate design, development, and market introduction through advanced design tools, analysis, and procedures.
- Provide stakeholders with data and analysis to support decision making.
- Accelerate codes and standards development for EVs.
- Develop technology for auxiliary systems that improve vehicle efficiency and promote market acceptance.

Subprogram Feedback

The U.S. Department of Energy (DOE) received feedback on the overall technical subprogram areas presented during the 2016 Annual Merit Review (AMR). Each subprogram technical session was introduced with a presentation that provided an overview of subprogram goals and recent progress, followed by a series of detailed topic area project presentations.

The reviewers for a given subprogram area responded to a series of specific questions regarding the breadth, depth, and appropriateness of that DOE VTO subprogram's activities. The subprogram overview questions are listed below, and it should be noted that no scoring metrics were applied. These questions were used for all VTO subprogram overviews.

Question 1: Was the program area, including overall strategy, adequately covered?

Question 2: Is there an appropriate balance between near- mid- and long-term research and development?

Question 3: Were important issues and challenges identified?

Question 4: Are plans identified for addressing issues and challenges?

Question 5: Was progress clearly benchmarked against the previous year?

Question 6: Are the projects in this technology area addressing the broad problems and barriers that the Vehicle Technologies Office (VTO) is trying to solve?

Question 7: Does the program area appear to be focused, well-managed, and effective in addressing VTO's needs?

Question 8: What are the key strengths and weaknesses of the projects in this program area? Do any of the projects stand out on either end of the spectrum?

Question 9: Do these projects represent novel and/or innovative ways to approach these barriers as appropriate?

Question 10: Has the program area engaged appropriate partners?

Question 11: Is the program area collaborating with them effectively?

Question 12: Are there any gaps in the portfolio for this technology area?

Question 13: Are there topics that are not being adequately addressed?

Question 14: Are there other areas that this program area should consider funding to meet overall programmatic goals?

Question 15: Can you recommend new ways to approach the barriers addressed by this program area?

Question 16: Are there any other suggestions to improve the effectiveness of this program area?

Responses to the subprogram overview questions are summarized in the following pages. Individual reviewer comments for each question are identified under the heading Reviewer 1, Reviewer 2, etc. Note that reviewer comments may be ordered differently; for example, for each specific subprogram overview presentation, the reviewer identified as Reviewer 1 in the first question may not be Reviewer 1 in the second question, e

Overview of the VTO Vehicle Systems Program: Lee Slezak (U.S. Department of Energy) - vs000

Question 1: Was the program area, including overall strategy, adequately covered?

Reviewer 1:
The reviewer stated that the VS Program area was adequately described, noting that the goals and objectives including technical guidance, vehicle systems R&D, integration, optimization and inoperability, tech-to-market, and transformational transportation systems were all discussed thoroughly. In addition, the reviewer commented that the VS focus areas were described very well and shown to be very well integrated.

Reviewer 2:
The reviewer replied yes, a good job on fully covering objectives and strategy.

Reviewer 3:
The reviewer replied yes to this question.

Reviewer 4:
The reviewer said for the most part, yes, and that strategy was quite clear. The reviewer observed that because of the breadth of VS' reach, it is hard to boil everything going on into a relatively short presentation, but from the presentation, the focus on several primary areas is quite clear. The reviewer also noted that VS' value is that it also includes a number of issue-specific smaller areas of activity (which nearly fill the entir AMR time slots) that were not really highlighted much in this presentation, adding that these smaller areas, however, often provide critical insight and solutions to the challenges facing VS and the VTO in general.

Question 2: Is there an appropriate balance between near- mid- and long-term research and development?

Reviewer 1:
The reviewer replied yes, elaborating that by its nature, there is a greater emphasis toward nearer-term developments, but that is appropriate given VS goals and approach. The reviewer remarked that most of the targets for VS efforts are really to address issues being seen in prototype or early production vehicles, or for the next generation of vehicles, so that it really is a near-term/mid-term focus by necessity. There are appropriately a few longer-term areas of effort.

Reviewer 2:
The reviewer said yes, there are realistic timelines.

Reviewer 3:
The reviewer observed that it looks like most R&D is focused on mid-term.

Reviewer 4:
The reviewer remarked that there was not any information provided about near-, mid-, and long-term research and development.

Question 3: Were important issues and challenges identified?

Reviewer 1:
The reviewer replied yes, elaborating that issues and challenges of reducing market barriers, technology validation, risk reduction, cost reduction, and performance improvement were discussed, and it was shown the program area helps support the Office of Ene gy Efficiency and Renewable Ene gy (EERE) Strategic Plan. The program area also identified the five EERE Core Question

Reviewer 2:
The reviewer answered yes, pointing out that VS is aimed at addressing a very broad range of challenges, so explaining this takes a special effort. The reviewer added that this effort was clearly taken to ensure that all major issues and challenges were identified and explained in a list that focused on cost reduction and performance

improvement, technology validation and risk reduction, and reducing market barriers. There was also a specific tie presented to the five EERE Core Questions

Reviewer 3:
The reviewer answered yes, adding that cybersecurity is a big issue.

Reviewer 4:
The reviewer replied yes to this question.

Question 4: Are plans identified for addressing issues and challenges?

Reviewer 1:
The reviewer said yes, adding that it was clearly explained how the various pieces within VS work together to ensure that overall goals are achieved. Thus, the reviewer concluded, this program was presented as much more than the sum of its parts, a key concept to grasp when looking at VS.

Reviewer 2:
The reviewer replied yes, adding that for each of the five EERE Core Questions the program area provided information as to how it will help to answer the questions.

Reviewer 3:
The reviewer answered yes, all the technical issues, but cautioned that cost and return on investment (ROI) issues need more attention

Reviewer 4:
The reviewer remarked that plans are not comprehensively outlined but that they are very much top level. The reviewer added that being a little bit specific with ta get specifications would be bette .

Question 5: Was progress clearly benchmarked against the previous year?

Reviewer 1:
The reviewer said yes.

Reviewer 2:
The reviewer said that given the breadth of activities on-going within VS and the broad range of challenges, there was not a significant focus on comparing this year's successes against the previous yea . Again, given this breadth, something needed to be eliminated for this presentation, and it appears that this specific comparison was likely an appropriate element to forego to ensure that the important elements of the VS Program were adequately addressed. The reviewer noted that key accomplishments over the past year were provided, and even divided out by activity area.

Reviewer 3:
The reviewer said that progress was identified in several areas of the program, including modeling and simulation, codes and standards, vehicle systems efficiency improvements and technology evaluations. Howeve , the progress was not really benchmarked against the previous year.

Reviewer 4:
This reviewer acknowledged not being a reviewer last year for this specific program

Question 6: Are the projects in this technology area addressing the broad problems and barriers that the Vehicle Technologies Office (VTO) is trying to solve?

Reviewer 1:
The reviewer declared absolutely, clarifying that these problems were clearly addressed in the presentation, focusing not only on its relationship with VTO overall but also in how VS is aimed at providing results tied to objectives ranging from technical guidance through transformational transportation systems. Specificall , the reviewer noted, the program identified how it is addressing the five EERE Core Question

Reviewer 2:
Yes, the reviewer replied, elaborating that the overall goal of petroleum displacement, energy security, U.S. competitiveness, and emissions reduction are being addressed by using systems engineering R&D to accelerate commercialization of integrated, highly efficient vehicles by reducing development risk, cost, and time

Reviewer 3:
The reviewer replied yes to this question.

Reviewer 4:
The reviewer said somehow.

Question 7: Does the program area appear to be focused, well-managed, and effective in addressing VTO's needs?

Reviewer 1:
The reviewer responded yes, clarifying that by its very nature, the program is aimed at a very broad range of challenges so that its focus has to be very broad, but its efforts are focused upon the challenges that VTO needs solved. The reviewer noted that some are efficienc , some are technologies that need to enable new vehicle technologies (such as infrastructure), and some are verification of technology/vehicle performance. The reviewer concluded that VS is tasked with accomplishing a lot, yet it is where the "rubber hits the road" and performance of new technologies is really proven.

Reviewer 2:
The reviewer said yes, the presenter did a very good job in explaining the program and showing that it is quite effective in addressing the needs of VTO.

Reviewer 3:
The reviewer replied yes to this question.

Reviewer 4:
The reviewer said mostly.

Question 8: What are the key strengths and weaknesses of the projects in this program area? Do any of the projects stand out on either end of the spectrum?

Reviewer 1:
The reviewer remarked that modeling and simulation work under the VS Program area has been a key strength over the years. The reviewer specified Autonomie as having been used worldwide by companies and research organizations and as a true success story of the program.

Reviewer 2:
The reviewer praised as a true strength of the program its mandate—enabling and proving the performance of advanced/new technologies. Thus, the reviewer observed, the program is developing the tools, data, standards, etc., necessary for success, while also testing technologies and full vehicle designs (such as through involvement in SuperTruck II) to show progress toward overall goals. The capabilities of the program (within DOE, the national laboratories, and industry) have been developed to address this broad mandate.

The reviewer cited as a weakness of this program that it is also tied to this broad aim, commenting that there are a lot of moving parts in it and thus its structure can be complicated, and it can be difficult to explain to outside organizations (and even internal ones) the importance of these activities. It also appears to this reviewer that this complexity may have impacted the budgetary situation for the program, which has seen significant drops over the past few years.

More glaring, the reviewer remarked, is perhaps a weakness based upon its strength. Because of its systems-level focus and success, the program is increasingly asked to participate in VTO-level or even EERE-level initiatives, such as Grid Modernization. The reviewer stipulated that while such efforts provide significant opportunities, they

cannot be at the expense of basic VS activities, and ultimately, capabilities, adding that additional funding must be provided with additional responsibilities.

Reviewer 3:
The reviewer cited as strengths the technical efficiencies of propulsion and cha ging while observing as a weakness cost not being fully vetted.

Question 9: Do these projects represent novel and/or innovative ways to approach these barriers as appropriate?

Reviewer 1:
The reviewer affirmed that the projects comprising the VS Program intended to provide vehicle system efficiency improvements, modeling and simulation, technology evaluation and codes and standards are innovative, well integrated, and successful in providing ways to eliminate barriers.

Reviewer 2:
The reviewer observed that many do represent novel applications, such as wireless charging technologies while other activities may appear to be simply bringing together a number of existing technologies to maximize impacts. However, the reviewer elaborated that these actually are innovative because they bring together technologies that have not necessarily been brought together before, and may require balancing among individual technologies that may have significant interactions complicating implementation. In addition, the reviewer stated, the VS Program also relies heavily upon innovative capabilities that have been developed at the national laboratories and that these capabilities have already resulted in significant progress such as in advanced aerodynamics

Reviewer 3:
The reviewer replied yes, from a technical aspect, but added that cost needs more attention.

Question 10: Has the program area engaged appropriate partners?

Reviewer 1:
The reviewer declared absolutely, elaborating that efforts have been coordinated with both industry manufacturing partners and also with appropriate standards organizations such as SAE. In general, the reviewer observed that VS is collaborating on a number of sustainable transportation technologies with other government agencies, within other parts of DOE and EERE, with industry, and with a number of other institutions.

Reviewer 2:
The reviewer affirmed that the VS Program area has a wide variety of partners that make the program much stronger with their involvement, adding that the partners definitely seem to be very appropriate

Reviewer 3:
The reviewer said yes, noting that many government, academia, and industry partners are involved.

Reviewer 4:
The reviewer indicated that it looks like most collaborations are between DOE research laboratories and some companies without enough attention from universities.

Question 11: Is the program area collaborating with them effectively?

Reviewer 1:
The reviewer replied yes, explaining that the organizations being collaborated with are exactly the types of companies or institutions that are necessary for technologies to move forward, and VS appears to focus heavily on making these successful relationships. The reviewer pointed out that a number of specific activities have been identified to ensure that e forts draw in the appropriate organizations and ensure completion of needed developments. In addition, there have been strong relationships built and maintained, both by DOE and National Laboratory personnel. The reviewer concluded that it is this more personal touch that clearly comes through when DOE management and individual researchers speak about VS projects.

Reviewer 2:
Yes, the reviewer replied, stating that through the presentation it was clear that the program area is effectively collaborating with the partners.

Reviewer 3:
The reviewer answered yes, effective relationships are established.

Reviewer 4:
The reviewer stated that it is not clear.

Question 12: Are there any gaps in the portfolio for this technology area?

Reviewer 1:
The reviewer replied no, the program area does not seem to have any gaps in this area.

Reviewer 2:
The reviewer observed that it is not so much of a gap, as such, at least yet, but based upon recent interest within VTO and EERE in Systems and Modeling for Accelerated Research in Transportation (SMART) Mobility, it would seem that VS would be an important place for greater involvement. Other than a few specific pieces that may be included within SMART Mobility, the reviewer noted it does not appear that there has been a planning effort yet to take full advantage of the capabilities within VS to move SMART Mobility forward.

The reviewer recounted that in the past years, VS often included a mix of relatively large projects, along with a few smaller specifically-ta geted ones, and that it appears reductions in funding (and greater impact of EERE-level initiatives such as Grid Modernization) have resulted in dropping some of these types of projects. The reviewer cautioned that the fear is more reductions will occur as greater interest is focused on office-level initiatives. The reviewer concluded that while Vehicle Systems is a natural place for strong participation in many of these initiatives, such additional opportunities must be coupled with additional funding, or else core Vehicle Systems efforts (and capabilities) will continue to be cut. If this happens, VS will lose much of the expertise and learning that has made it successful.

Reviewer 3:
The reviewer stated that cost effectiveness needs to be a focus for successful deployments.

Reviewer 4:
The reviewer offered that there has been some focus on chargers, particularly wireless, which is fine, but it appears as though power electronics and electric machines are not part of this program.

Question 13: Are there topics that are not being adequately addressed?

Reviewer 1:
The reviewer stated that topics in the program area are being adequately addressed.

Reviewer 2:
The reviewer commented that there is always a greater need for performance testing and data from new technologies either ready to enter the market, or which have recently initiated market penetrations, such as under the test and evaluation activities. The reviewer observed that this is a particular place of coordination with VTO's deployment efforts, especially through Clean Cities, adding that fleets or individuals considering new technologies need data upon which to make informed decisions. The reviewer cautioned that VS has worked hard to maintain this capability but that recent program directions toward efforts such as Grid Modernization appear to have simply reduced the available funding for this and other important areas.

Reviewer 3:
The reviewer remarked economy of scale to obtain cost objectives.

Reviewer 4:
The reviewer offered that there has been some focus on chargers, particularly wireless, which is fine, but it appears as though power electronics and electric machines are not part of this program.

Question 14: Are there other areas that this program area should consider funding to meet overall programmatic goals?

Reviewer 1:
The reviewer replied that this is very well thought out.

Reviewer 2:
No, the reviewer responded, adding that the programmatic goals should be able to be met with the current projects being studied.

Reviewer 3:
The reviewer praised the focus on software/code development as wonderful and asked if there is there a plan to unify controller area network protocols for EVs.

Reviewer 4:
The reviewer stated that if SMART Mobility is to become a focus for the EERE/VTO program, VS is a natural place to include targeted efforts focused upon transportation system-level efficiencies. Howeve , the reviewer stipulated, adding this new area cannot be at the cost of existing VS activities, which are already struggling under significant budget reductions over the past few years

Question 15: Can you recommend new ways to approach the barriers addressed by this program area?

Reviewer 1:
The reviewer replied no, the program is well structured to address the barriers in this program area.

Reviewer 2:
The reviewer responded that the program is on track, and added that cost and incentives need to be part of EV Everywhere for the charging infrastructure and vehicle incremental cost.

Reviewer 3:
The reviewer suggested that it could be useful to include some specific analysis of various electrificatio architectures in a range of applications in order to develop information upon which adopters could make decisions. In addition, the reviewer commented that it could also be useful if such data could be compared to various alternative fuel technologies and applications, focused upon performance against overall VTO goals (e.g., petroleum, GHG, and criteria emission reductions).

Reviewer 4:
The reviewer judged that additional university engagement should be mandatory, elaborating that the program should not let only one particular university—due to proximity to a specific laboratory or company—be listed on all the proposals. The reviewer added that each university should be limited to be partnered with only one submission or only one grant, offering that this diversifies university engagement

Question 16: Are there any other suggestions to improve the effectiveness of this program area?

Reviewer 1:
The reviewer replied no, the program area continues to be effective in evaluating the VTO areas of research and development in a vehicle systems context.

Reviewer 2:
The reviewer said a good team is working on a very important issue, and added that this is just the first step to autonomous vehicles.

Reviewer 3:

The reviewer recommended allowing the program the budgetary flexibility to maintain a mix between la ger and smaller projects to ensure that the true breadth of VS can continue to be addressed successfully. The reviewer added that this program continues to accomplish a great deal, in spite of its reducing budget and increasing demand from EERE-level initiatives.

Reviewer 4:

The reviewer suggested enhanced engagement of universities, remarking that with little bit of money universities can contribute much more than the program expects.

Project Feedback

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 1.0 to 4.0)*. 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.

Table 1-1 – Project Feedback

Presentation Title	Principal Investigator and Organization	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
Medium- and Heavy-Duty Vehicle Field Evaluations	Kelly, Ken (NREL)	1-15	3.63	3.50	3.75	3.25	3.53
DOE's Effort to Improve Heavy Vehicle Fuel Efficiency through Improved Aerodynamics	Salari, Kambiz (LLNL)	1-18	3.50	3.75	3.25	3.50	3.59
Idaho National Laboratory Testing of Advanced Technology Vehicles	Francfort, James (INL)	1-22	3.25	3.00	3.25	3.00	3.09
Advanced Vehicle Testing and Evaluation	Jacobson, Richard (Intertek)	1-25	3.10	3.10	3.20	2.80	3.08
Advanced Technology Vehicle Lab Benchmarking (L1 and L2)	Stutenberg, Kevin (ANL)	1-28	3.60	3.60	3.40	3.40	3.55
SuperTruck - Development and Demonstration of a Fuel-Efficient Class 8 Tractor and Trailer, Vehicle	Zukouski, Russ (Navistar)	1-32	3.50	3.50	3.60	3.40	3.50

Presentation Title	Principal Investigator and Organization	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
Commercial Vehicle Thermal Load Reduction and VTCab-Rapid HVAC Load Estimation Tool	Lustbader, Jason (NREL)	1-36	3.63	3.38	3.38	3.38	3.44
Volvo SuperTruck	Amar, Pascal (Volvo Trucks)	1-39	3.75	3.83	3.75	3.40	3.75
System for Automatically Maintaining Pressure in a Commercial Truck Tire	Anderson, Norm (The Goodyear Tire and Rubber Company)	1-43	3.25	3.38	3.25	3.38	3.33
EV - Smart Grid Research and Interoperability Activities	Hardy, Keith (ANL)	1-47	3.50	3.63	3.88	3.00	3.55
Wireless and Conductive Charging Testing to Support Code and Standards	Carlson, Barney (INL)	1-50	3.70	3.50	3.80	3.40	3.58
High-Efficiency, Low-EMI and Positioning Tolerant Wireless Charging of EVs	Chabaan, Rakan (Hyundai)	1-53	3.25	3.25	2.75	3.13	3.17
Wireless Charging of Electric Vehicles	Onar, Omer (ORNL)	1-56	3.50	3.50	3.50	3.33	3.48
Zero Emission Drayage Truck Demonstration (ZECT I)	Miyasato, Matt (SCAQMD)	1-58	2.90	2.90	3.30	2.90	2.95
Hydrogen Fuel-Cell Electric Hybrid Truck and Zero Emission Delivery Vehicle Deployment	DeCandis, Andrew (Houston-Galvelston Area Council)	1-61	2.38	2.00	2.75	2.13	2.20

Presentation Title	Principal Investigator and Organization	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
Combined Aero and Underhood Thermal Analysis for Heavy-Duty Trucks	Sofu, Tanju (ANL)	1-64	2.50	2.90	2.70	2.40	2.71
Cummins Medium-Duty and Heavy-Duty Accessory Hybridization CRADA	Deter, Dean (ORNL)	1-69	3.10	2.80	3.60	3.13	3.02
Vehicle Thermal System Modeling in Simulink	Lustbader, Jason (NREL)	1-73	3.83	3.50	3.67	3.25	3.57
Advanced Climate Systems for EV Extended Range (ACSforEVER)	Meyer, John (Hanon Systems)	1-76	3.38	3.38	3.25	3.38	3.36
ePATHS - electrical PCM Assisted Thermal Heating System	Wang, Mingyu (Mahle Behr USA, LLC)	1-79	3.63	3.50	3.63	3.13	3.50
SAE J2907 Motor Power Ratings Standards Support	Miller, John (ORNL)	1-82	3.50	3.50	3.40	3.60	3.50
Analyzing Real-World Light-Duty Vehicle Efficiency Benefits	Gonder, Jeff (NREL)	1-85	3.13	3.25	3.25	3.00	3.19
UTEMPRA - Unitary Thermal Energy Management for Propulsion Range Augmentation	Chowdhury, Sourav (Mahle Behr USA, LLC)	1-88	3.00	3.25	3.38	3.13	3.19

Presentation Title	Principal Investigator and Organization	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
Zero Emission Cargo Transport II: San Pedro Bay Ports Hybrid and Fuel Cell Electric Vehicle Project	Impullitti, Joseph (SCAQMD)	1-92	2.30	2.20	3.00	2.40	2.35
Multi-Speed Transmission for Commercial Delivery Medium-Duty Plug-In Electric Drive Vehicles	Chavdar, Bulent (Eaton)	1-96	3.20	3.40	3.00	3.40	3.30
Integrated Boosting and Hybridization for Extreme Fuel Economy and Downsizing	Tsourapas, Vasilios (Eaton)	1-100	3.50	3.30	3.10	3.20	3.31
Advanced Bus and Truck Radial Materials for Fuel Efficiency	Dos Santos Freire, Lucas (PPG)	1-103	3.10	3.10	3.00	3.20	3.10
Design and Implementation of a Thermal Load Reduction System in a Hyundai PHEV	Kreutzer, Cory (NREL)	1-107	3.25	3.13	3.63	3.25	3.23
EV Everywhere Charging Infrastructure Roadmap	Karner, Donald (EAI)	1-111	2.25	2.25	2.00	2.00	2.19
Energy Impact of Connected and Automated Vehicles	Peng, Huei (University of Michigan)	1-115	3.40	3.30	3.30	3.20	3.31
Methods to Measure, Predict, and Relate Friction, Wear, and Fuel Economy	Gravante, Steve (Ricardo)	1-119	3.42	3.17	3.42	3.25	3.27

Presentation Title	Principal Investigator and Organization	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
Improved Tire Efficiency through Elastomeric Polymers Enhanced with Carbon-Based Nanostructured Materials	Polyzos, Georgios (ORNL)	1-123	2.83	3.33	2.67	2.67	3.04
VTO Vehicle to Building Integration Pathway†	Pratt, Richard (PNNL)	1-126	3.33	3.50	3.67	3.33	3.46
VTO Systems Research Supporting Standards and Interoperability†	Smart, John (INL)	1-128	3.38	3.25	3.13	3.13	3.25
VTO Modeling & Controls Software Tools to Support V2G Integration)†	Saxena, Samveg (LBNL)	1-131	3.40	3.20	3.30	3.30	3.28
VTO Diagnostic Security Modules for Electric Vehicle to Building Integration†	Rohde, Ken (INL)	1-134	3.50	3.50	3.50	3.50	3.50
Evaluation of Vehicle Technology Benefits on Real World Driving Cycles using Regional Transportation System Model	Rousseau, Aymeric (ANL)	1-136	3.00	3.30	2.90	3.10	3.15
Evaluation of Dynamic Wireless Charging Demand	Li, James (ORNL)	1-139	2.83	2.67	3.33	3.17	2.85
Overall Average			3.24	3.22	3.28	3.12	3.22

† Denotes a poster presentation

Medium- and Heavy-Duty Vehicle Field Evaluations: Ken Kelly (National Renewable Energy Laboratory) - vs001

Presenter
Ken Kelly, National Renewable Energy Laboratory

Reviewer Sample Size
A total of four reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer found that the work with fleets and OEMs was excellent. Gathering these participants and getting their cost share was a critical barrier to success that was vigorously attacked on this project.

Reviewer 2:
The reviewer stated that the approach of this project was excellent. The field data collected, and the testing and analysis tools that were used provided very valuable information regarding MD and HD vehicles. This information was exchanged with a very large set of groups, including research organizations, other agencies, and within DOE programs.

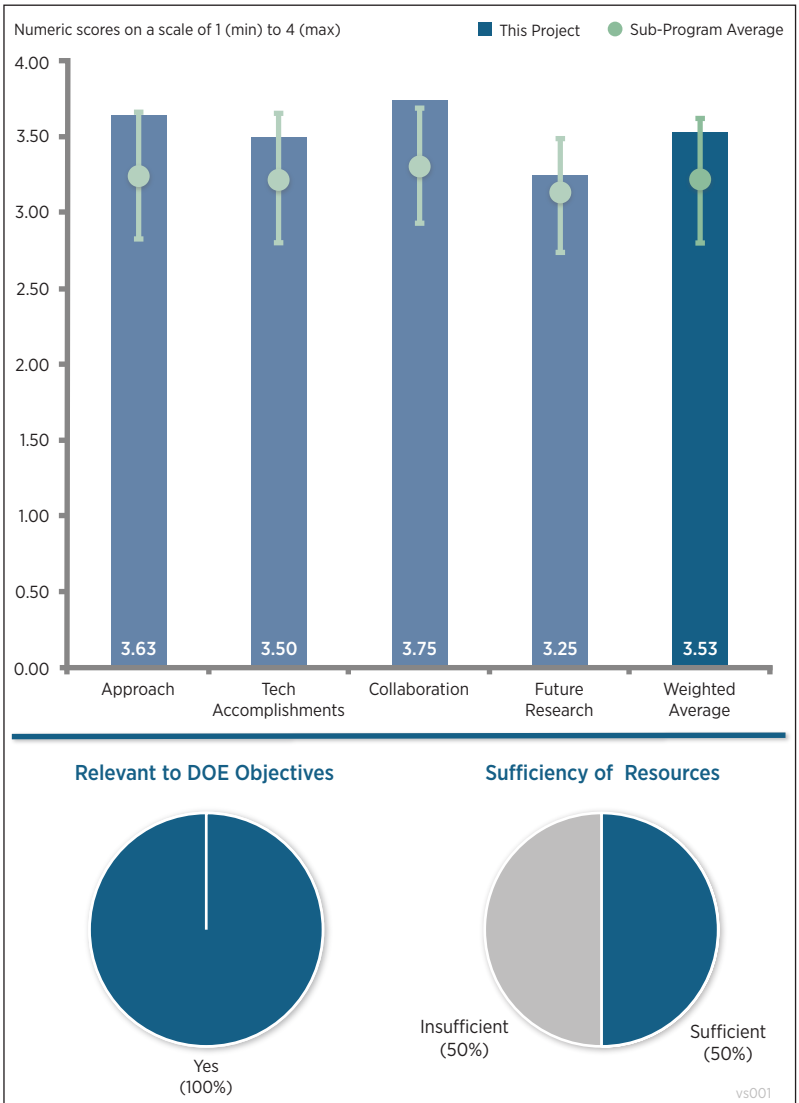

Figure 1-1 – Medium- and Heavy-Duty Vehicle Field Evaluations: Ken Kelly (National Renewable Energy Laboratory) - Vehicle Systems

Reviewer 3:
The reviewer believed that analysis derived from the MD and HD data collection would have increased accuracy if the data collection included frequent direct measurements of the total mass of the vehicles. Several of the fleet data collection involved vehicles that frequently change the mass of their payloads.

Reviewer 4:
The reviewer stated that the project had very good fleet partners and that this real-world data were essential. The reviewer noted that the way in which fleets/applications were ta geted could possibly be more methodical. The reviewer questioned where the holes were in terms of possible applications. Still, the reviewer commented that it was a good approach chosen of characterizing the data and then testing on the dynamometer. Also using a validated vehicle model to do what if scenarios was a very good idea. However, the reviewer commented that power characteristics would be helpful.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer stated that excellent progress had been made since the kick off in January 2015 on the Miami-Dade project and anticipated the final report will be submitted in fiscal year (FY) 2016 The Foothill Transit project had in use performance results presented to the public and will also have a final report completed in F 2016. The United Parcel Service (UPS) project was complete and reported fuel economy and excellent emissions results.

Reviewer 2:
The reviewer thought that excellent progress was made with data collection across a wide range of fleet applications.

Reviewer 3:
The reviewer found that the amount of data collected was very impressive. The characterization of the fuel economy improvement in the Miami-Dade data will be very helpful in encouraging hybrid usage. The reviewer inquired about the point at which the project team can start recommending the technologies to be examined in future tests.

Reviewer 4:
The reviewer commented that the presenter provided evidence to support the idea that the data collection benefited the fleet owners, but did not support the idea that it significantly benefits R&D planning, and strategy for DOE a the national laboratories.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer found that participation by fleets and vehicle OEMs was excellent and a key to the success of this project.

Reviewer 2:
The reviewer stated that collaboration and coordination in this project has been outstanding. The list of industry partners and other government organizations helped to make this project extremely successful.

Reviewer 3:
The reviewer stated that the fleets providing the data was good collaboration. Also fleets sharing their maintenance records showed other cost savings. The reviewer thought that when the killer applications are found, such as the Miami-Dade, some kind of gathering could be held with major fleets/OEMs in the same space to inform them of the results and influence their o fering and selling positions.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer stated that the proposed future work in collaboration with Idaho National Laboratory (INL) and Argonne National Lab (ANL) should prove to be an excellent project.

Reviewer 2:
The reviewer stated that there was an excellent focus on future work for existing fleets, but identification of futur fleets was lacking

Reviewer 3:
The reviewer liked the idea of collaborating with the other DOE institutions. However, the reviewer believed that more effort should have been made to target possible other killer applications by modeling in advance. The

reviewer asked what power takeoff (PTO) applications are out there that could provide fuel savings and if there are certain cities with terrain, traffic, or other conditions that make hybrids pay o f more quickly. The reviewer wondered how the next killer application could be found. Finally, if the project team would be able to make targets for technologies, routes, types of fleets, etc. based on results so far and modeling

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer stated that the data collected and analyzed throughout this project provided information to support the overall DOE objective of petroleum displacement.

Reviewer 2:
The reviewer observed significant petroleum use by MD and HD vehicles

Reviewer 3:
The reviewer thought that the project provided objective third party operational test data to fleet operators. These data can help decision makers to make investments in technologies that are effective and economically viable for displacing petroleum consumption.

Reviewer 4:
The reviewer stated that this was the empirical way to confirm the best applications for hybrids and alternative fuels.

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

Reviewer 1:
The reviewer thought that the resources have been sufficient to fund the project to completion

Reviewer 2:
The reviewer thought it was great that this program got more money this year, but mentioned it would be even more useful to find other applications where fuel saving technologies pay o f.

DOE's Effort to Improve Heavy Vehicle Fuel Efficiency through Improved Aerodynamics: Kambiz Salari (Lawrence Livermore National Laboratory) - vs006

Presenter
Kambiz Salari, Lawrence Livermore National Laboratory

Reviewer Sample Size
A total of four reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

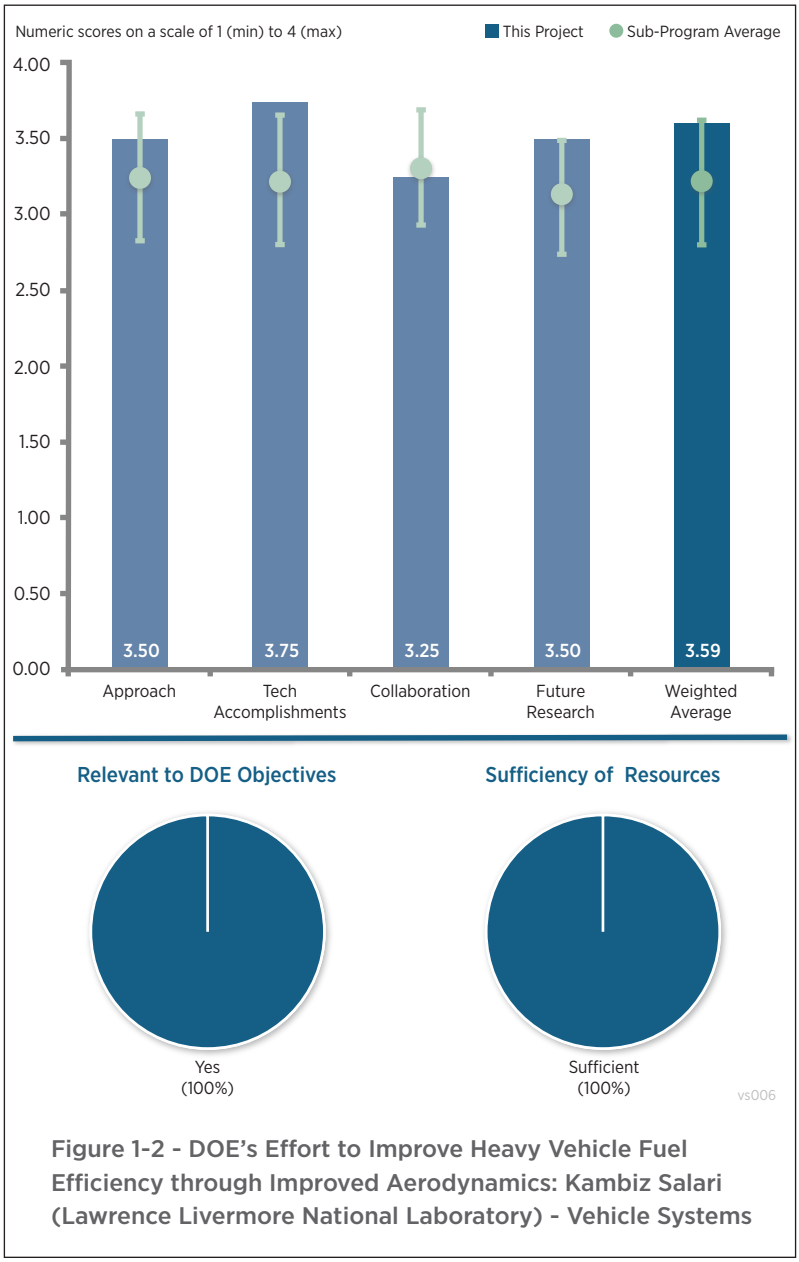

Figure 1-2 - DOE's Effort to Improve Heavy Vehicle Fuel Efficiency through Improved Aerodynamics: Kambiz Salari (Lawrence Livermore National Laboratory) - Vehicle Systems

Reviewer 1:
The reviewer was impressed with the progress in the last year on this project. Good work on aerodynamics in general, platooning in particular, and with the generic speed form.

Reviewer 2:
The reviewer stated that the Principle Investigator (PI) and his team had a well-defined and logical approach to this aerodynamics research. A good scientific approach combined computational fluid dynamics (CFD) and wind tunnel experimentation, supplemented with on-road demonstration. The reviewer found the tanker trailer work intriguing: the fuel savings were not trivial, and the challenges for aerodynamic drag reduction were large, so this was worthwhile for government R&D. The integrated tractor and trailer work gave the industry a new way to think about the aerodynamics of these vehicles, and demonstrated the potential improvements for looking at the tractor and trailer as a system.

Reviewer 3:
The reviewer found that the approach was a good mix of analysis, model testing, and real world testing. Testing the geometries in a wind tunnel was a great way to prove out a concept without incurring high costs of a field test. The reviewer stated that the PI leveraged the national laboratory and resources appropriately to fill in where the manufacturer's expertise lacked.

Reviewer 4:
The reviewer found that the approach to model, improve, then validate the results was a good approach. The presenter implied that all shape modifications are valid including dramatic changes to the traile . The reviewer

thought that the project should have some industry feedback and certain constraints for logistics. For example, adding appendages to trailers and trucks to accomplish the goals is feasible. Outright changing shapes without considering things like inter modal transportation (very slow speed, but needs to stack) may be theoretically possible, but would not get DOE to its goals. The reviewer said that the project should bind itself to the state of the art that is possible.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:

The reviewer stated that the Generic Speed Form 2 (GSF2) discoveries represented groundbreaking aerodynamics work, and it will be interesting to see how industrial partners use these results in their future work (perhaps elements of this can find their way to Super ruck II eventually). The reviewer added that the drag characteristics of the GSF2 are completely different than baseline trucks; increased yaw angle drag reductions could be important in the real world as no truck operates in a zero-yaw condition in real life. The reviewer also stated that drag reductions were significant: 60-80% reduction or more. Hopefully this will change the discussion in the industry about truck shapes.

The reviewer continued saying that the truck platooning work addressed some previous concerns that the National Renewable Energy Laboratory (NREL) discovered in their first platooning tests. It will be important to quantify how the aerodynamic drag of the system of trucks improves with platooning, and how individual trucks may be affected. Finally, the reviewer stated that the cooling air work was important as increased fan power could negate aero drag reductions with platooning.

Reviewer 2:

The reviewer thought that the progress made on this project was great. There were several milestones that were achieved in this time period. The PI's willingness to share findings has led to more awareness of the breakthroughs, which will hopefully lead to more adoption of the GSF2. The comparison in drag coefficients on Slide 16 show the tremendous accomplishments made with this design.

Reviewer 3:

The reviewer stated that the accomplishments were completed and well described in this presentation. The reviewer added that it is important to share this work in a strong way to help industry deliver on the potential the project team is uncovering. For instance, sharing how the wind averaged drag is calculated was a good use of two minutes in the review. Finally, the reviewer commented that the platooning accomplishments were particularly noteworthy, very helpful in support of industry and NREL activities.

Reviewer 4:

The reviewer thought that progress appeared to be very good. The presenter verbally indicated that one of the designs was being used by Navistar (outstanding transition). The reviewer thought that the reporting aspect of the project was lacking, even though the technical was performing extremely well. The reviewer stated that the project should do the calculations and simulations (based on published drive cycles), and report on how much fuel is saved by the reduction of drag, so it is clear what impact there is and how close the project is to meeting the DOE goals.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

The reviewer stated that the project has a very good mix of research, OEMs, manufacturers, and end users.

Reviewer 2:

The reviewer noted that the team is collaborating with a number of the right organizations, and added that expansion would always be helpful, but not necessary. Navistar is using the GSF2 geometry now, which is excellent to hear. The work on platooning aerodynamics shows a good inter-lab relationship with NREL, as they had identified the cooling challenge in a real-world testing e fort last year that has now translated to lab research work at Lawrence Livermore National Laboratory (LLNL).

Reviewer 3:
The reviewer noted that the project is using NREL and the National Aeronautics and Space Administration for their model validation and testing. NREL is also collecting on-the-road data from the industry. The reviewer thought that the team has good coordination and each member is playing to their strengths.

Reviewer 4:
The reviewer stated that these discoveries are very important for industries. The reviewer suggested that the project team continue to find opportunities to openly share these finding

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer stated that it is very exciting to continue this work, particularly in this area of zero drag.

Reviewer 2:
The reviewer found that the team's future work plans are reasonable, logical, and are appropriate next steps based on the accomplishments of the project to date. The plans to continue coordination with industry on designing next-generation aerodynamic vehicles is extremely important, as it will move this groundbreaking lab work into production.

Reviewer 3:
The reviewer stated that the proposed future work is well thought out. The project is trying to further its efforts in reducing drag and improving fuel economy. The reviewer thought that the project team's efforts to coordinate industry participants makes it highly valuable.

Reviewer 4:
The reviewer stated that the additional iteration is good future research, but added that the project should add quantifiable goals of what the future research will be. For example: achieving a certain percentage of improvement over the current iteration. The reviewer noted that the presenter indicated greater spacing and possibly analyzing more trucks for the platooning is also a plan. This should all be captured as part of the program plan.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer stated very much so.

Reviewer 2:
The reviewer stated that reduction of aerodynamic drag of commercial trucks is very relevant to DOE petroleum displacement goals, due to the significant and necessary fuel use of these trucks. The potential drag reductions from this project can result in a large decrease in transportation petroleum use. The reviewer commented that research work is helping guide the discussions about the state-of-the-art in aerodynamics within the research and industrial communities, and as such moves the production vehicles forward in their aerodynamic performance.

Reviewer 3:
The reviewer noted that on Slides 3 and 4, the presenter made a great case for why the project was highly relevant to DOE's objective of reductions in petroleum consumption. The project informs DOE so they can in turn inform industry. Results of the project were also relevant to the industry as the speaker noted that Navistar is using the geometry developed in the project.

Reviewer 4:
The reviewer commented that reducing aerodynamic drag directly supports DOE's objectives of reduced fuel consumption. There is definitely an improvement in fuel consumption, but it is hard to quantify the actual savings as the presentation left the calculations up to the reader.

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

Reviewer 1:
The reviewer stated that the funds are sufficient to achieve the milestones set forth, but added that additional funds for groundbreaking work like this would always be helpful.

Reviewer 2:
The reviewer stated that based on what the project has been able to accomplish, the reviewer believed the resources are sufficient

Reviewer 3:
The reviewer noted that progress is occurring and exciting.

Reviewer 4:
The reviewer thought that the project resources seem to be sufficient

Idaho National Laboratory Testing of Advanced Technology Vehicles: James Francfort (Idaho National Laboratory) - vs021

Presenter
Shawn Salisbury, Idaho National Laboratory

Reviewer Sample Size
A total of five reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer found that this project is well designed and provides supportive data that can be utilized by consumers for choice and adaptation decisions. It collects needed data which will inform consumers and government agencies as to the life cycle and utility of the vehicles, and further program needs.

Reviewer 2:
The reviewer stated that there were comments by reviewers (this year, and apparently in last year's AMR as well) regarding the lack of standard drive cycles. In this particular case, the reviewer stated support for the approach that INL has taken, by not relying solely on standard drive cycles. The end goal of these projects is petroleum displacement, and while standard drive cycles provide a (rather unreliable) means to compare fuel consumption, they do not represent real world benefits. The testing that INL is performing goes a long way in providing the average customer more reliable information.

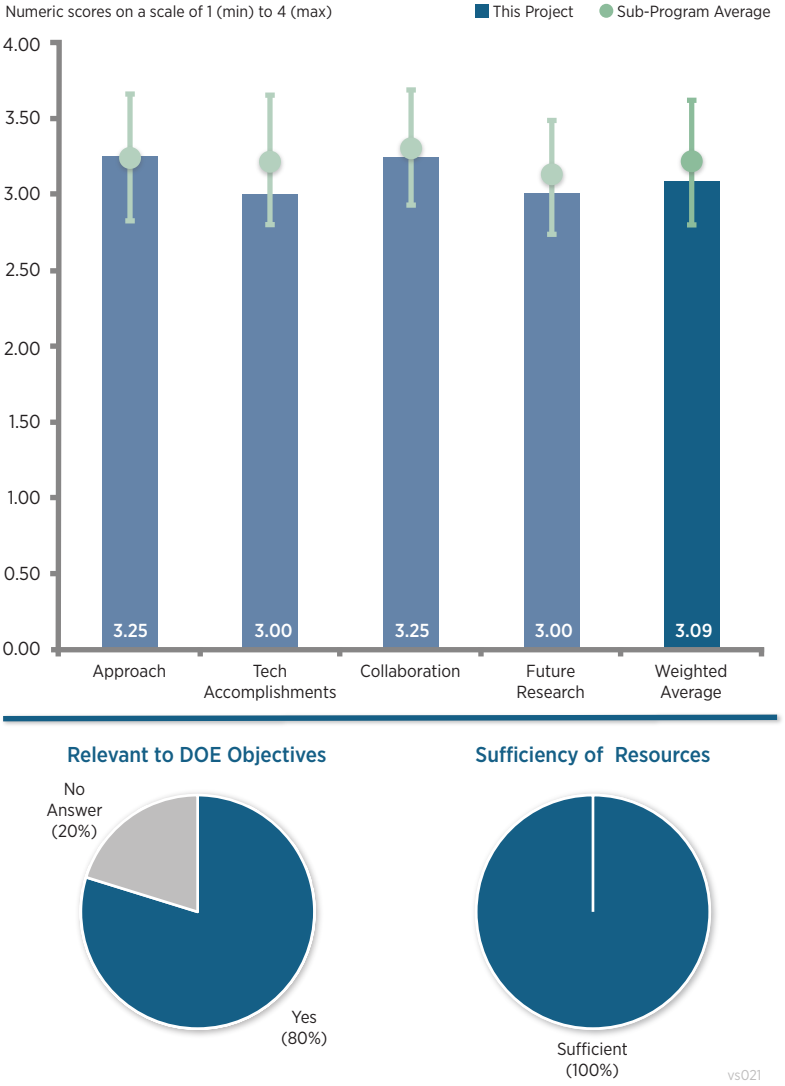

Figure 1-3 – Idaho National Laboratory Testing of Advanced Technology Vehicles: James Francfort (Idaho National Laboratory) - Vehicle Systems

Reviewer 3:
The reviewer stated that the project tests a wide range of vehicles and lots of miles of miles on individual vehicles, which is helpful information to have. The tests are developed using standards, as well as experts on new tech that might not have standards. That is a good approach.

The reviewer thought that acquiring knowledge on battery degradation is important for resale value, second leases, etc. The reviewer questioned if that knowledge is getting to the car buying public, banks, or car selling networks to make use of that knowledge. The presentation says that results are presented and published, but the reviewer wanted to know how that is occurring to the widest possible audience. The reviewer questioned if the press is a possibility as well, for example the Wall Street Journal for business impact, car magazines, etc. Finally, the

reviewer stated that getting the data on the public taxis is a great idea. It should point to how hybrid designs and the charging system can be improved.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer stated that steady progress appears to be made.

Reviewer 2:
The reviewer noted that the testing of 95 vehicles within this program in the past couple years is statistically significant to derive the comparable performance data. By using la ge fleet operators (such as the New York City taxi cabs) some real-world data, such as efficiency compared to ambient temperature, become increasingly valuable for adoption decisions.

Reviewer 3:
The reviewer stated that the charger results are helpful and battery testing results are good. The project generated lots of reports with the 12 Volt (V) results given to OEMs. The reviewer noted that it looks like a fair amount of miles remain to be driven on some of the cars.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that there were no issues here.

Reviewer 2:
The reviewer stated that INL and Intertek are well suited partners for these type of activities, each bringing complementary skills and expertise to the project. INL demonstrates exceptional leadership to organize the project with focused deliverables.

Reviewer 3:
The reviewer stated that taxis and Via would have good data, especially with taxis in New York City. The reviewer added that as much sharing as possible with OEMs would help leverage work. Follow up questions after the presentation indicated OEMs are involved.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer stated that looking forward to the effect of electric propulsion to such areas as autonomous vehicle is paramount to the greater goals of EV acceptance and petroleum displacement. This project presentation brings that clarity to the future work.

Reviewer 2:
The reviewer stated that increased and enhanced data collection and exchange with national laboratories to support modeling and analysis for possible DOE VTO projects should help inform DOE of what projects to run. The reviewer questioned if the project team can get a hold of new vehicles before they are released, to help OEMs test and influence the tweaking of designs, or possibly the project team and DOE prefer testing to be done on production vehicles.

Reviewer 3:
The reviewer believed that Advanced Vehicle Test fleet can be leveraged to provide even more benefits b including a limited level of emissions testing during real world driving. This can provide an independent evaluation

of the emissions reduction capability of these vehicles, similar to the work done by the International Council on Clean Transportation in uncovering the Volkswagen diesel issue.

Reviewer 4:
The reviewer thought that the project team needs more diverse users and must test in cold climates.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer stated that the data collected will help the EV industry optimize and gain some scale.

Reviewer 2:
The reviewer commented that this project brings needed data for consumer choice and modeling validation, which is necessary for adoption and greater goals of petroleum displacement.

Reviewer 3:
The reviewer stated that the test data are necessary to show how hybrids are saving fuel. Demonstrating how the vehicles age should increase trust of the car buying public in hybrids.

Reviewer 4:
The reviewer stated yes, by providing more real-world data to the consumer, and helping the consumer make a more informed selection. On the other hand, the reviewer believed much more benefit can be had by publicizing the website and its contents more. The reviewer acknowledged familiarity with the advanced vehicle testing activity (AVTA) testing for over seven years now, and knows where to look for it. However, the reviewer was not entirely sure that the average consumer knows that such a resource is available. A Google search for AVTA yields Antelope Valley Transit Authority. A Wikipedia page on fuel economy does not appear to have any reference to the AVTA site either. There appears to be no links to the AVTA website on www.fueleconomy.gov, which the reviewer thought was inexcusable. As a taxpayer, the reviewer believed that tax dollars are being put to very good use when they are spent on these kinds of testing activity, but also believed that there could be much more bang for the buck if the site was publicized more. More publicity could get more people within the United States to utilize the information that the AVTA website contains.

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

Reviewer 1:
The reviewer stated that it is not 100% clear that sufficient testers or people for the time remaining exist to complete the project.

Reviewer 2:
The reviewer stated that though resources are always spread thin for this type of expensive project, the project team appeared to have leveraged some excellent partners.

Reviewer 3:
The reviewer said that more of this kind of work can be done, but given the budget pressures, believed this project has the right level of funding.

Advanced Vehicle Testing and Evaluation: Richard Jacobson (Intertek) - vs029

Presenter
Jeremy Diez, Intertek

Reviewer Sample Size
A total of five reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer thought that the approach is good. However, questioned if the technical barrier is really "risk aversion from OEMs." The main barrier the reviewer saw was public resistance/ reluctance to buying advanced technology vehicles. This is where the program has value, by demonstrating long-term benefits of these vehicles

Reviewer 2:
The reviewer commented that this project demonstrates a well-organized and well-managed program with clear objectives and goals.

Reviewer 3:
The reviewer stated that the approach of this project is adequate. By providing baseline, interim component and end of life testing a good set of data will be provided. A strong area of the project's approach is that it includes a very good set of vehicles being evaluated in areas of climate diversity.

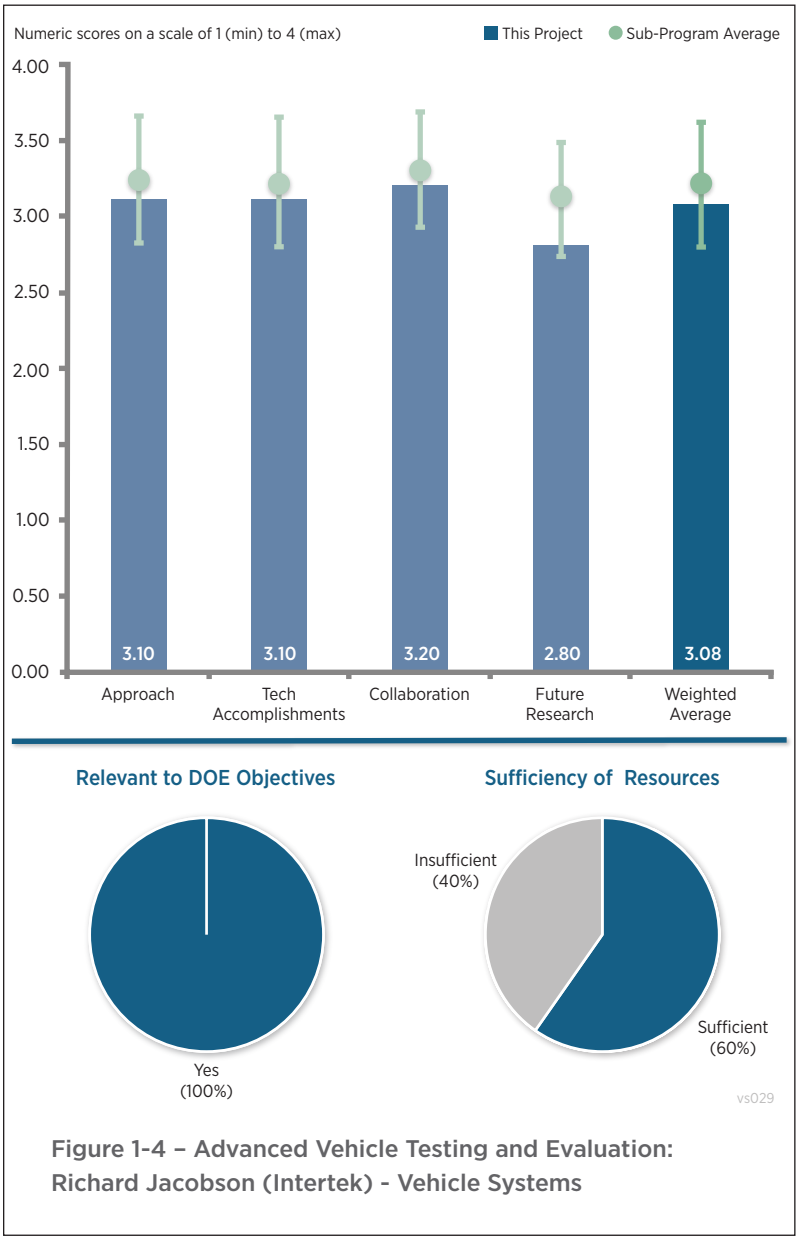

Figure 1-4 – Advanced Vehicle Testing and Evaluation: Richard Jacobson (Intertek) - Vehicle Systems

Reviewer 4:
The reviewer stated that it is a good approach to monitor 12 V loads, but questioned how the components are picked. The reviewer added that it is great to check the components throughout the life of the vehicle, but wanted to know what the results were, besides the two vehicles that failed the transmissions. It would be helpful to get someone involved, possibly the OEM or a lab, to do root cause on the failures of the transmissions. This information could be used to improve components and perhaps system design. The reviewer commented that a good range of vehicles of consumer type hybrids was chosen. The MD trucks will be an important add in the future. The suggested direction of some cold climate testing is a good one; Colorado can get a little cold, but not like Minnesota or Alaska.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer thought that the data from this project is well intended to inform the DOE for future research and consumer information necessary to support widespread acceptance of plug-in/hybrid/electric (xEV) technology.

Reviewer 2:
The reviewer stated that the data collected is valuable and provides information that might be otherwise unavailable. It is useful for analysis supporting DOE goals of investing in technology for petroleum displacement and clarifying technology benefits for regulatory agencies (e.g., California Air Resources Board questions on plug-in hybrid electric vehicles).

Reviewer 3:
The reviewer noted that many miles and components were tested for the money spent. The reviewer questioned if the 12 V testing gave an idea of the breakdown of auxiliary loads.

Reviewer 4:
The reviewer noted that there appears to be good technical accomplishments in the project, but it would be useful if more data could be provided on the vehicles that have been tested.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer noted that the array of national laboratories for technical support and fleet partnerships for road data are an outstanding example of quality coordination.

Reviewer 2:
The reviewer stated that the testing program is logistically challenging and requires a good deal of collaboration between various government and industry entities. The project team did very good coordination work.

Reviewer 3:
The reviewer found that the project has good collaboration with a variety of national laboratories. In the future it would be good if the project could also include OEMs as collaborators.

Reviewer 4:
The reviewer stated that there was good collaboration and breakdown in duties between INL, ANL, and NREL. Also, good fleet partners were selected. The reviewer was hopeful that the OEMs would join the project. Their involvement would decrease the amount of money needed to be spent, as the reviewer would imagine they could make testing of the vehicles and their components much easier. Agreements would have to be drawn up with them so that they feel they cannot be hurt in any way with the data obtained. Finally, the reviewer thought that a MD fleet that wants to test fuel saving technology needs to be found

Reviewer 5:
The reviewer stated that there should be a diversified end user group providing data instead of the two fleets Also, varied climates need to be incorporated.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer noted that varied climates, including extreme cold and poor weather areas are included, like Chicago.

Reviewer 2:
The reviewer stated that the future work indicated for the project will continue to provide the necessary data needed to evaluate the advanced vehicle technologies and should provide information to help eliminate barriers.

Reviewer 3:
The reviewer noted that as this project scope is quite long term, necessary for acquiring statistically relevant data, and that continuation with consistent data gathering is necessary.

Reviewer 4:
The reviewer liked the idea of investigating how the secondary-use market will be impacted by the battery condition. Also, finding out how battery condition at the end of the first life might influence the secondary lea sale auto market. The reviewer suggested a colder location than Colorado that also is close enough/convenient enough to get to.

Reviewer 5:
The reviewer found that the project was generally excellent, but possible reliance on future participation by OEMs seems questionable. OEMs would need to be convinced of more specific benefits Also, the study loses some aura of independence if OEMs are providing vehicles.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer stated that this testing will validate electric propulsion vehicles.

Reviewer 2:
The reviewer believed that this demonstrates real-world benefits of advanced technology vehicles to the general public and provides data on benefits of specific technologie

Reviewer 3:
The reviewer found that the project is definitely relevant and supports the overall DOE objectives of petroleum displacement. Testing and evaluating advanced vehicle technologies in fleet applications will provide good information to DOE about the state-of-the-art of these vehicles.

Reviewer 4:
The reviewer noted that the project provides real-world data to support consumer decisions and widespread acceptance of xEV technology.

Reviewer 5:
The reviewer stated that the test data are key to lead the direction for future products which save fuel.

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

Reviewer 1:
The reviewer did not think it was clear that enough money has been, or will be, allocated to support the future research.

Reviewer 2:
The reviewer had the impression that budgetary constraints are limiting the test program more than in prior years.

Reviewer 3:
The resources stated that resources for this type of vehicle data can be endless, but the project appears to be meeting goals with present funding.

Reviewer 4:
The reviewer noted that the resources for this project seem to be adequate to accomplish the effort.

Reviewer 5:
The reviewer thought the project teams needs more diverse users and must go to cold places as heater, wipers, and defrosters place much more demand on the complete system.

Advanced Technology Vehicle Lab Benchmarking (L1 and L2): Kevin Stutenberg (Argonne National Laboratory) - vs030

Presenter
Kevin Stutenberg, Argonne National Laboratory

Reviewer Sample Size
A total of five reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer found that the testing work is sharply focused on obtaining vehicle data that are used in support of DOE projects and goals.

Reviewer 2:
The reviewer stated that testing under real-world conditions significantly enhances the value of the data, allowing it to inform off-cycle benefits of technolog .

Reviewer 3:
The reviewer though it was a good idea to look at the beginning and end of life, as this project is doing. ANL fits into the partnership by doing the dyno testing. The in-vehicle component and standardized cycle testing on the vehicle level are needed. The reviewer understood that Level 2 testing is more invasive. If OEMs get the results and can use them, the purchase price seems like something they would be willing to donate. Finally, the reviewer questioned how the technology to be examined is determined.

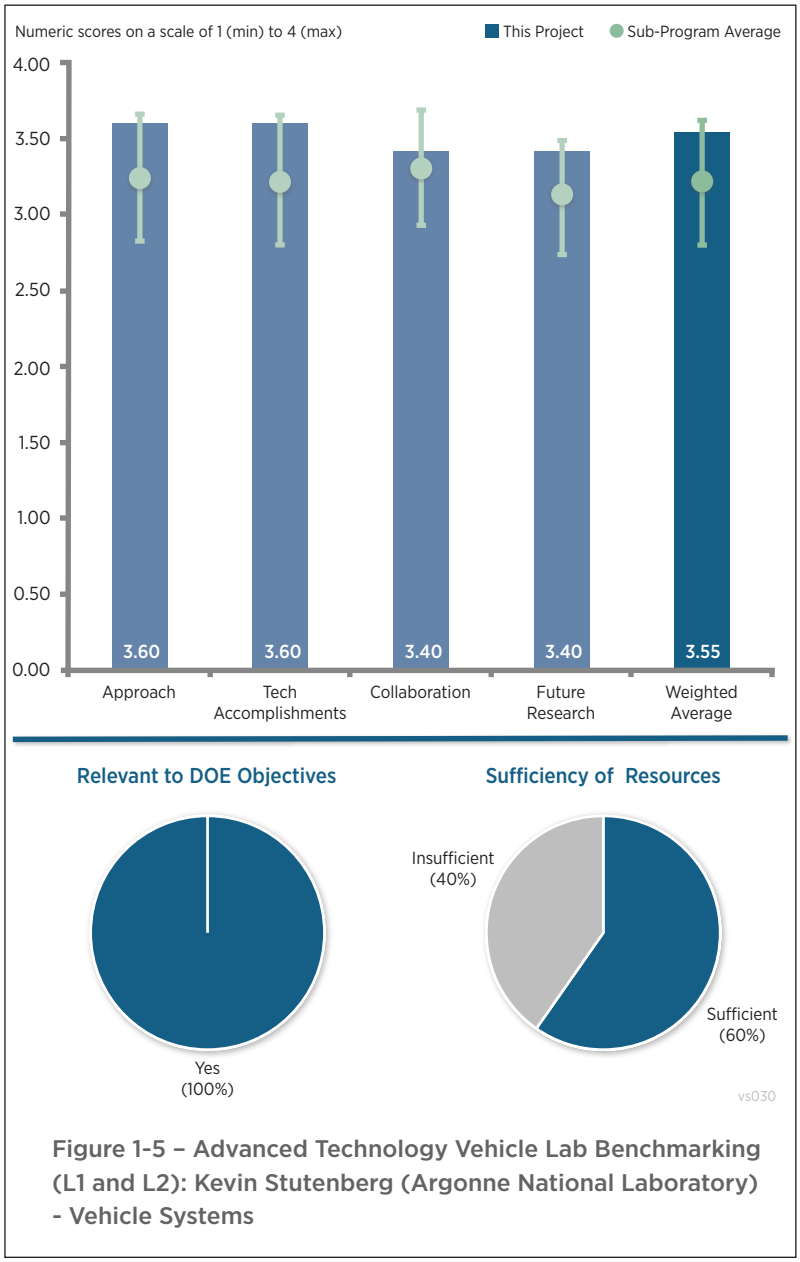

Figure 1-5 – Advanced Technology Vehicle Lab Benchmarking (L1 and L2): Kevin Stutenberg (Argonne National Laboratory) - Vehicle Systems

Reviewer 4:
The reviewer stated that ANL has done great work with both the Level 1 and Level 2 testing. The reviewer was concerned with some of the issues faced with developing models for simulating the 5-cycle test; it is hard to obtain efficiency data for driveline components for low-temperature operation. Testing the components on a stand using a large reservoir of the lubricant maintained at the specified temperature is rather hard, and not quite representative. The reviewer wondered if ANL could add some extra instrumentation (torque sensors) and measure efficiencies in-situ, perhaps under steady state conditions to avoid driveline dynamic behavior, and use that to characterize component efficiencies

Reviewer 5:
The reviewer suggested some visible barrier flow-down from industry to perhaps guide the deep-dive testing program and provide this industry collaborative strategy in these AMR reviews. In other words, the reviewer questioned if the tough problems that OEMs or suppliers face today are getting enough attention in using the target vehicles and data from the benchmarking project most strategically to move the needle in the commercial world. The reviewer added that the slides say this is happening as part of the planning effort, but examples of this direct linkage would be useful. Overall the testing program is impressive, seems solid and well-refined over years of honing.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer thought that this was excellent work, as always.

Reviewer 2
The reviewer stated that progress and technical accomplishments continue to be very good, with excellent reporting and analysis of the test data and good distribution of info to various partners. The public-facing data storehouse is a good way to disseminate data to the general public.

Reviewer 3:
The reviewer commented that there was good progress overall, but there are significant gaps in the range of vehicles that were tested due to budgetary and infrastructure constraints. Additional care needs to be taken to ensure that the most relevant and rapidly penetrating technologies are assessed.

Reviewer 4:
The reviewer found the result that heat pump/heater usage at cold temperatures is a big hit to the battery was an important result. That is a good comparison of energy needed for each vehicle for heat by the uses. The reviewer wanted to know who will look into why the Golf is lower, and what about their approach requires less energy.

Reviewer 5:
The reviewer stated that the project directly aligned with DOE missions/goals by continuously providing controlled data acquisition and providing a valuable service to the industry.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that collaborations with appropriate laboratories and industry partners is thorough.

Reviewer 2:
The reviewer stated that there was good representation across industry and laboratories, and noted the comments in the approach section in terms of alignment to industry's strategic needs (for benchmarking data).

Reviewer 3:
Overall, the reviewer thought that the collaboration between the various labs is excellent. The extent of OEM involvement is quite good as well. The recent proposal by ANL to get the OEMs to have skin in the game by paying for the vehicle purchase, while the testing would be funded by DOE is a very interesting one, and should be followed with more vigor. The reviewer also commented about one of the observations made in last year's review regarding the exclusion of the U.S. Environmental Protection Agency (EPA). While the reviewer tended to agree with that observation, and felt that ANL could involve EPA more extensively, it could also be said that by working separately, ANL and EPA provide two neutral viewpoints.

Reviewer 4:
The reviewer noted that additional efforts to engage OEMs and Tier 1 suppliers would allow for more meaningful testing. The reviewer added that the engagement on the codes/standards efforts is good.

Reviewer 5:
The reviewer found that the codes and standards, and modeling support are good areas for this project in which to collaborate. Some data are available for download, hopefully most of it, and U.S. Driving Research and Innovation for Vehicle Efficiency and Ene gy sustainability (U.S. DRIVE) also has some of the data available. The reviewer noted that there are many different collaborations, but asked if there are any OEMs. The reviewer stated that the project team and OEMs should be in this effort to characterize their vehicles together. Both organizations want to see more hybrids and battery electric vehicles (BEVs) sold.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer thought that the budget is too constrained to allow for future work to be fully completed.

Reviewer 2:
The reviewer stated that by necessity, future work is dependent on what new advanced tech vehicles are available.

Reviewer 3:
The reviewer asked if the project team can tie the results to changes in hardware or software used by the OEMs. If so, it might make it easier to keep the budget. The reviewer added that getting the results analyzed and reported is very important.

Reviewer 4:
The reviewer stated that the inclusion of end-of-life assessments is a good supplement for future work. Of course, benchmarking data acquisition is a never-ending process so future work is generally similar work with new products and measurement technology advancements. The reviewer noted that any comments about how the measurement/analysis landscape has changed over time would be welcome.

Reviewer 5:
The reviewer suggested that ANL should look at measuring the emissions on some of some of the non-standard cycles that they run as well, to get a better understanding of how good the vehicle emissions are in real world driving.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer stated that this project provides hard data on benefits of advanced technology vehicles, and explains the mechanisms for fuel savings. This provides guidance on which technologies are most effective in achieving petroleum displacement.

Reviewer 2:
The reviewer commented that assessing the benefit of new technologies seems to be informing DOE on future areas to target for funding.

Reviewer 3:
The reviewer thought that this project is very relevant, especially if OEMs are using it to drive improvements in their design.

Reviewer 4:
The reviewer thought that supporting activity to the front lines is relevant to the DOE objectives.

Reviewer 5:
The reviewer stated that this project feeds into all the modeling activity as well as supports much of the AVTA.

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

Reviewer 1:
The reviewer thought that further funding is needed to better assess rapidly evolving technologies in the marketplace.

Reviewer 2:
The reviewer asked how the project team would determine that start-stop may not make the cut. That indicates this area needs more money, asserted the reviewer.

Reviewer 3:
The reviewer believed that ANL is obtaining a wealth of data, especially from the Level 2 testing, and there could be significant knowledge gained if there were more resources dedicated to understanding the data bette .

Reviewer 4:
The reviewer stated that the milestones are designed with budgetary constraints in mind, so by definition they are sufficient. Howeve , if the desire is to accelerate the dissemination of data, then resources are insufficient

Reviewer 5:
The reviewer noted that activity will simply fill the budget available. The numbers of samples per year appears appropriate for the pace the technology is fundamentally advancing.

SuperTruck - Development and Demonstration of a Fuel-Efficient Class 8 Tractor and Trailer Vehicle: Russ Zukouski (Navistar International Corporation) - vs064

Presenter
Russ Zukouski, Navistar International Corporation

Reviewer Sample Size
A total of five reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer stated that all of the technical barriers appear to have been addressed in a well-designed manner and the project is producing meaningful results. The project team is doing a good job of approaching the efficiency challenge with a whole systems approach.

Reviewer 2:
The reviewer stated that the approach of dividing the project into four focus areas was highly successful.

Reviewer 3:
The reviewer noted that the approach to restart is very strong. T3 testing and T4 plans are exhaustive and the project team should learn much from these two builds and test opportunities.

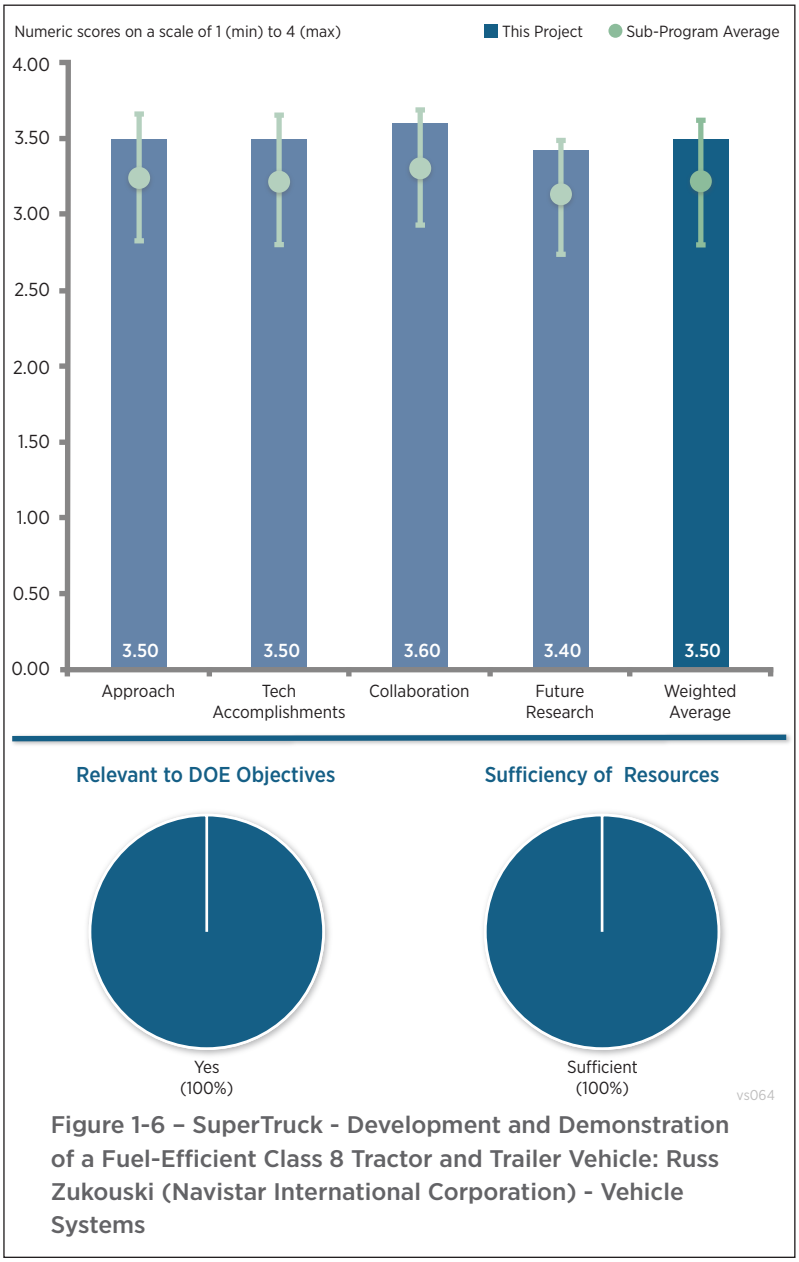

Figure 1-6 – SuperTruck - Development and Demonstration of a Fuel-Efficient Class 8 Tractor and Trailer Vehicle: Russ Zukouski (Navistar International Corporation) - Vehicle Systems

Reviewer 4:
The reviewer stated that the approach contains all the key enabling technologies that can help the program to achieve the goal. The reviewer noted it is unclear how the hybrid portion of technologies is contributing to overall improvement.

Reviewer 5:
The reviewer noted that the presentation described the team's approach to pursue fuel savings in four areas: lightweighting; rolling resistance; aerodynamic improvement; and powertrain technologies. The original approach called for use of an e-Turbo, but that was dropped due to problems. The reviewer stated that it seems like a good strategy was used to focus on waste heat recovery (WHR) and other technologies to adapt to this issue. The planned approach for testing includes multiple different drive cycles weighted together. This approach to consider multiple cycle effects is good, but it would have been nice to understand how the cycles and weights were chosen.

Furthermore, the reviewer asked why there is not a test component to capture the relative impact of overnight idling in the conventional baseline compared with running off the 48 V battery then recharging while driving during the next day.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer stated that the project team is very close to the 50% brake thermal efficiency (BTE) goal and the 82.3% freight efficiency improved passed the goal. In spite of the period pause, their schedule has produced significant accomplishments

Reviewer 2:
The reviewer noted that Navistar achieved the project goals with room to spare. According to the reviewer, the list of improvements is very long, and it was unfortunate that there was only 20 minutes to learn about them.

Reviewer 3:
The reviewer stated that following a pause on the project a couple of years ago it seems like the team has made good accomplishments in all four areas of fuel efficiency improvement: both for the T3 truck generation and so far on components incorporated into the T4 generation. The team seems on track to achieve the goals of the program with the upcoming demonstration and testing of the T4 vehicle. The reviewer thought it was great to hear that the electrified air conditioning system not only saves fuel, but also saves cost by enabling one electric compressor to replace what had previously been two compressors, one to cool the cab and another for the sleeper area. The reviewer also appreciated that the majority of the features in the T4 vehicle will get carried forward into new production vehicles.

Reviewer 4:
The reviewer was impressed with the technical accomplishments after the restart. The reviewer exclaimed that it can be very difficult to restore momentum on a project such as this and the team has, which was well done. The fuel economy performance of 10.45 after 10,000 miles is in line with expectations and should improve given the plans with T4. The reviewer also observed some shifts made with new learnings (e.g., WHR and e-Turbo).

Reviewer 5:
The reviewer stated that the 64% improvement is excellent considering that this is not the final package. Howeve , the schedule is so much behind their competitors, that it would not look too good when SuperTruck II is coming. The reviewer questioned how many miles do the trucks run in the driving route for vehicle tests. Furthermore, the reviewer asked what the road grade is and the baseline miles per gallon (MPG).

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer thought that this project has an outstanding set of partners.

Reviewer 2:
The reviewer stated that all of their partners appear to be fully engaged in the project.

Reviewer 3:
The reviewer stated that the project seemed to have a good list of partners and coordination/contribution from the partners. These included Bosch, Wabash, ANL, LLNL, Eaton, Dana, and Hendrickson.

Reviewer 4:
The reviewer stated that working with all key partners is excellent, as proposed.

Reviewer 5:
The reviewer did not see as much evidence of collaboration as expected.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer found the plan to be solid and comprehensive.

Reviewer 2:
The reviewer noted that the project's future work will focus on completing the build, integration/calibration, and testing of the T4 truck. Again, most promising is the future plans beyond the project to incorporate most of the efficiency features from the program into future production vehicles

Reviewer 3:
The reviewer acknowledged being very interested to see the progress and results of T4, new cab shape, and other planned improvements.

Reviewer 4:
The reviewer noted that this project is nearing completion and is therefore short on future plans.

Reviewer 5:
The reviewer stated that the project team is done, too, and will include many of the features into their commercial product.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer thought that the returns on investment in long-haul fuel economy will be huge.

Reviewer 2:
The reviewer stated that the project has demonstrated significant petroleum displacement with its efficienc improvements.

Reviewer 3:
The reviewer noted that the program goals of increasing freight efficiency by over 50% and showing a path to 55% BTE are highly relevant to achieving national petroleum displacement, and this project appears on track to meet these goals.

Reviewer 4:
The reviewer stated that freight efficiency improvement is always in line with DOE objectives

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

Reviewer 1:
The reviewer stated that, while $76 million is significant funding, the upside petroleum reduction potential to the trucking industry is significant

Reviewer 2:
The reviewer stated that progress is good and proves sufficient resources have been attained even after the restart

Reviewer 3:
The reviewer commented that this was a huge job, requiring big bucks.

Reviewer 4:
The reviewer stated that this project represented a major funding effort, including over $35 million in DOE funds over the course of the project and roughly $5 million in FY 2016. This level of funding warrants more scrutiny than

the reviewer can provide from a 20 minute presentation, and hoped that the DOE program managers have provided this scrutiny through the life of the project. It does seem like the team is realizing good results from the project funding.

Reviewer 5:

The reviewer stated that there seems to be sufficient to complete the program, but timing is a big concern when all other competitors all completed their goals.

Commercial Vehicle Thermal Load Reduction and VTCab-Rapid HVAC Load Estimation Tool: Jason Lustbader (National Renewable Energy Laboratory) - vs075

Presenter
Jason Lustbader, National Renewable Energy Laboratory

Reviewer Sample Size
A total of four reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer thought that the project has an appropriate scope and approach to meet the objectives, and that it was well presented and complete.

Reviewer 2:
The reviewer noted that the presentation graphics suggest that analysis possibly omits the effects of engine and pavement as a heat source.

Reviewer 3:
The reviewer stated that the project is very focused on reducing the load to benefit the plethora of options existing to help improve their efficienc . Expansion into other sectors is good, but should stay equally focused on those that need it. The reviewer commented that without sleeping in the trucks, the payback may be very limiting. Buses, yes, others maybe not.

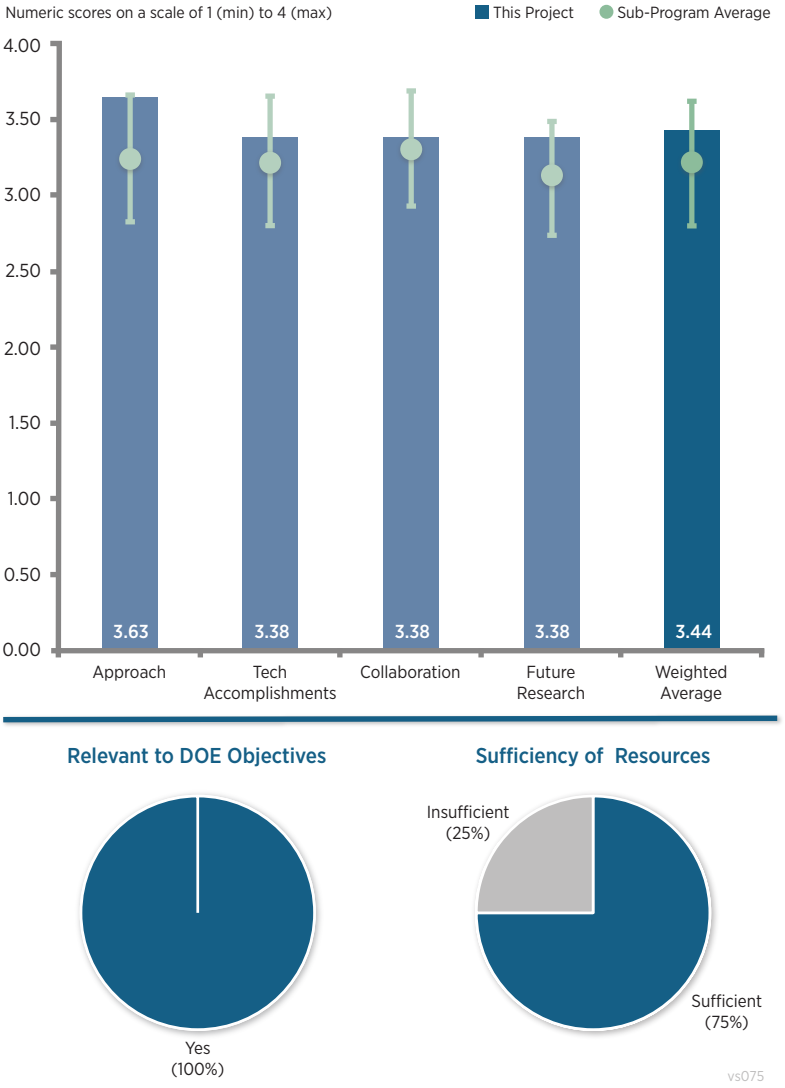

Figure 1-7 – Commercial Vehicle Thermal Load Reduction and VTCab-Rapid HVAC Load Estimation Tool: Jason Lustbader (National Renewable Energy Laboratory) - Vehicle Systems

Reviewer 4:
The reviewer stated that the project aims to increase the fuel efficiency of commercial vehicles by reduce the thermal load of the vehicles. A numerical tool is being developed for fast quantification of thermal load reduction solutions. Experimental testing and numerical modeling methods, which is typical, were adopted to evaluate the impact of the solution. The solution is a combination of ultra-white paint, advanced curtains, and insulations. The reviewer wondered why these three methods were adopted and whether there were any other methods being considered before coming to the final solution

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer found that the accomplishments of the project are impressive, taking three base technology areas and finding quite a bit of performance for minor improvements

Reviewer 2:
The reviewer stated that the technical accomplishments and progress that have been made so far are impressive. The predicted payback time is three years, although this reviewer wondered about the collaborating OEMs' opinion on this and their future plan.

Reviewer 3:
The reviewer observed excellent progress. Acknowledging that it may be irrelevant, this reviewer had a little trouble following whether the accomplishments were a result of the 2015/2016 work or from the prior project.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that the collaboration with the trucking industry is excellent!

Reviewer 2:
The reviewer stated that these features will be offered by the truck OEMs, so it is good to work with the truck builders. The reviewer did think better promotion of this with fleets will help pull the changes into more truck

Reviewer 3:
The reviewer noted that OEMs of long-haul trucks and suppliers of the insulation solutions are engaged in this project. If the presentation can provide OEMs' opinion and future plan as the project moving forward, that would be great.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer commented that the future work is well planned and will cover some other applications, e.g., day cab, buses, etc.

Reviewer 2:
The reviewer was sure the value exists in other applications. Keeping a high requirement for engagement and analysis is suggested.

Reviewer 3:
The reviewer stated that the future research proposal for calendar year (CY) 2016 and 2017 is a natural follow on. It would be good to see this work be included or brought into collaboration with SuperTruck at some level.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer stated that significant amounts of petroleum are consumed to satisfy HD auxiliary loads. This analytic capability offers OEMs and fleet owners the capability to quantitatively estimate ROI for investments in technologies that reduce petroleum consumption.

Reviewer 2:
The reviewer thought that this is very relevant to the goals of the DOE, 21st Century Truck Project, and the GHG regulations of EPA and the National Highway Traffic Safety Administration (NHTSA). The reviewer stated that the team did a good job.

Reviewer 3:
The reviewer noted that the project investigates the energy lost during the truck downtime, a substantial use of energy without transporting goods. The results, with some additions, could apply to both active as well as downtime. The reviewer added that this definitely applies to the DOE objective of petroleum displacement through efficienc .

Reviewer 4:
The reviewer stated that fuel efficiency improvement of commercial trucks is an important part of DOE s overall objective of energy saving and petroleum displacement.

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

Reviewer 1:
The reviewer stated that it seems sufficient for the great progres

Reviewer 2:
The reviewer found that the project appears to be adequately resourced.

Reviewer 3:
The reviewer stated that NREL has been collaborating with Volvo Trucks and Daimler Trucks for a while and they have the ability and sufficient resources to finish the project in time The reviewer is looking forward to extensive participation and input from Volvo Trucks and Daimler Trucks.

Volvo SuperTruck: Pascal Amar (Volvo Trucks) - vs081

Presenter
Pascal Amar, Volvo Trucks

Reviewer Sample Size
A total of six reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer stated that no criticism of this project is possible given the outstanding freight efficiency improvements.

Reviewer 2:
The reviewer commented that the combination of simulation and testing yielded excellent results.

Reviewer 3:
The reviewer stated that Volvo's approach for the entire four-year project has been robust and disciplined, and it delivered.

Reviewer 4:
The reviewer stated that this five-year effort has employed and successfully implemented a classical technical/project approach. Phase One (Concept Selection) consisted of baseline test, technology development, and concepts evaluation through model development, engine and mule truck testing, and validation. Phase Two (Development and Integration) consisted of technology refinement and validation through engine bench testing and demonstrator truck development, and finally integration, optimization, and demonstration. The approach focused on achieving program goals through three pathways: fuel savings through various tractor and trailer technologies, hotel load savings measures, and overall vehicle weight reductions. This three-way approach provided flexibility to achieve project goals with each pathway playing a significant role. Finall , the approach employed a variety of robust simulation and testing mechanisms to guide technology selection and component sizing, develop algorithms, and ultimately verify freight efficiency improvements under controlled tests for repeatability and real world conditions. The reviewer believed that the early project focus (in Phase One) on mid-term freight efficiency impacts and customer ROI was a key element. Overall, a very strong approach which has led to project success.

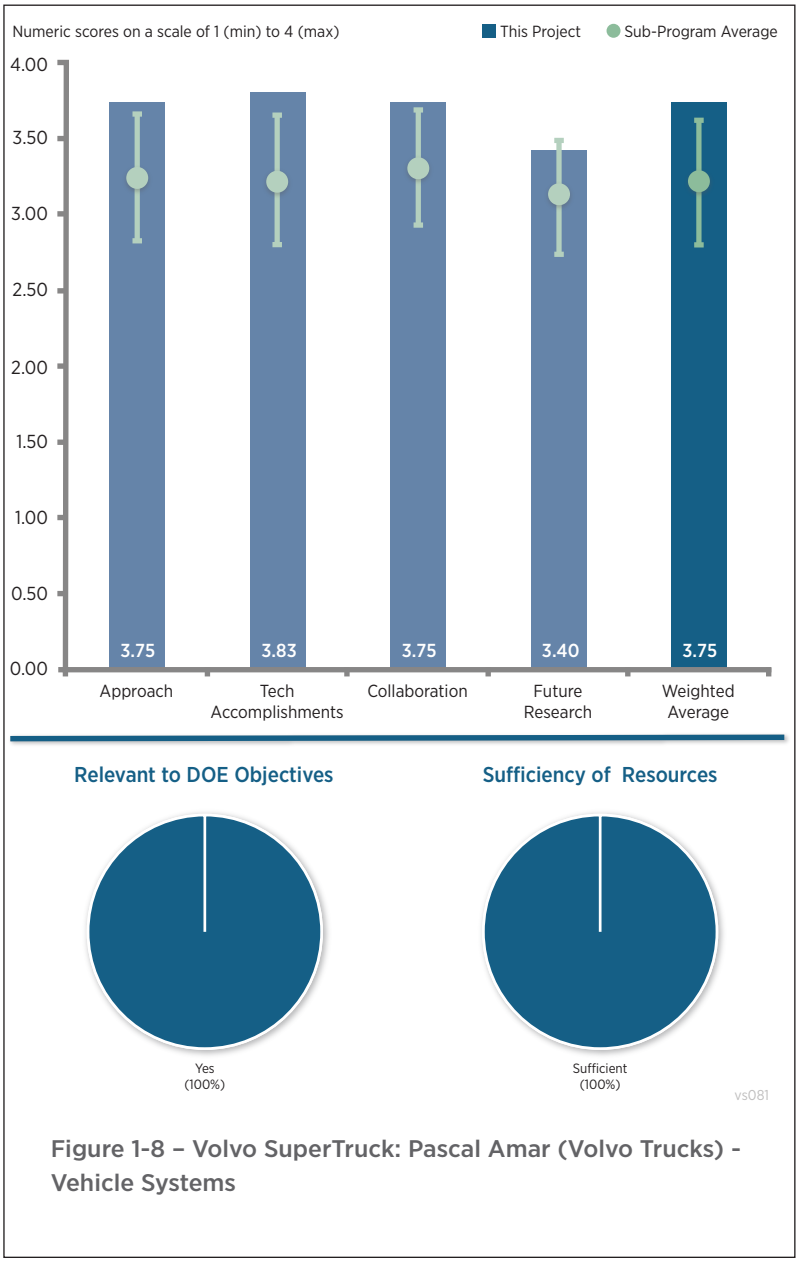

Figure 1-8 – Volvo SuperTruck: Pascal Amar (Volvo Trucks) - Vehicle Systems

Reviewer 5:
The reviewer stated that the approach includes all key enabling technologies, which is comprehensive.

Reviewer 6:
The reviewer thought that the project had a good approach.

Question 2: Comments on technical accomplishments and progress:

Reviewer 1:
The reviewer exclaimed that with a goal of 50% MPG improvement, the project team achieved 70% (and even higher on freight efficiency), which is pretty outstanding

Reviewer 2:
The reviewer stated that the project far exceeded the goals, and received an award because of it. The improvements were sound and kept to what was viable and implementable. Outstanding!

Reviewer 3:
The reviewer found the freight efficiency strong and in line with features delivered. The project team developed some stretch goals, big and aggressive, for instance, all-aluminum frame rails.

Reviewer 4:
The reviewer stated that the fuel economy and freight efficiency improvement far exceeded the project goals, while also reducing vehicle weight and improving the payload capacity.

Reviewer 5:
The reviewer stated that the project is now completed and has demonstrated and verified a long list of successes, including surpassing the program goal for fuel economy (69% as opposed to target of 50%) and achieving 88% freight efficienc . Equally as important is the fact that several team members have already commercialized a number of technologies resulting from this project. Specificall , in 2015 improved trailer aero devices were implemented, in 2016 tractor aero improvements have been commercialized, and in 2017 powertrain improvements are being commercially implemented in 11 liter and 13 liter engines. Specificall , in 2016 chassis fairing and roof and bumper aero improvements have been launched in all Volvo vehicles. As a result, a lot of technologies are already making it to the customer.

The reviewer also noted that an interesting slide was presented outlining the technology readiness levels and customer pay back of a variety of the technologies examined. The ROI on the different technologies varies significantly depending upon the specific duty cycle and customer need

Reviewer 6:
The reviewer was very impressed with the achievement of 88% improvement. Specifically completed the goal one year shorter than their major competitors. Slide 6 is an excellent slide to show the individual key components and technology contribution to total improvement. However, the reviewer stated that it is not clear how the truck was tested for that 88% fuel economy improvement. The reviewer questioned how many miles were really running, at what road grade, and the baseline MPG.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that partner coordination and participation appeared to be very strong, with each contributing in their area of expertise.

Reviewer 2:
The reviewer stated that the project team had a long list of collaborators, and together they got the job done.

Reviewer 3:
The reviewer noted that good collaboration was evident, and wants to see it continue with features going to production

Reviewer 4:
The reviewer stated that the project has incorporated a strong and diverse project team from the beginning,

covering all the requisite areas. This team has helped bring the project to successful fruition and currently serves to promote commercialization.

Reviewer 5:
The reviewer stated that the project team utilized all partners to complete the program goal.

Reviewer 6:
The reviewer thought the project had a good team.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer noted that the project team is done. The only suggestion of future work was coming up with less-expensive alternatives for the small amount of carbon fiber used

Reviewer 2:
The reviewer stated that the team wants to continue optimizations after the end of the project.

Reviewer 3:
The reviewer stated that the program is completed, and there is no need to detail the future work.

Reviewer 4:
The reviewer commented that as the project has ended, the proposed future research is limited. But, the PI does indicate efforts will be made to continue to evaluate the demonstrator vehicle to identify further areas of improvement, as well as possible additional candidate solutions for commercialization. Additionally, if not already planned, it may be beneficial to conduct a thorough project debrief to surface all the lessons learned over the past five years from this project and to use them to inform and guide similar future activities

Reviewer 5:
The reviewer noted that none are really planned.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer stated that the project team is actually going to use much of what they did in their production vehicles, the reduction in petroleum use could be huge.

Reviewer 2:
The reviewer stated that the project exceeded the goals and directly supports the DOE objectives.

Reviewer 3:
The reviewer noted that the project team exceeded DOE's goals.

Reviewer 4:
The reviewer noted that HD transport is a major contributor to the nation's petroleum use and dependence, and added that it is actually the fastest growing component overall. Thereby, developing advanced technologies that improve the efficiency of the nation's trucking fleet and successfully implementing them will significant contribute to meeting DOE's and the nation's petroleum displacement goals.

Reviewer 5:
The reviewer stated that freight efficiency is always in line with the DOE objectives

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

Reviewer 1:
The reviewer stated that it is amazing that Volvo is able to complete the program with the half of the funding compared to their competitors. The job was well done!

Reviewer 2:
The reviewer believed that there will be a big payback on the R&D money spent.

Reviewer 3:
The reviewer stated that given the success, funding must have been sufficient

Reviewer 4:
The reviewer stated that the resources (both financially and from a corporate capability perspective) have been sufficient, as demonstrated by the project's successful conclusion

Reviewer 5:
The reviewer stated that this project is ending and has sufficient resources to close out

System for Automatically Maintaining Pressure in a Commercial Truck Tire: Norm Anderson (The Goodyear Tire and Rubber Company) - vs085

Presenter
Norm Anderson, Goodyear

Reviewer Sample Size
A total of four reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

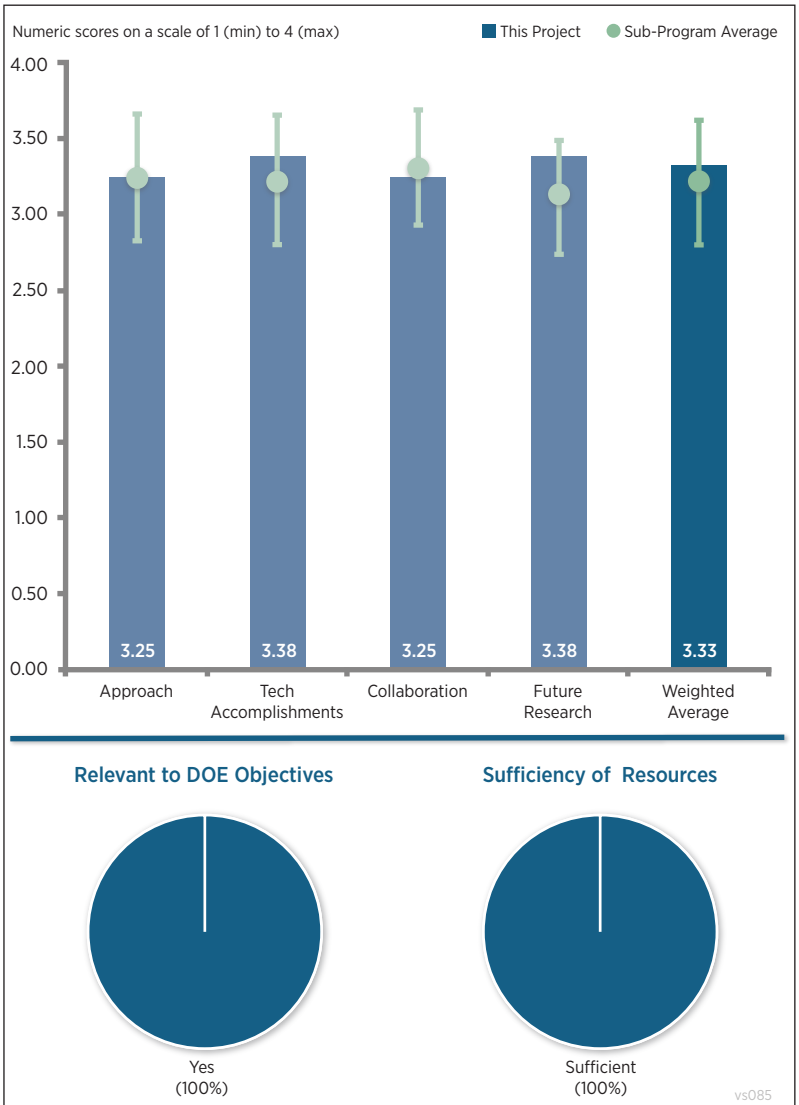

Figure 1-9 – System for Automatically Maintaining Pressure in a Commercial Truck Tire: Norm Anderson (The Goodyear Tire and Rubber Company) - Vehicle Systems

Reviewer 1:
The reviewer stated that the project's approach was specifically targeted to address issues arising from improperly inflated tires. The technology developed can be used on all vehicles, including in-use vehicles. The project also included surveying potential customers for interest in the technology. The project team also provided detailed analyses to support the rationale for the project. The reviewer found it interesting that despite providing a rationale focused on significant potential pressure losses without this technology (such as talk of the impact of a 20% pressure loss), the team's own testing appeared to indicate that their control tire lost 2.6 pounds per square inch (psi)/month compared to the technology under this project keeping this to a 0.3 psi/month drop, a much smaller difference. As fleet testing expands, it will be interesting to see how the technology-equipped and non-technology tires fare in comparison.

The reviewer added that the approach developed for the project was also interesting in that it originally included both internally- and externally-regulated systems. It was unfortunate that the internally-regulated system did not meet performance requirements, as that system may have been more interesting.

Reviewer 2:
The reviewer stated that the approach to develop a self-contained tire pressure maintenance system is reasonable and offers the potential for success. The switch from an internal pressure regulator (self-contained within the tire itself) versus an external regulator (which must be attached to the valve stem of the tire) is understandable, but there are implications in how complex the installation of the Air Maintenance Technology (AMT) tire is. The former design required no additional steps relative to a conventional tire, but this external regulator design

requires an extra step to install the regulator on the stem. Perhaps this is a minor challenge, but fleets often look for operational reasons to avoid adopting a technology.

The reviewer continued, saying the approach to conduct real-world testing is very important, as it will demonstrate the benefits and challenges for the tires in operation. It is very good to talk directly to fleets about whether the would buy the system, as Goodyear is doing. This ensures that Goodyear understands how the technology will be received, increasing the chances for successful deployment. Goodyear is looking at multiple vocations (both long haul and regional haul), and looking at multiple tire positions on the truck, to increase the potential for market uptake.

Reviewer 3:

The reviewer stated that the overall approach is good: customer needs and interest were studied, some design requirements were specified, project management proved nimble enough to handle a major design change, and considerations were made for design for manufacturing and assembly. The approach to design verification is good. The first round of fleet testing resulted in variation in inflation los The reviewer noted that the project team determined that a leaking issue caused this variation. The product design was improved prior to the start of the second round of fleet testing (delayed to June). Time-history data collection made this possible. However, the reviewer believed that the design verification process could be bette . New potential failure modes that may be introduced by the AMT system should be identified. The design verification plan should center on verifying those failure modes. Some of those failure modes have been exposed through standard lab and on-road testing, still some non-standard tests may be required to excite new failure modes.

The reviewer found that the combination of lab, track, fleet testing is good. A large amount of test miles have been accumulated. However, the author does not specify what constitutes a successful test. The reviewer commented that ideally, a statistically significant sample of tires should be tested to failure and cycles to failure compared against tires with AMT to verify superior life and that no new failure modes were introduced.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:

The reviewer found that the team has successfully demonstrated the ability of the system to exceed the performance goals set for pumping rate, ensuring the system can maintain tire pressure appropriately. The performance of the external regulator (Goodyear's contingency plan) was acceptable, and solved issues seen with the internal regulator. This kept the basic DOE-funded concept of a tire with self-maintaining pressure viable. The reviewer noted that Goodyear has done extensive testing of the completed tires, in laboratory and real world testing with multiple trucks, demonstrating that the changes to the tires do not compromise their reliability and durability.

Reviewer 2:

The reviewer stated that during this year, the project made a no-go decision concerning the internal regulator, choosing the external regulator as the preferred solution. The devices went out for installation into test fleets this past February. Initial in-use tests appear to show monthly losses of 0.3 psi (compared to 2.6 psi for un-equipped tires). The original goal was to reduce psi loss to 1 psi/100 miles. There were some leaking issues with the initial prototype on the first fleet, so there were some forts to redesign slightly before application to additional fleets. The reviewer noted that the redesign did result in some delay moving out to the next fleets

Reviewer 3:

The reviewer thought that the successful change in suppliers and design (internal compared to external regulator) is admirable. Size and weight were reduced, although it was not specified how much. The author does not address the approach to minimizing overall cost of pumping system including assembly, which was listed as a barrier to be overcome. The reviewer noted that two performance indicators are given. First, pumping rate exceeded bogey of greater than 1 psi/100 miles. Lab and on-road testing demonstrated that the chosen design met the pumping rate

requirement. Second, mean inflation loss was superior to tires without AMT. However, variation in inflation loss was significantly higher for tires with AMT.

The reviewer commented that while progress has been made with testing, it is unclear what the goals of testing are. Likewise, the manufacturing process was improved, but progress was not specified in terms of key metrics (production rate, process capability, scrap rate, process cost, etc.). The reviewer commented that at this stage in the project, the project team has not measured progress toward DOE goals. Fuel economy and life improvement targets must be validated. This is slated to be done as part of future work, but it behooves the project team to establish and communicate the validation plan.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer found that the collaborations were acceptable: most of this project is done by Goodyear with support from an (unnamed) set of suppliers for the pressure regulators. Goodyear has effectively collaborated with fleets to some extent by discussing the potential system with them to get feedback.

Reviewer 2:
The reviewer noted that suppliers provided prototype components and seemed to provide required support. Focus fleet testing is being performed by external customers. The author does not describe the terms of their participation, but apparently that interaction is contributing toward project goals.

Reviewer 3:
The reviewer stated that Goodyear has been the primary and largely lone member of the project team, working with several vendors for specific components/testing/assembl . Goodyear is also working with several fleets to conduct in-use testing. The reviewer commented that it is surprising to see this tight a circle of a team under a VS project, where there typically tends to be more collaborators. However, it seems largely appropriate for this project.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer found that the future work appears acceptable and contains logical steps to wrap this project up in September. This reviewer would like to hear more about Goodyear's general plans and timetables for commercialization.

Reviewer 2:
The reviewer stated that the long-term trials planned, including retread testing and fuel economy evaluation, are important. The specific goals for testing should be communicated, including reaction plans if failures are experienced. Plans for product validation of tires with AMT produced using the production-intent assembly process should be established and communicated.

Reviewer 3:
The reviewer noted that the project is currently 90% complete, and scheduled to be finished in September 2016. This person indicated reported that there are still a number of important activities left to take place, which were clearly identified. Still, activities are significant enough that it could raise the question as to whether the project wil be completed on time.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer stated that the project is focused upon increased efficiency through ensuring proper inflation o tires. This project has strong potential for relatively immediate impact upon in-use vehicles, resulting in near-term

petroleum reduction, emissions reduction, and safety benefits. The reviewer commented that while the project's specific focus is on truck tires, the technology could be applied to LD vehicles too, increasing its impact

Reviewer 2:

The reviewer stated that the technology is very promising. This technology could also have applications in LD fleets, further reducing petroleum losses and increasing safet .

Reviewer 3:

The reviewer commented that maintaining accurate and correct tire pressure is very important to maintaining fuel economy in commercial vehicles by reducing rolling resistance, and this system enables this to be done without user inputs. Although it was developed for commercial truck tires, its possible application to LD tires could be even more impactful for petroleum displacement. The reviewer commented that as Goodyear noted, the avoidance of premature tire wear and resulting replacement tire production is another petroleum displacement opportunity that can be significant

Reviewer 4:

The reviewer stated that the project is highly relevant to DOE's overall objective of reducing petroleum consumption.

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

Reviewer 1:

The reviewer noted that this project highly leverages recipient cost share and represents a good value to DOE. The overall budget seems reasonable to accomplish the goals of this project and result in direct technology commercialization.

Reviewer 2:

The reviewer stated that a no-cost extension was received in FY 2015, with additional funding provided in FY 2016. With the end of the project approaching soon, it appears as though there are no issues, or at least none were identified

Reviewer 3:

The reviewer stated that resources are sufficient to achieve the stated work, with more than adequate cost share

EV - Smart Grid Research and Interoperability Activities: Keith Hardy (Argonne National Laboratory) - vs095

Presenter
Keith Hardy, Argonne National Laboratory

Reviewer Sample Size
A total of four reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer noted that the project provides a wide range of support across multiple industries and interfaces through interoperability committees. The focus on carrying interoperability from standards through implementation and validation makes good use of limited resources.

Reviewer 2:
The reviewer stated that collaboration with standards organizations seems to be the key approach to activities in which the ANL Grid Interoperability team participates. This approach can be effective, but can also hinder measurable progress. There also seems to be a large number of activities supported by this group, and they are spread across a number of grid-related standards and technologies. This breadth of involvement appears to be good, depth was difficult to determine in the short time allotted for presentation

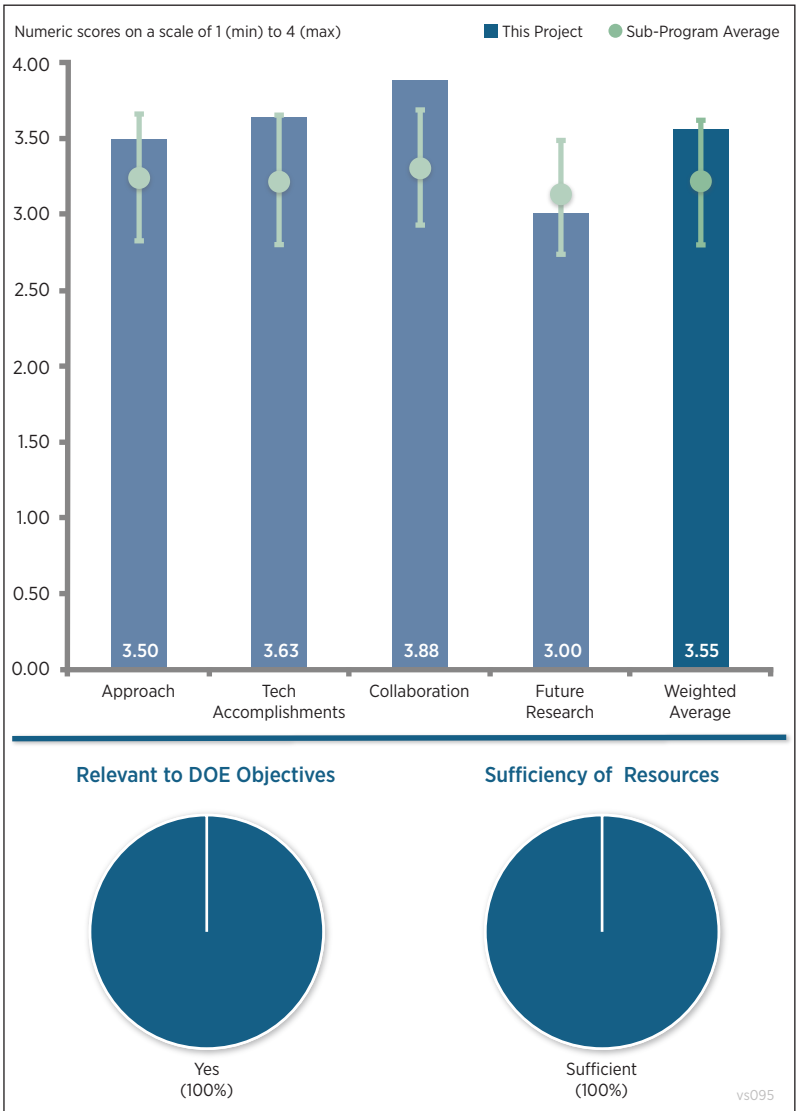

Figure 1-10 – EV - Smart Grid Research and Interoperability Activities: Keith Hardy (Argonne National Laboratory) - Vehicle Systems

Reviewer 3:
The reviewer stated that the approach slide for this initiative seemed a little like a list of what is being done, compared to the approach of how it was selected. Understanding that this is a difficult (and diverse) collection of initiatives, it would be helpful to have a top-down viewpoint slide that sets the stage for the actions carried out. The reviewer asked whether there is an interoperability and standards development strategy that is guiding the selection of these specific sub-projects. The reviewer also asked what else remains unanswered that would be next in queue and why.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer commented that the project has pushed forward across a wide range of activities and the technical accomplishments are significant. Coordination across organizations and continents through participation in multiple interoperability committees (e.g., European Interoperability Center, Grid Integration Technical Team (GITT), etc.) provides extremely valuable coordination of national and international work.

Reviewer 2:
The reviewer stated that notwithstanding the approach comments, the technical accomplishments of selected initiatives seem substantial and reasonable to advance the multi-party work between labs, standards organizations, various government departments, and industry.

Reviewer 3:
The reviewer stated that the presentation shows the expected variation in progress when working on standards, which progresses more slowly than the technology they are setting standards for.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that it was great work coordinating with various international bodies, OEMs, and other national laboratories.

Reviewer 2:
The reviewer thought that the coordination across organizations and continents through participation in multiple interoperability committees (e.g., European Interoperability Center, GITT, etc.) provides extremely valuable coordination of national and international work.

Reviewer 3:
The reviewer noted that the project is (by definition) required to have close coordination and collaboration, and appears to be quite successfully achieving the same.

Reviewer 4:
The reviewer commented that the key aspect of this groups activities is support and collaboration.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer stated that there is ongoing activity with clearly presented timelines for future work in grid-related technologies.

Reviewer 2:
The reviewer commented that the continued efforts to develop tools and validate equipment provides significant value. Some effort should be spent on moving hardware and software developed into industry.

Reviewer 3:
The reviewer noted that the chart for future work needs to be grounded with qualitative comments on what the new frontiers are and why. The reviewer found it very difficult to navigate this chart without intimate knowledge of acronyms and connected project phasing logic. In other words, the roadmap is too complex for the audience to appreciate the sufficiency of detailed subjects and steps laid out

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer thought there was a clear alignment to advance standardization and in the public interest.

Reviewer 2:
The reviewer acknowledged that, having sat on a SAE committee for standardization of some test procedures, the reviewer understood how hard it is to have all the OEMs agree with each other on a topic. The national laboratories provide a valuable service as a neutral third party. The reviewer did not think that the need for codes and standards can be exaggerated. It would not be very convenient to have each OEM with its own electric vehicle supply equipment (EVSE), as this would be a huge barrier for acceptability by the average consumer.

Reviewer 3:
The reviewer stated that DOE supporting industry codes and standards for grid-related technologies is very relevant to the objectives of the department.

Reviewer 4:
The reviewer found that the tools developed will be of significant assistance to industry in both facilitating connectivity and assuring interoperability.

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

Reviewer 1:
The reviewer stated that given the budget situation, this project is adequately resourced and funded. The reviewer believed that the work being done here is very important and the engineers at the national laboratories are in a unique position to perform this task, and perform it well. So, it is necessary that this activity is adequately funded.

Reviewer 2:
The reviewer stated that the team is doing well with current resources. Consideration should be given to developing and implementing a market transformation plan.

Reviewer 3:
The reviewer noted no exceptions flagged. As typical, the reviewer assumed that the project would make progress faster with additional funding.

Reviewer 4:
The reviewer stated that a large variety of activities supported requiring a lot of resources. Although doing more with less, the support of these technologies could involve less product development, which could make even better use of funds available.

Wireless and Conductive Charging Testing to Support Code and Standards: Barney Carlson (Idaho National Laboratory) - vs096

Presenter
Barney Carlson, Idaho National Laboratory

Reviewer Sample Size
A total of five reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer thought that the approach to the standards development process is logical and thorough. The proposed reporting methodology is excellent, covering both performance in a variety of possible charging connections as well as the health effects.

Reviewer 2:
The reviewer stated that the project has specific goals and methods to achieve those goals. Codes and standards support is critical for this emerging technology.

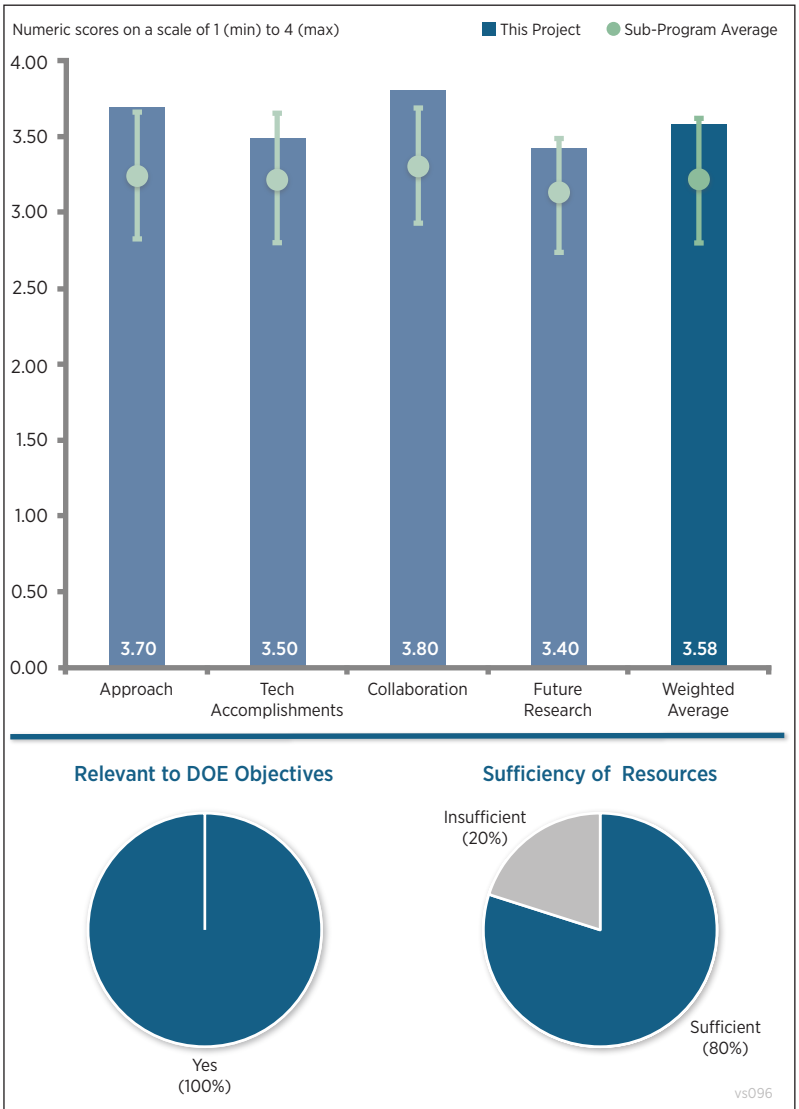

Figure 1-11 – Wireless and Conductive Charging Testing to Support Code and Standards: Barney Carlson (Idaho National Laboratory) - Vehicle Systems

Reviewer 3:
The reviewer noted that as with any project that was well described up front and executed well, this project is very straight forward to addressing the wireless charging technology.

Reviewer 4:
The reviewer thought that testing support for standards development is a key component and has been planned to properly support the codes being developed.

Reviewer 5:
The reviewer stated that the project appears very focused and well-framed. Cybersecurity was mentioned on at least two slides (barriers and laboratory), but the reviewer assumed this was not in scope for this project as no other mention of work or results were presented.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer stated that there was excellent progress on objectives. The test facility is well designed to execute the research plan and the technical data acquired on the systems tested to date is valuable.

Reviewer 2:
The reviewer noted that beyond the testing and characterizations of the field intensit , this project has spawned an excellent support of the standards needed to advance this technology. The wireless technology success is critical in achieving market adoption and consumer acceptance.

Reviewer 3:
The reviewer stated that the plan is on track to support the codes and standards development.

Reviewer 4:
The reviewer found that the results to date are impressive and show the potential benefits, as well as the possible hazards of wireless charging.

Reviewer 5:
The reviewer stated that the work was presented in a very understandable way with apparent achievement of the stated objectives. Perhaps a little over-emphasis on details of the wireless charging work at the expense of some data results from the ENERGY STAR® evaluations of EVSEs. The reviewer would like to see a sampling of what kind of efficiency variations were observed in this testing and asked if there were any other qualitative insights

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that the project has made the proper connections with SAE, other labs, and industry. The results from the project are reaching the appropriate audience.

Reviewer 2:
The reviewer stated that the choice of an OEM and standards organization created an exceptional partnership team that brings all of the diverse expectations of the stakeholders into one program; this is very likely to support a greater synergy to all of industry, and more robust standards.

Reviewer 3:
The reviewer stated that the project does not appear at a loss for appropriate collaborators.

Reviewer 4:
The reviewer stated that the right partners and coordination, through testing of the other DOE wireless charging projects, gives a wealth of data and analysis in support of the standards development activity.

Reviewer 5:
The reviewer stated that there was excellent coordination with interested vehicle manufacturers and charger suppliers. The reviewer would like to see SAE on the list if possible.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer stated that future works supports the J2954 standards evolution and should provide good information on interoperability requirements.

Reviewer 2:
The reviewer stated that the proposed interoperability work somewhat rounds out the project scope and completing the standards will conclude the study. Without compelling issues, the work may be considered complete at that time.

Reviewer 3:
The reviewer found that the work is all applicable to the intended outcome and well planned.

Reviewer 4:
The reviewer stated that the proposed future work is good and should be expanded to include additional wireless charging systems including HD if possible.

Reviewer 5:
The reviewer would have like a discussion of current and near-term continued work. The reviewer questioned what the longer-term outlook for R&D is in this space.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer stated that providing testing for wireless charging technology enables introduction of the technology, which makes EV usage a bit more palatable to some audiences. EV usage will promote petroleum displacement.

Reviewer 2:
The reviewer noted that wireless charging is a technology enabler needed for widespread acceptance of xEV technology. Understanding the boundaries and limitations and bringing them into standards is supportive of that mission.

Reviewer 3:
The reviewer stated that this supports commercialization of wireless charging, which may increase adoption of EVs and can displace petroleum.

Reviewer 4:
The reviewer stated that DOE and the industry must have a picture of this technology and how it effects the use of electricity as a fuel for on road vehicles.

Reviewer 5:
The reviewer noted that this project assists in evaluating key parts of the DOE vision infrastructure for plug-in electric vehicles (PEVs).

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

Reviewer 1:
The reviewer thought that the resources appear to be barely adequate. Some work appears to have been deferred due to lack of budget.

Reviewer 2:
The reviewer stated that the resources appear to be sufficient at the moment, but the need could increase if the project takes on the testing of more vehicle wireless charging systems.

Reviewer 3:
The reviewer stated that without particular issues being expressed, it appears that the correct quantity were deployed into this project.

Reviewer 4:
The reviewer stated that the accomplishments were not specifically presented but seem to indicate sufficien funding.

Reviewer 5:
The reviewer stated that funding appears to have matched the work required to date. No mention of shortage or concern in material provided.

High Efficiency, Low EMI and Positioning Tolerant Wireless Charging of EVs: Rakan Chabaan (Hyundai) - vs102

Presenter
Rakan Chabaan, Hyundai

Reviewer Sample Size
A total of four reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer commented that this project is following a normal automotive company approach to R&D projects. It is an iterative approach to establish whether certain system configuration(s) can meet a set of predetermined threshold values for consideration for future production.

Reviewer 2:
The reviewer stated that the project looked at many alternatives, started large and worked towards small. It looks to be investigating the appropriate bandwidth of dimensions and their impact to efficienc .

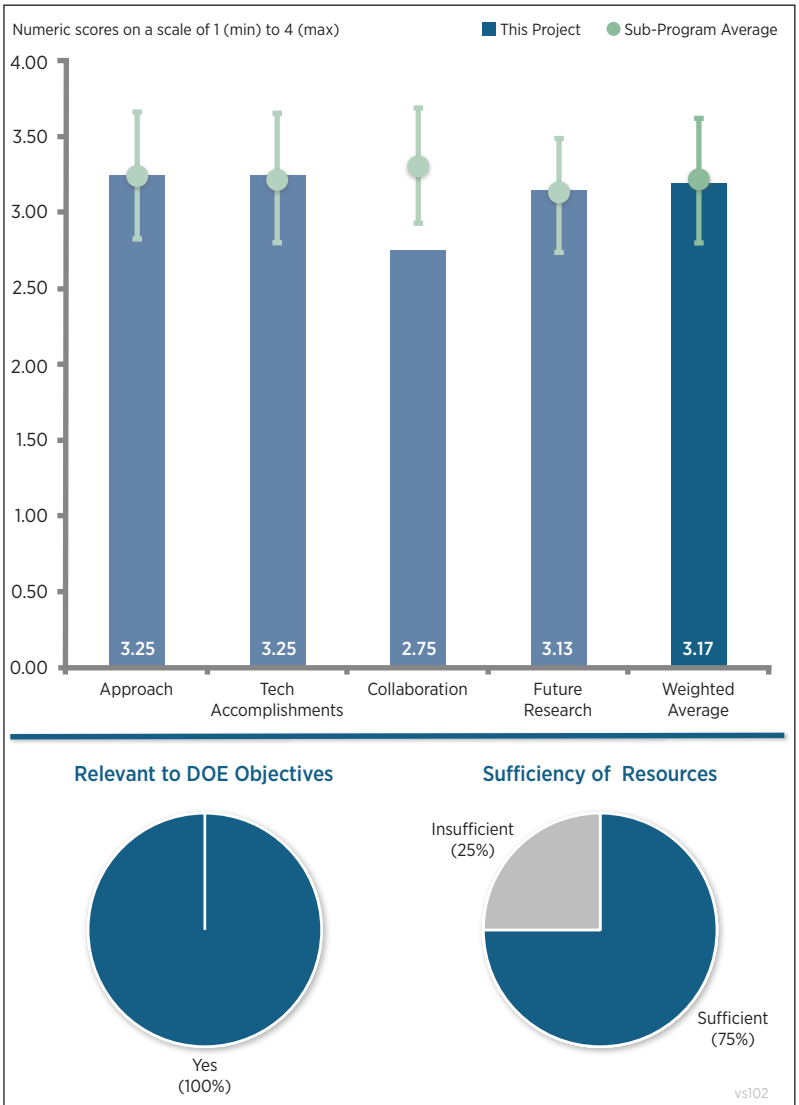

Figure 1-12 – High Efficiency, Low EMI and Positioning Tolerant Wireless Charging of EVs: Rakan Chabaan (Hyundai) - Vehicle Systems

Reviewer 3:
The reviewer stated that based on the original set of slides, the periods of time for each phase is not defined as there is no timeline provided for each phase. The technical barriers are explained well on Slide 2, and the power level and charging efficiency goals are clea .

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer stated that based on the system exceeding the 6.6 kW and 85% efficiency goals, the technical accomplishments are good.

Reviewer 2:
The reviewer thought that the evaluation of selected configuration was quite adequate for the purpose. There was no attempt to bring alternative configurations into the project. The project seems to be based on a pre-determined single configuration

Reviewer 3:
The reviewer commented that the effects on efficiency and the study of ene gy transfer into unintended objects are good. The reviewer did not see a list of other issues that remain for commercialization. The reviewer further noted environmental concerns about installation spaces, how to help the user align with the charger for maximum efficiency and use, and working with SAE in the cha ging recommendation.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that it seems adequate with Mojo, SAE, and others who have a serious stake in the outcome as collaborators.

Reviewer 2:
The reviewer would have liked to have seen a reference to SAE. Because there is variability in the charge efficienc , the reviewer questioned how EPA will align the charger during certification testing, and if there will be a recommendation in the SAE procedure. A 1% point difference in charge efficiency could a fect MPG equivalent (MPGe) on the vehicle label by two MPGe.

Reviewer 3:
The reviewer noted that the Slide 22 collaboration and coordination information make it seem that Mojo is doing all the work. There is no detail as to how Mojo and Hyundai are interacting, nor is there any information as to what work Hyundai is doing. In addition, the presenter submitted his presentation at the start of the annual review instead of in April like he was required to do by DOE. The reviewer said that this suggests little coordination with DOE.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer noted that the plan to continue refining the system is positive, as is the objective to add the system to five vehicles. Still, there is no indication that the future research will include a pathway to commercialization

Reviewer 2:
The reviewer stated that the outcome of the last phase of the project is to have a proof of concept to present to management for decisions on commercialization. No comment was provided by Mojo who may be a prime commercialization partner. It would be good to have their input to the question of whether this technology is ready for introduction to the commercial sector.

Reviewer 3:
The reviewer thought that having the OEM partner will be helpful in overcoming the barriers to commercialization. This project presentation does not list the barriers of cost compared to current systems that charge the vehicle, so it is unclear if this will be hindrance to adoption of the technology.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer noted that one goal of wireless charging is to make recharging PEVs easier, which should result in more EV miles traveled. In turn, this results in achieving DOE's objective of petroleum displacement.

Reviewer 2:
The reviewer commented that yes, because if it is successful it would assist with barriers to charging and increase the transfer rate and efficiency of a wireless cha ge system. This can increase adoption of EVs thereby displacing petroleum use.

Reviewer 3:
The reviewer stated that automatic charging of EVs will allow for more consistent charging of EVs which will result in less petroleum use.

Reviewer 4:
The reviewer stated that wireless charging must efficiently take place for EVs to cha ge at scale.

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

Reviewer 1:
The reviewer noted that based on the remaining funds of $427,000 and the spend rate the last three fiscal years, there may be a funding issue looming.

Reviewer 2:
The reviewer stated that funding seems sufficient based on outcomes presented. Nothing was presented regarding resources or how partners have participated.

Wireless Charging of Electric Vehicles: Omer Onar (Oak Ridge National Laboratory) - vs103

Presenter
Omer Onar, Oak Ridge National Laboratory

Reviewer Sample Size
A total of three reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer noted that this is a multi-year project that is intended to define a set of parameters that may be used to develop and commercialize a high transfer rate wireless charging system. The work has been logical in its sequence of tasks in the development of the wireless system. The intended outcome of achieving a system definition for development of a commercial system seems to be on track.

Reviewer 2:
The reviewer questioned if there has been any cross-talk with the Hyundai-Mojo Mobility project, to pool together lessons learned.

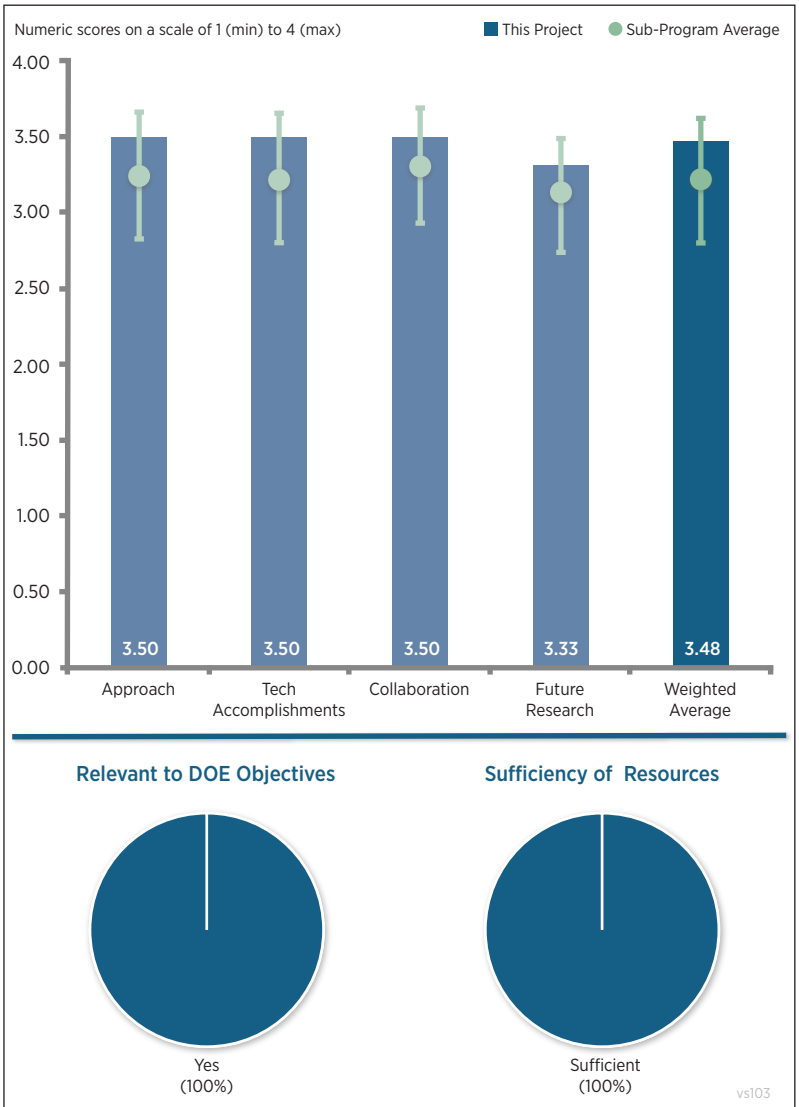

Figure 1-13 – Wireless Charging of Electric Vehicles: Omer Onar (Oak Ridge National Laboratory) - Vehicle Systems

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer noted that there was excellent progress towards the 20kW static and dynamic WPT.

Reviewer 2:
The reviewer stated that the project team is following the schedule according to plan.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that the project team has the right partners to achieve the objectives of the project. More partners would seem to be a deterrent to progress at this level of R&D.

Reviewer 2:
The reviewer noted that the 2015 AMR review showed a partner funding level of $3.3 million, while the 2016 AMR presentation showed $2.6 million.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer noted that the project is 98% complete. This person referenced comments regarding project resources and explained that this is an academic question. However, certain questions did come to mind for this reviewer. The impact of misaligned coils on loss of efficiency was described by the reviewer as significant Thus, the reviewer inquired about the possibility of having a self-aligning mechanism in the stationary coil, perhaps even a ferromagnetic core, which would result in a significant enough ene gy saving that it would pay back the extra cost in a reasonable period of time.

Reviewer 2:
The reviewer stated that the work is designed to meet objectives and overcome barriers through testing of systems. This project, and what has been learned regarding high transfer rates, should be consolidated and a follow-on FOA should be initiated to take this work further and to get it dispersed into the commercial sector. The reviewer would like to see a larger test community in a real world operative environment included.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer stated that wireless charging is absolutely needed to run BEVs in large scale.

Reviewer 2:
The reviewer stated that wireless charging can support increased adoption of EVs by making charging much easier. It will contribute based on the economic realities of deploying these systems widely. Another project should evaluate the economics of wireless charging systems for vehicle populations of ever increasing volume.

Reviewer 3:
The reviewer could buy the argument that WPT results in customers less likely to have to rely on petroleum as an energy source because of forgetting to charge their vehicles, but only if the WPT system inefficiency does not swamp the benefits obtained by switching to electricity as a source of motive powe . It would help if there are studies showing what the minimum efficiency of a WPT system needs to be (in comparison to a physically plugged in system) to ensure that, overall, there is no increase in petroleum consumption. The J2954 standard has a minimum efficiency ta get of 85%. The reviewer noted that while this is not within the scope of this project, and the reviewer was not privy to all the discussions that went on in the J2954 committee that set this target, studies/ simulations backing the choice of this apparently arbitrary target would be helpful.

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

Reviewer 1:
The reviewer stated that at this phase of the project, with the project being listed as 98% complete, this is perhaps academic.

Reviewer 2:
The reviewer noted that no comment on resources was provided but this project seems to be going more slowly than it may have gone in a different environment. This could indicate either low efficiency of hours employed or a strain based on resource constraints.

Zero Emission Drayage Truck Demonstration (ZECT I): Matt Miyasato (SCAQMD) - vs115

Presenter
Brian Choe, SCAQMD

Reviewer Sample Size
A total of five reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer thought that this was a great project.

Reviewer 2:
The reviewer stated that the approach of developing Class 8 drayage trucks that will be used in real world service conditions, and compare the use data against baseline diesel trucks will address the barriers and objectives of the project to evaluate market viability and promote market acceptance.

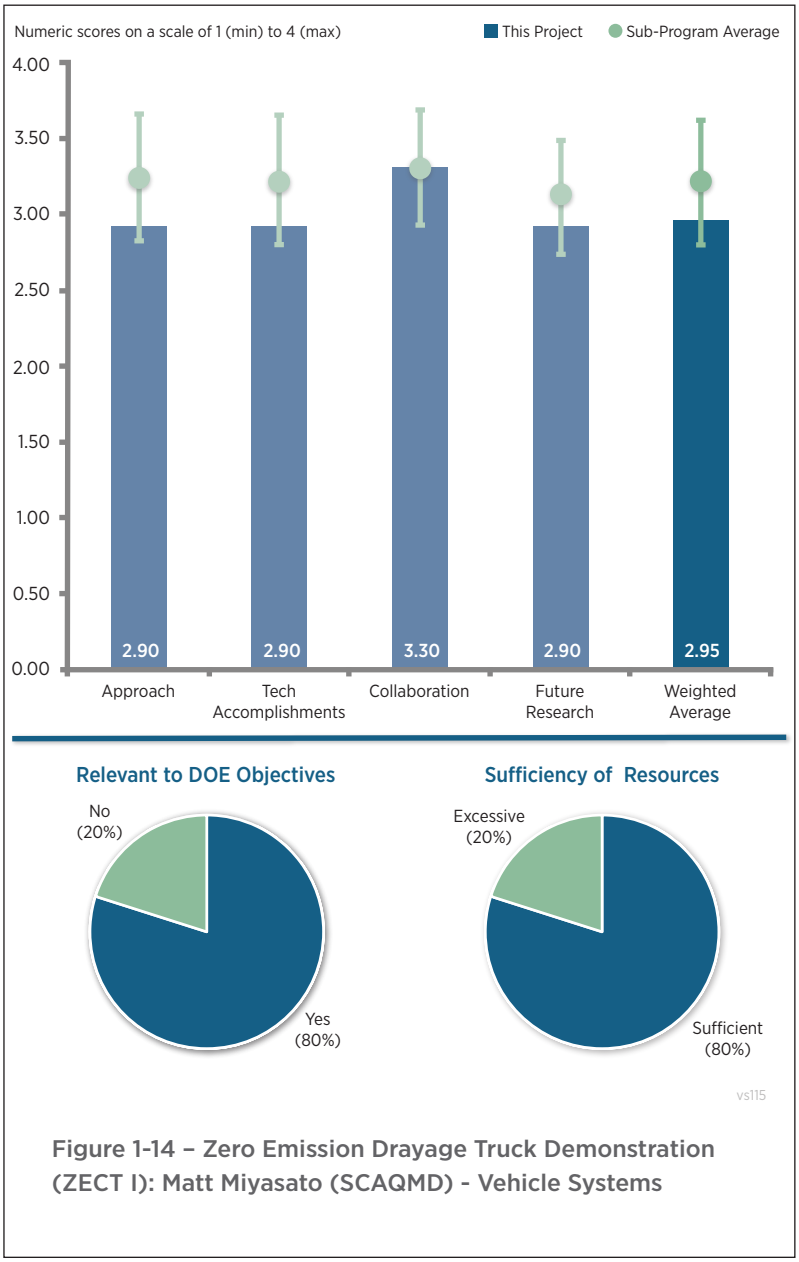

Figure 1-14 – Zero Emission Drayage Truck Demonstration (ZECT I): Matt Miyasato (SCAQMD) - Vehicle Systems

Reviewer 3:
The reviewer thought it is admirable that the researchers chose to include both BEVs and plug-in hybrid electric trucks (PHETs) in the scope. This will provide very useful information about the comparative costs and benefits of the two types. Then the next step can be optimizing the designs for cost and efficacy in various types of use. The reviewer would be interested in seeing how the compressed natural gas part works out and if it is cost effective.

Reviewer 4:
The reviewer stated that the additional system weight and battery management system issues required a different and larger system is required, further delaying data collection and analysis. Prior modeling and systems analysis should have highlighted and predicted much of this.

Reviewer 5:
The reviewer stated that the project focuses on building trucks, but it is not clear that the vehicle requirements were considered before building them. Route and performance analysis should have been performed earlier. It is not clear if anything was learned about the technologies during the project, or if the technology is viable. There has been no discussions on the technical and financial viability of those options

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer noted that the project team has trucks up and running, and have identified shortcomings and strengths so that the next set will work better. That is good progress!

Reviewer 2:
The reviewer noted that the technical accomplishments and progress has been satisfactory this year. Data has been collected and analyzed on baseline trucks and Transpower battery electric trucks (BETs). The contracts have been executed in 2015 and there is a schedule to have more vehicles put into service this year. The reviewer said that given the delays in finally getting the contracts executed in previous years of this project, it will be difficult t accomplish all of the data collection needed by September 2017.

Reviewer 3:
The reviewer stated that the trucks were built and tested, but it appears that little to no analysis was done regarding the viability of the technologies and remaining challenges. The project appears to have no R&D or analysis.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that this is a broad and obviously effective collaboration.

Reviewer 2:
The reviewer stated that the team assembled by the South Coast Air Quality Management District, of Transpower and U.S. Hybrid to develop the Class 8 trucks, as well as Total Transportation Services, Inc. and NREL to collect and analyze data, seem to be adequate and has good coordination.

Reviewer 3:
The reviewer stated that multiple partners are involved, including fleets, manufacturers, OEM, and universities

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer is anxiously awaiting results that compare the BEVs to the PHETs. For drayage use, the smaller range and cheaper battery may enable most of the petroleum savings at much lower cost. The reviewer requested that some cost information be included in the future reports!

Reviewer 2:
The reviewer stated that the plans to deploy the remainder of the drayage trucks into service is very good. However, because many of the trucks will not be deployed until later this year, it will not be possible to collect the two years' worth of data while the trucks are in drayage service by September 2017 as required by the agreement. The reviewer asked if there is a possibility to have a no-cost extension to allow time for the data collection.

Reviewer 3:
The reviewer noted that considering the large amount of funding, some analysis should have been done ahead of time to assess the viability of the vehicle technologies considered and the vehicle requirements. In addition, it does not seem that any analysis was performed or is planned in the future. The reviewer questioned what metrics will be used to assess the success of the technologies.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer stated that yes, it displaces large volumes of fuel in Class 8 operations.

Reviewer 2:
The reviewer stated that the project is relevant to the DOE objectives of reducing petroleum use by introducing BET and PHEV trucks into service and promoting acceptance to replace conventionally powered trucks.

Reviewer 3:
The reviewer stated that these vehicles reduce petroleum use, but noted that the cost is significant

Reviewer 4:
The reviewer stated that this is a niche market with a very localized impact.

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

Reviewer 1:
The reviewer thought it is a lot of money, but the project team is buying unique trucks and operating them for years.

Reviewer 2:
The reviewer stated that there appears to be adequate funding to complete the project as outlined; however, given when the trucks will be deployed, there will not be enough time (two years) to collect the data required without a no-cost extension.

Reviewer 3:
The reviewer stated that the project is not focused on any R&D activities, and so far no analysis has been performed. The reviewer acknowledged being puzzled as to what will be learned at the end of the project other than truck liability.

Hydrogen Fuel-Cell Electric Hybrid Truck and Zero Emission Delivery Vehicle Deployment: Andrew DeCandis (Houston-Galveston Area Council) - vs116

Presenter
Andrew DeCandis, Houston-Galveston Area Council

Reviewer Sample Size
A total of four reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

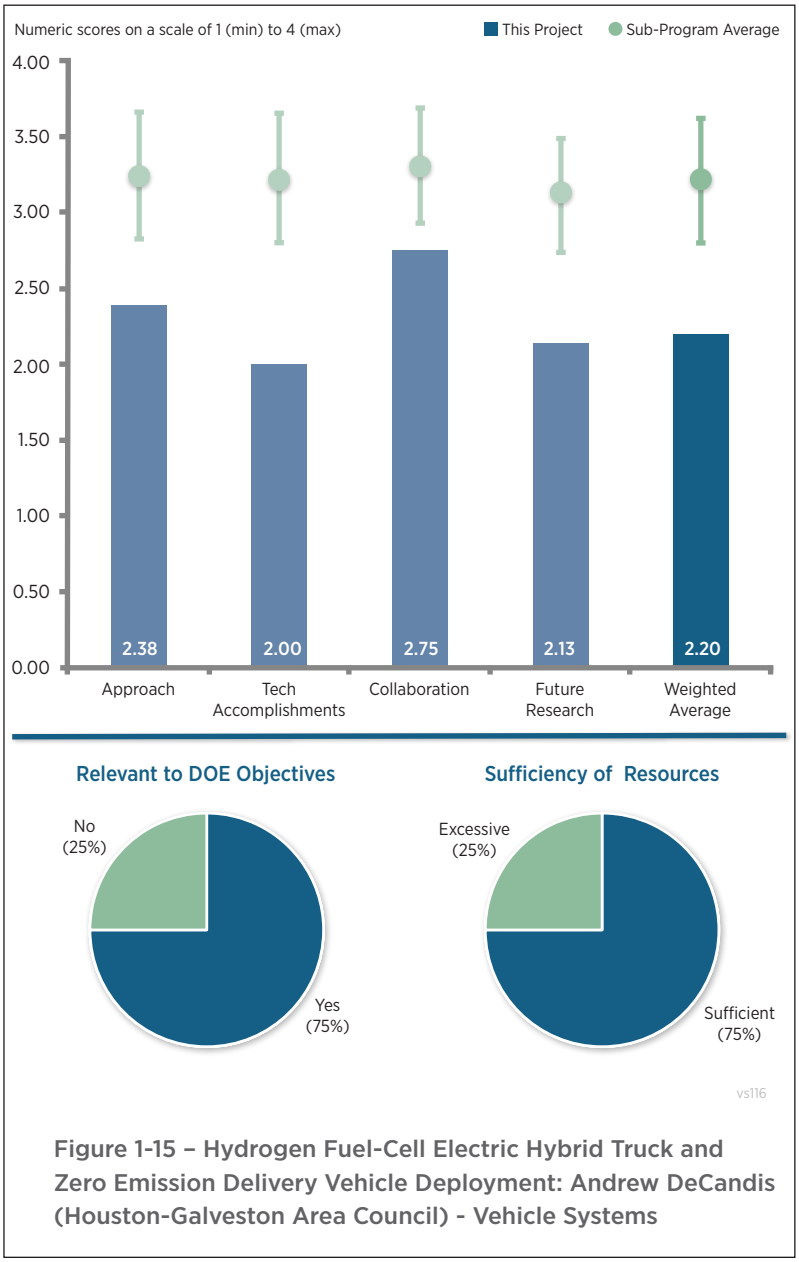

Figure 1-15 – Hydrogen Fuel-Cell Electric Hybrid Truck and Zero Emission Delivery Vehicle Deployment: Andrew DeCandis (Houston-Galveston Area Council) - Vehicle Systems

Reviewer 1:
The reviewer found that the approach to put 30 all-electric delivery vehicles and three hydrogen (H_2) fuel cell Class 8 trucks into service and show them to be available, cost effective, and meeting performance expectations for operation and emissions is very good, and if successful will certainly help to address the barriers to be overcome in the project.

Reviewer 2:
The reviewer stated that the approach is to buy vehicles based on end user requirements and test the vehicles with a fleet operato . The fleet operato , UPS, verbally indicated from the audience that requirements were provided to the team. It would have been helpful if the specifications were provided as part of the reporting presentation. There should be some way to verify the requirements will be met, and a go/no-go decision point if the specifications do not meet the requirements.

Reviewer 3:
The reviewer stated that a preliminary analysis should have been performed before the start of the project to understand the vehicle requirements. The presenter mentioned several times the range anxiety in Houston area. This should have been understood and quantified before any vehicle was built

Reviewer 4:
The reviewer thought that this project would have benefitted from some cursory modeling and analysis to understand what vehicles would be appropriate relative to drive cycle, requirements, etc. Without this, the vehicles can be poorly matched and underutilized due to range anxiety, cost, etc. The focus needs to be on demonstrating not only the capability but the feasibility (on a cost basis) of these technologies.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer noted that it was reported during the presentation that 10 of the UPS delivery trucks have now been delivered and that all 18 will be available in July of this year. It was good to see that the project has started to purchase parts and equipment for the hydrogen fuel cell electric hybrid trucks.

Reviewer 2:
The reviewer noted that the project has been running late and starting to purchase equipment at that point in time highlights the issues with the project and the technology.

Reviewer 3:
The reviewer stated that the project indicated that to be successful the technologies need to be cost effective, meet operational requirements, and emissions requirements. These metrics should be quantified up front and tracked to see if the project met its goals. The presenter indicated metrics would be figured out late , which is the wrong way to approach a project, as design choices need to be made up front to meet the metrics.

Reviewer 4:
The reviewer stated that work has largely been centered on revising scope, surveys, and subcontracts, yet it appears little has been done to develop or procure vehicles. Analysis needed to be done up front to understand the vehicle requirements relative to the market to make intelligent decisions on technology. Also, understanding the complexity in vehicle development, the reviewer believed that it will be difficult to have the fuel cell vehicle operating by this time next year.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that the addition of UPS as a fleet partner that will be operating 18 of the zero emission delivery vehicles is excellent and will provide good information regarding the use of these trucks.

Reviewer 2:
The reviewer stated that the project has an experienced OEM as well as a large fleet operator as collaborators. There is a very high likelihood the technology will be adopted by UPS if it proves to be cost effective.

Reviewer 3:
The reviewer stated that fleets and OEM partners are involved in the project, but they appear to have little to no experience in the area of fuel cell vehicles and their specific safet .

Reviewer 4:
The reviewer was concerned that some suppliers have dropped and the project has required some re-scope to find other partners for the vehicles.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer stated that to complete the project as planned with 30 zero emission delivery trucks, it is critical that a partner for the 12 trucks is decided upon quickly. Because the project ends in September 2017, it is not clear how two years' worth of data will be collected on all of the UPS trucks, and it is even more of a question regarding the 12 additional trucks for which a partner is not selected yet.

There should be more detail provided in the presentation regarding the type of data that will be collected in this project. It was discussed in the question and answer (Q&A) period, but in the future it should be specifically addressed in the presentation document.

Reviewer 2:
The reviewer noted that the plan is to buy vehicles and test them. The project does not define what the goal of testing the vehicles is other than to gather data. The testing goals should be defined up front. The reviewer questioned if the goal is to validate the goals of the project are being met and what the goals are to be tested. This will drive the data acquisition and the instrumentation preparation that is easier to design into the vehicle up front (saves time and money) rather than as a modification

Reviewer 3:
The reviewer stated that the project appears to be focused on deployment with little to no R&D focus. The reviewer was very unclear about what will be learned from this project. The reviewer questioned why DOE funding is needed if OEMs are producing similar vehicles.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer stated yes, by promoting hydrogen fuel cell Class 8 trucks and all-electric delivery vehicles, the project definitely supports the objective of petroleum displacement

Reviewer 2:
The reviewer commented that by definition, an alternative fuel vehicle (i.e., fuel cell or EV) displaces petroleum

Reviewer 3:
The reviewer stated that the project is now trying to find fleets to use vehicles rather than develop vehicles tha need fleets. That statement highlights all the issues with the project.

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

Reviewer 1:
The reviewer stated that the resources for the project appear to be sufficient to complete the milestones

Reviewer 2:
The reviewer thought that the project appears to currently have sufficient resources

Reviewer 3:
The reviewer stated that the project does not appear to be focused on R&D. It is very unclear why DOE would fund such activities.

Combined Aero and Underhood Thermal Analysis for Heavy-Duty Trucks: Tanju Sofu (Argonne National Laboratory) - vs132

Presenter
Tanju Sofu, Argonne National Laboratory

Reviewer Sample Size
A total of five reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The approach described on Slide 4 provides a well thought out process for accomplishing the project objectives.

Reviewer 2:
The reviewer expressed a little confusion about how this study could be beneficial to OEMs in designing a more fuel efficient HD truck. The distance between the leading truck and trailing truck and driving in single lane or two lanes do have some effect on the aerodynamics of the trailing vehicle and thus underhood heat transfer. However, the reviewer was not sure how OEMs can utilize the results of this study to guide truck design. The results might have some value to automated vehicles, though, because the speed and distance between vehicles can be fully controlled by computer.

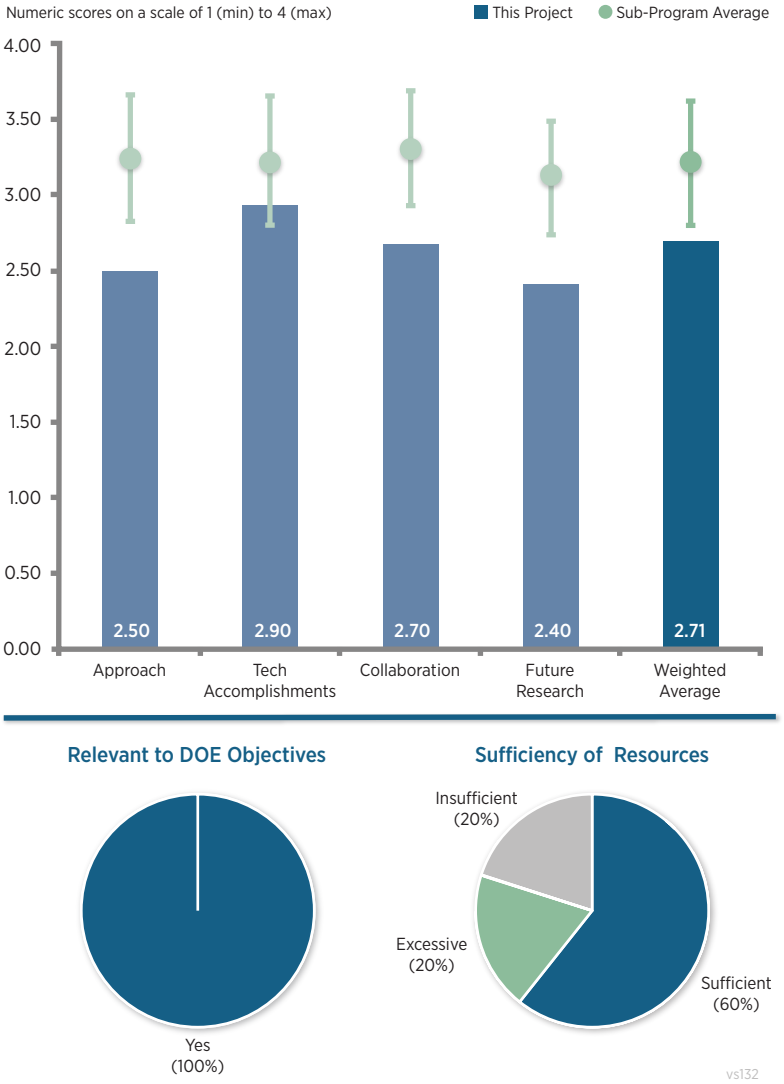

Figure 1-16 – Combined Aero and Underhood Thermal Analysis for Heavy-Duty Trucks: Tanju Sofu (Argonne National Laboratory) - Vehicle Systems

Reviewer 3:
The reviewer commented that this project seems to be a routine CFD application study. The reviewer then stated that the first goal on Slide 2, "development of a computational framework," is not only unnecessary as it already exists, but is also not evidently being pursued from the presented progress. The reviewer noted that the third goal on Slide 2 seemed vague ("emission control issues") and somewhat disjointed from the other two goals; it should be dropped, particularly in view of the schedule delays encountered. Similarly, the emphasis on multi-vehicle platooning, which emerged suddenly on Slide 4 and seemed to dominate the rest of the presentation, seemed to have little direct connection to any of the stated goals.

On Slide 3, the reviewer asked for quantification of the amount of "useful mechanical work" that is parasitic to the cooling system and subject to reduction through design optimization. For heavy vehicles, it is typically a relatively small fraction of total fuel energy relative to the thirds discussed here.

The reviewer stated that the value of this work would be significantly strengthened with recourse to some experimental data for model validation. The reviewer saw no indication of any effort or plan in that area.

Reviewer 4:

The reviewer said that the overall objectives of this project are basically to analyze heavy vehicle optimization through analysis of the interdependent phenomena of vehicle external aerodynamics, cooling system performance, and underhood thermal analysis. Predicting the engine and component temperatures under the hood can speed up the design cycle and help achieve greater fuel efficiencies through coolant system optimizations with impacts from aerodynamics.

The reviewer summarized the accomplishments in this project, which has been ongoing since 2012 and started with the development of extensive computer-aided design (CAD) and CFD models looking at aerodynamic drag and underhood thermal simulations in heavy and medium duty trucks. In FY 2015, vehicle platooning simulations commenced for different configurations, and in F 2016 cooling package optimization in HD vehicles is underway as well as additional platooning underhood thermal simulations for two different configurations

The reviewer found an area of some lack of clarity in the third bullet under Goals on Slide 2, which identified addressing emission control issues to meet the new diesel engine requirements and increased electrification of the engine system. It is not entirely clear to the reviewer how this directly fits into the balance of the primary scope of the project. Additionally, it is really not clear what the overall end point or targeted conclusion is of the project. The project appears to have followed a somewhat circuitous path to date, although this may be a result of funding limitations in more recent years. It may be beneficial to provide some additional clarity with a narrower focus and a clearer end point moving forward.

Reviewer 5:

The reviewer's view of the presentation material was that the project did not look like any optimization of fuel efficiency from aerodynamics had been done nor a trade-o f of aerodynamics and the ability to cool the powertrain. This presentation came across as a study of vehicle positioning while driving down the road while the powertrain could remain at an appropriate temperature with less airflow due to shielding from a lead blocking vehicle

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:

The reviewer acknowledged that a lot of analysis has been accomplished with this project, and the project team has done a good job of distilling the information down to metrics that matter (e.g., fuel savings). It seemed to the reviewer that the analysis was more than originally intended and the project team did allude to some scope creep in the project that allowed the team to do more than what was promised over the last three years.

Reviewer 2:

The reviewer was unclear as to why allowing or not allowing these vehicles to drive in the patterns described in the material is a barrier. The reviewer thought that it is well known that running vehicles close together improves fuel economy due to the changes in aerodynamic loads on the vehicles. This material is good in that it does discuss the magnitude of that advantage, but the reviewer did not see any clear results to what allows or does not allow operation in the vehicle on road formations described.

There were data presented about 4° Celsius (C) and 1°C rises in the coolant temperatures from these conditions, but no indication if these rises in temperature are acceptable or not. The reviewer wanted to know if the single vehicle condition controlling to the limit and +4°C is not acceptable, or is the +4°C still beneath the allowable temperature limit.

Reviewer 3:

The reviewer remarked that there has been a steady list of accomplishments starting in FY 2013 until the present, including aerodynamic drag analysis of HD and MD vehicles, vehicle platooning and underhood thermal analysis under single and double lane scenarios with multiple vehicles, and fan shroud optimization. These analyses have

shown significant potential platooning team fuel savings for two vehicles in a single lane configuration (24%) an less advantages in two lane configurations (7%), including optimal separation distances. The platooning cooling air flow rates are compared to that with no traffic for various scenario

It was not entirely clear to the reviewer as to the drive cycle used for the aerodynamic studies for the MD vehicles that exhibited a maximum 11% improvement in fuel economy. If the cycle were merely a steady state highway test speed, it is probably not very representative of actual use (and unlikely to be commercially viable from a ROI standpoint) as MD vehicles are not typically going to be traveling at highway speeds. Additionally, the reviewer was unclear about the value of the two-lane platooning studies as it is unlikely this configuration would be implemented in practice due to the resulting congested travel lanes for other vehicles.

Reviewer 4:

The reviewer said that the project team summarized the accomplishments in previous years before the current year. The reviewer found the slide of FY 2013 accomplishments hard to read and asked the project team to please increase the font size.

For the current year, the team analyzed the aerodynamic effect of the leading truck on the trailing truck and thus the air flow into the trailing truck. Based on the stud , an optimized fan shroud was designed that has a 1.4% raise in cooling air flo . The aerodynamic modeling over the big truck is very computationally expensive, and the reviewer did not see too much value of it.

Reviewer 5:

In selecting vehicle changes, the reviewer suggested that some consideration should be given—and documented here—as to how to realize the cost of retrofit, weight, and other pragmatic fleet-usage considerations The variables chosen for attention lacked realism or justification, such as a 30 foot following distance at 55 miles per hour (without any indication of adaptive or collaborative cruise control), multi-lane platooning, fan on/off scenarios, etc. Upon questioning in the session, the project team acknowledged some of these things being of academic interest only. The conclusions to date should be presented in less detail, at a higher level, looking beyond the raw CFD results or the fillet radius to a more synthesized basis, such as ranking of design improvements and implications for energy savings.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

As mentioned by the presenters, the reviewer stated that there seemed to be difficulty in obtaining all the useful data to proceed. There also seemed to be a disconnection with the vs006 project presented prior to this project.

Reviewer 2:

The reviewer indicated that this project originated as a cooperative research and development agreement (CRADA) with Cummins at a high 50/50 cost share. As such, the limited project partners are acceptable and understood although it might be good to consider an additional one now given the somewhat changing scope in particular, the new perspectives on platooning, and overall transportation as a system.

Reviewer 3:

The reviewer noted that the only collaborator on this project is Cummins. The reviewer commented that it would be great if the team can have discussions with other truck OEMs and get their opinions on this study.

Reviewer 4:

The reviewer observed that Cummins has its own modeling and simulation, but it was mostly limited to system integration. The project team acknowledged a stall in the project in order to find the collaborative partne . It would have been good to have more than one collaborator on this effort.

Reviewer 5:

The reviewer stated that the lack of a vehicle OEM or even a trailer manufacturer clearly limited and handicapped the study.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer stated that the project team listed other analyses that would be done to complete the project objective of an optimal design of vehicle thermal system.

Reviewer 2:
The reviewer commented that an expansion of more vehicle speeds will be useful in seeing the full value to the proposals.

Reviewer 3:
The reviewer found the very brief path forward material to be vague and insufficient for justifying the remaining $400,000 DOE budget.

Reviewer 4:
The reviewer observed that only a brief synopsis of future proposed work is provided with regards to optimization of the cooling air mass flow rate of the heat exchanger and vehicle platooning underhood thermal transient analysis of varying heat rejection rates with fan on and off conditions. It would be beneficial to have a more focused and detailed pathway of planned future activities and where they are leading. As it stands, it is somewhat difficult to see a clear future project path and end point.

Reviewer 5:
The reviewer remarked that the project team has two paths forward. The first is heat exchanger optimization, which is necessary no matter what, although the reviewer did not expect much novel finding or breakthrough in this route because this work has been done for decades. The second is the transient thermal analysis of the trailing truck. This work would be even more computationally expensive. However, the reviewer had the same doubts as in the Approach section; namely, whether this is really necessary or beneficial to the design of a more fuel efficient truc

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer stated that successfully synergizing external aerodynamics, cooling system performance, and underhood thermal analysis can lead to a beneficial cascading e fect with regards to achieving greater vehicle system efficienc . For example, optimizing these elements and their resultant cooling rates can lead to smaller and differently oriented radiators, potential application of other cooling strategies/fluids, and increased flexibilit in external aerodynamic designs of truck tractors. There is an overall combinatorial effect that can be leveraged. As such, this analysis is relevant to the overall DOE objective of achieving greater vehicle fuel efficiency and increased petroleum displacement.

Reviewer 2:
While the reviewer did not see barriers to implementing this vehicle driving technique, or if these techniques are already in practice by Class 8 operators, the reviewer stated that this is clearly a method to reduce petroleum usage.

Reviewer 3:
The reviewer said that understanding how platooning impacts fuel efficiency essentially quantifies how drivin behavior could help in lowering petroleum use even further after component design is optimized. The two lane platooning is viable perhaps on a four- or five- lane highway like I-495, but perhaps not so viable on a two-lane highway.

Reviewer 4:
The reviewer pointed out that the overall goal of this project is truck energy savings, which are relative to DOE's overall petroleum displacement objective. However, the reviewer did not think the research method is efficient enough to approach the goal.

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

Reviewer 1:
The reviewer commented that the project completed quite a bit of analysis given the resources provided.

Reviewer 2:
The reviewer said that the project requires computer resource and manpower, and the budget is sufficient to support the project.

Reviewer 3:
The reviewer remarked that funding for this project has been limited in the last several years due to budgetary constraints. If a clearer project pathway with set milestones and end point is established moving forward, the project could justifiably be considered for additional funding

Cummins Medium-Duty and Heavy-Duty Accessory Hybridization CRADA: Dean Deter (Oak Ridge National Laboratory) - vs133

Presenter
Dean Deter, Oak Ridge National Laboratory

Reviewer Sample Size
A total of five reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer stated that this is a two-phase project. In Phase One (modeling), the project team got accessory data to put into model. In Phase Two (testing and validation), the team put the system modeled into a test vehicle at Cummins. This approach was not only logical but cost effective, doing lower cost modeling earlier on and saving more costly field testing until the end of the project.

Reviewer 2:
The reviewer said that the project team modeled, then tested to validate the model. It is a valid approach.

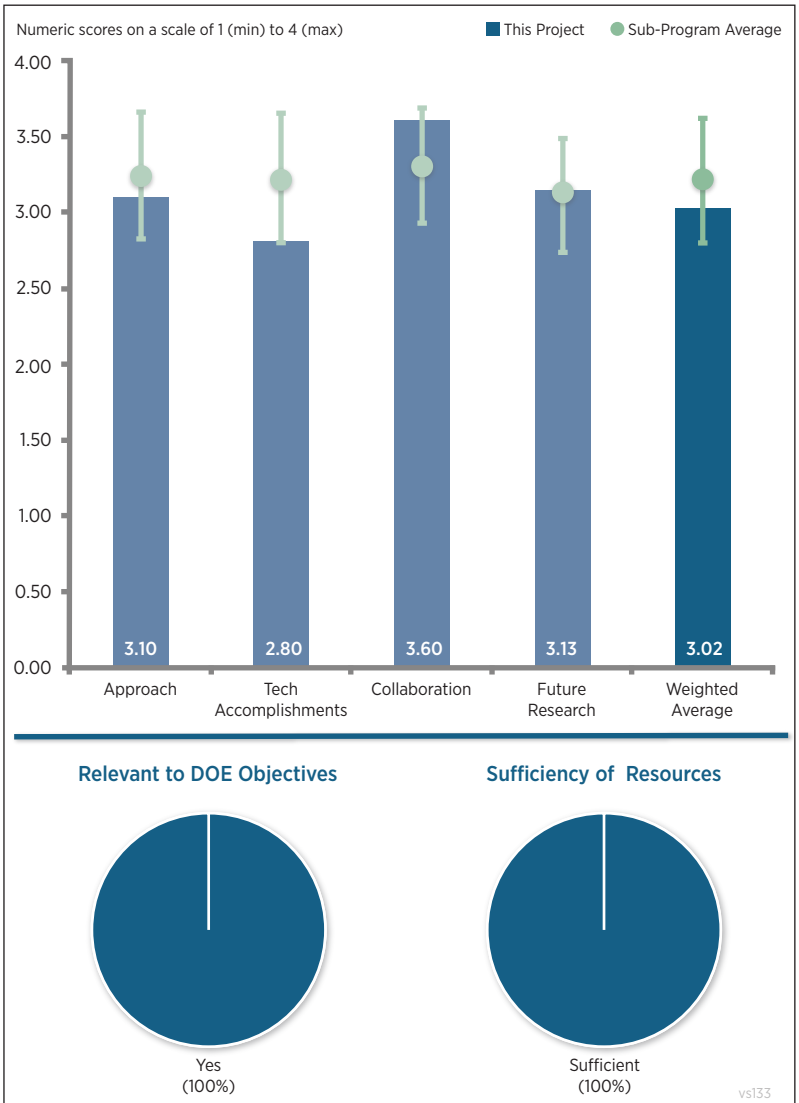

Figure 1-17 – Cummins Medium-Duty and Heavy-Duty Accessory Hybridization CRADA: Dean Deter (Oak Ridge National Laboratory) - Vehicle Systems

Reviewer 3:
The reviewer found the approach to be solid as it moved from analysis to prototype testing to full vehicle, and it was completed in a relatively short period of time.

Reviewer 4:
The reviewer stated that this project directly focuses on the real-world losses experienced by long-haul trucks while idling and in hotel mode. The use of a CRADA is sometimes necessary to gain more than pre-commercial results by working with industry; according to the reviewer, the project was unfairly criticized during the review as not showing results. In the context of the project approach, the project is outstanding for having the cooperation of a major OEM. The project did expose room for improvement on accessory loads that are optimized for in-use (which is obviously necessary) and lack of validated modeling tools for the load cases being studied.

Reviewer 5:
The reviewer remarked that these kinds of projects present a problem. The approach on using modeling and simulation to find more efficient solutions is well known and common practice. Because no results were presente

due to a proprietary relationship with Cummins, it is impossible to evaluate whether the modeling was broad enough and complete.

The reviewer commented that a more appropriate way to present projects that have proprietary data should be identified. The suggestion on this particular project would be to discuss the technical approach, the modeling systems being used, and how they were applied. This reviewer emphasized that those items are not proprietary and, if presented in earnest, would allow evaluators to have a sensible discussion of the project without violating the agreement with the CRADA partner.

The reviewer said that it seemed that the project team takes this as an opportunity to, in effect, take a free pass on doing a serious presentation. Projects like this should be reviewed in the poster session in the future.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer found that this project completed all five of the project milestones. The project team showed good alignment between model and field testing with about a 5% erro . The team considered all the accessories including refrigeration but believed that the ones focused on in this project were the best ones to attack.

Reviewer 2:
The reviewer noted that the project team achieved and completed its technical goals. The team focused on the long haul truck segment, and new model development occurred. Accessories are already designed well for steady state operation. Idling reduction is low hanging fruit. The air conditioning (A/C) test cell seems helpful to industry.

Reviewer 3:
The reviewer noted that, based on the boundaries in Question 1, the technical accomplishments to the engineering tools are very good. Of course, the CRADA does not allow elaboration to other results.

Reviewer 4:
The reviewer said that no technical accomplishments were presented. Because a statement was made as to the desire of Cummins to gain proprietary rights to some of the resulting systems configurations, it can only be surmised that there were valuable accomplishments but there was no way to evaluate that.

Reviewer 5:
The reviewer stated that the project is complete with a model and did well with the resources and time available. The major outstanding issue is the model, which is still not releasable due to proprietary threads. In order to really benefit other projects, this final closeout item needs to be worked out; otherwise, DOE did not gain from executin the CRADA (the reason for the reviewer's rating). It would have been helpful if there were more components modeled.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer said that collaboration with Cummins has the greatest potential of future product impact than any other engine system development company could have.

Reviewer 2:
The reviewer remarked that there were a variety of players involved including ORNL, Cummins, NREL, EMP, and MasterFlux. The collaboration and the role each member took on was well thought out.

Reviewer 3:
The reviewer stated that there was a nice example of collaboration with EPA/Southwest Research Institute (SwRI) on the available model and test. The reviewer asked how this project team can educate the suppliers in this space better.

Reviewer 4:
The reviewer noted that this project was a CRADA with one specific manufacturing compan . There was collaboration with NREL as well. The reviewer noted that CRADAs by definition are cooperative agreements with one company. This question really does not apply to this project.

Reviewer 5:
The reviewer asserted that this was a closed CRADA and Cummins led the decisions on who was involved. There were some suppliers involved, so it seemed that proper collaborations were included.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer stated that if the initiatives of this program come to fruition, they could have an enormous effect on petroleum displacement.

Reviewer 2:
The reviewer picked up on a statement that Cummins will proceed with further R&D based on the work completed. This is an excellent outcome of the program.

Reviewer 3:
The reviewer proposed that the models from this completed project be used to feed other projects. It would have been helpful if more components could be modeled, but this project ran out of time and funding to do so.

Reviewer 4:
The reviewer said that the project has ended.

Reviewer 5:
The reviewer noted that the program is basically completed.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer commented that if the initiatives of this program come to fruition, they could have an enormous effect on petroleum displacement.

Reviewer 2:
The reviewer stated that this was an enabling project that can be used to evaluate technologies that directly support DOE's goal.

Reviewer 3:
The reviewer said that reducing energy losses due to accessory loads will reduce fuel consumption, which reduces petroleum use.

Reviewer 4:
The reviewer commented that the project focuses on reducing or optimizing accessory loads of HD line haul trucks. Overnight drivers are down for 10 hours consuming 4-7 gallons of diesel while idling to support accessory loads needed during down time. Optimizing the loads help to reduce petroleum consumption.

Reviewer 5:
The reviewer thought that this area has real opportunity, but so many players and concepts makes it tough. The reviewer very much encouraged DOE to find some way to share the highest level learnings from projects like this one and asked how that can that be done. It sort of falls into how DOE promotes learnings to the industry.

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

Reviewer 1:
The reviewer believed that there was no indication that project funding was an issue in this program.

Reviewer 2:
The reviewer stated that the project is complete and there are enough resources.

Reviewer 3:
The reviewer noted that because the project is finished and Cummins is proceeding with using the work, resources must have been sufficient

Reviewer 4:
The reviewer remarked that the project was able to complete all its milestones with the funds provided.

Vehicle Thermal System Modeling in Simulink: Jason Lustbader (National Renewable Energy Laboratory) - vs134

Presenter
Jason Lustbader, National Renewable Energy Laboratory

Reviewer Sample Size
A total of six reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer asserted that making a first principles model for heating, ventilation, and AC (HVAC)/thermal system is an excellent approach. Having it integrated into the rest of the vehicle/powertrain model is great.

Reviewer 2:
The reviewer remarked that the project objectives and approach are commendable. They are realistic, logical, and offer a solid foundation for future work by NREL and the industry.

Reviewer 3:
The reviewer stated that this simulation has appropriate fidelity to make meaningful contributions to the design of advanced HVAC systems for EVs as it uses the Matlab/Simulink platform, a simulation platform that is widely used by industry and academia. This simulation can co-simulate with Autonomie.

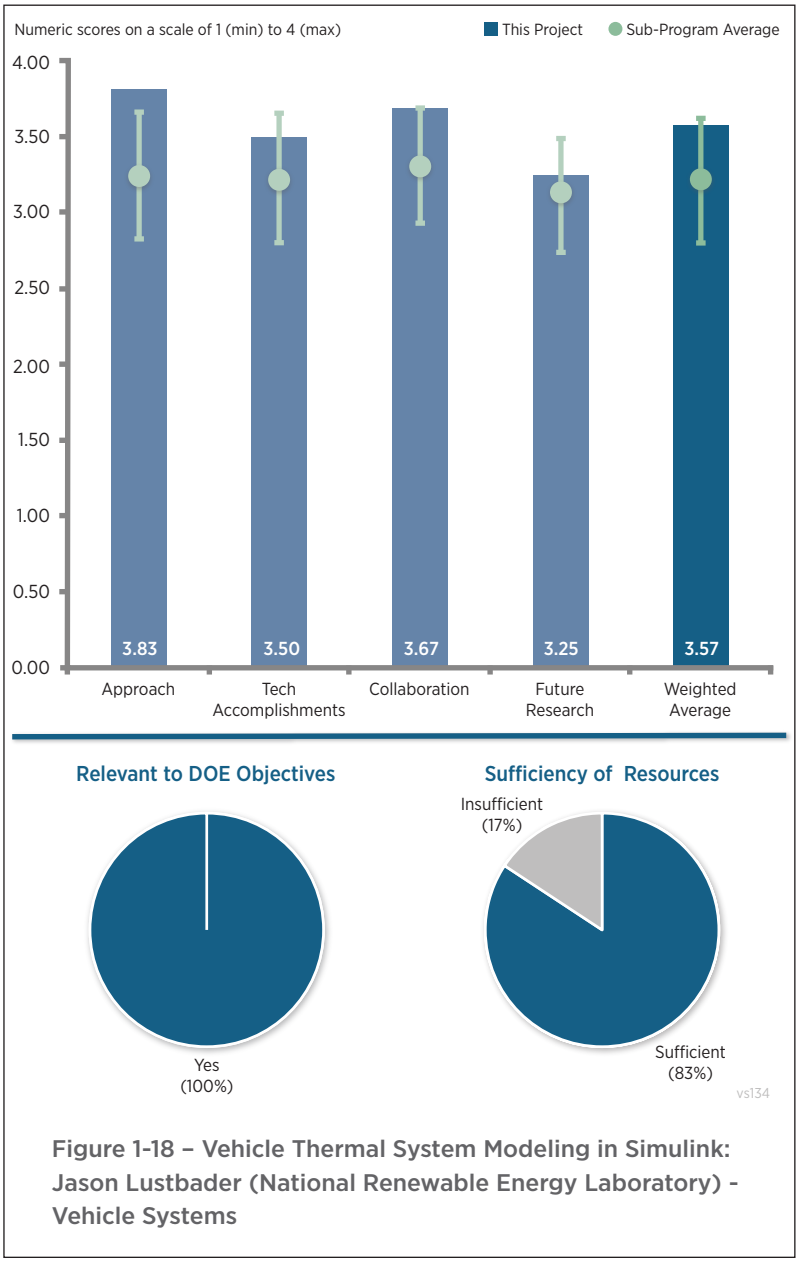

Figure 1-18 – Vehicle Thermal System Modeling in Simulink: Jason Lustbader (National Renewable Energy Laboratory) - Vehicle Systems

Reviewer 4:
The reviewer commented that the proposed approach to handle the stiff network by using an artificially low bulk modulus would also introduce lower frequency modes in the system. The reviewer asked if this could result in the system behaving oddly. If there is no interest in the fast transients at all, the reviewer proposed that the obvious approach would be to ignore compressibility of the fluid (at least, where it exists as a single phase) as this would not give rise to any of the spurious modes.

Reviewer 5:
The reviewer remarked that the emphasis on freely available prototype code based on the popular Matlab/Simulink

framework, CRADAs for application studies, and the consideration of integration with Autonomie and similar tools seems smart and appropriate.

Improvements for milestone four should ideally be at least partly directed by the end-user. This could be facilitated by a small beta-test group outside of NREL to try out the available capabilities, supported by an intermediate milestone three deliverable from the documentation task.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer enthused that the project accomplishments to date are impressive. The approach to fill in the holes in exiting vehicle environmental controls analysis is working.

Reviewer 2:
The reviewer commented that the simulation is being applied to multiple advanced HVAC design projects that vehicle component OEMs are conducting. It appears to be a successful enabler for innovating and transitioning HVAC technology for EVs.

Reviewer 3:
The reviewer indicated that the project shows flexibility of operation and integrated control

Reviewer 4:
The reviewer commented that the project is encountering the typical bootstrapping challenge of balancing capabilities development with application studies to verify and demonstrate the capabilities. The presentation made the latter part seem a little too heavy and detailed for the current status of the tool. In other words, more numerous and diverse yet simpler test cases at this stage may lead to a more robust and versatile software.

Reviewer 5:
The reviewer noted that, while significant progress has been made, it appears that the F 2017 deliverables are identical to the FY 2016 deliverables. According the 2015 AMR presentation, milestone three should have been completed sometime in the second quarter of FY 2016, but it has been moved back to end of FY 2016 in this year's AMR presentation.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer observed that presumably the changes seen due to mergers and acquisitions in the industry have not had much impact on the collaboration.

Reviewer 2:
The reviewer mentioned that there are multiple industry partners that are actively using this simulation on their R&D projects.

Reviewer 3:
The reviewer said that the project has an excellent set of partners.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer enthused about not wanting to wait to see this project integrated with drive cycles to refine controls and understand consumption benefits. The reviewer suggested that the project team also needs to make the component models parametric and validate this as well.

The next phase of the project should be showing real-world benefits of these technologies on advanced powertrain vehicles.

Reviewer 2:
The reviewer commented that the future project work is an absolute must. Improving the simulation environment in this area is desperately needed.

Reviewer 3:
This reviewer highlighted the FY 2015 reviewer question 2 on Slide 30, and strongly pointed out that the response failed to answer the question. Assuming the answer is "no, not as of today," two recommendations arise for devoting a portion of the remaining project resources. The first recommendation is, as application cases continue (Slide 31, bullet 2), to strongly prioritize those that are non-proprietary and work to develop detailed, hands-on tutorials based on them. The reviewer's second recommendation is, before end of project, to issue a competitive Request for Information for licensing CoolCalc and CoolSim and work out terms so that an interested party other than NREL can be positioned to provide the essential, substantial training, maintenance, and support services needed by vehicle system engineers in industry.

Reviewer 4:
The reviewer remarked that developing a flexible, publicly available Matlab/Simulink-based framework for vehicle thermal management system is a perfectly reasonable goal. However, it would be a stretch to expect that this tool would be used by the OEMs and the suppliers. The reviewer said that this is not to say that the tool is lacking in capability—it is just that most of the companies that have been involved in this kind of work for some time have their own established processes that are very reliant on specific advantages that their software of choice o fers. Many man-years of effort would have gone into developing these processes, and it would it be hard for the OEMs to abandon all of that in a favor of new software, even if it were more capable. That said, as someone from the industry, the reviewer would have been more than happy to give it a try and see if it can do a better job than the current set of tools in use!

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer stated that this is an excellent project and very worthwhile.

Reviewer 2:
The reviewer said this was great modeling work and will be very useful.

Reviewer 3:
The reviewer commented that, yes, this simulation provides useful capability to increase EV range and displace petroleum.

Reviewer 4:
Besides motive power, the reviewer noted that climate control is the second most energy expensive service. Further development is needed to mature the technology portfolio.

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

Reviewer 1:
The reviewer stated that this project deserves more funding because it is a useful tool for industry and academia to design more efficient and e fective HVAC solutions for EVs. The current funding level is insufficient to add new capabilities and successfully address relevant domain challenges.

Reviewer 2:
The reviewer commented that the project appears to be appropriately resourced.

Advanced Climate Systems for EV Extended Range (ACSforEVER): John Meyer (Hanon Systems) - vs135

Presenter
Nicos Agathocleous, Hanon Systems

Reviewer Sample Size
A total of four reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer noted that the work plan and goals are well thought out. The approach addresses the questions surrounding the implementation of the technology. The notion of utilizing the thermal inertia of the components is a practical way to maximize benefit at minimum cost.

Reviewer 2:
The reviewer found the objective to achieve passenger comfort with reduced auxiliary loads to be a very significant hurdle to overcome in efforts to achieving widespread acceptance of xEV technology. This project does attempt a logical and direct approach in achieving the stated objectives of the program.

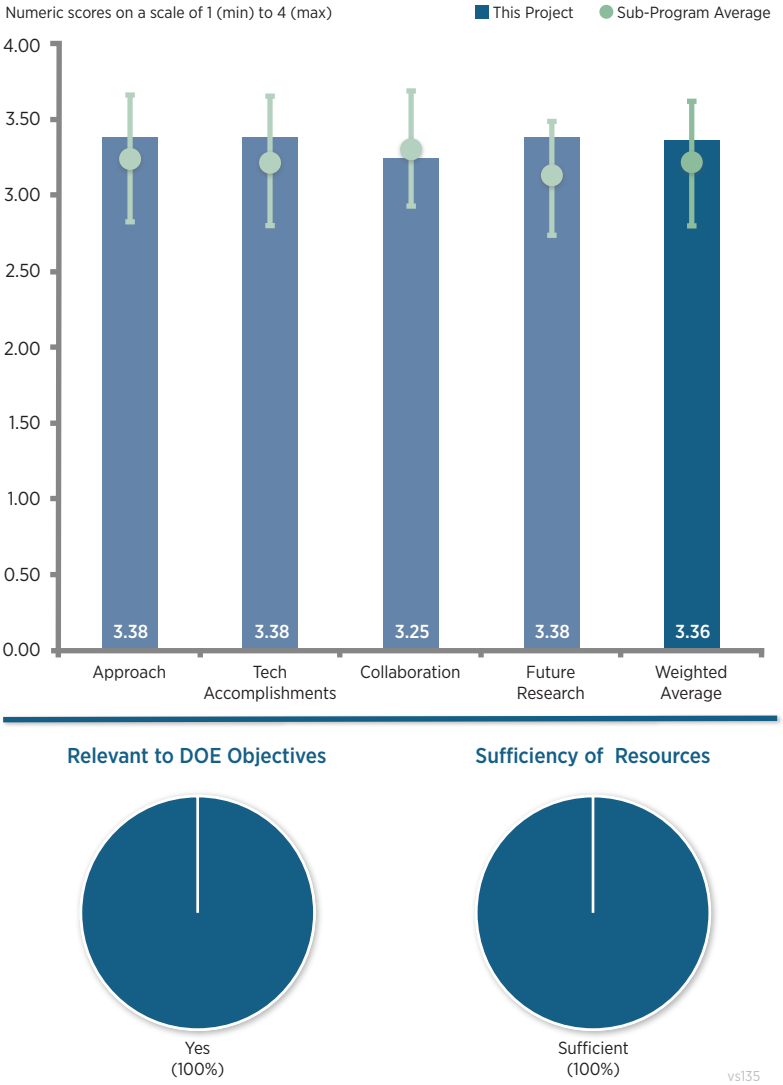

Figure 1-19 – Advanced Climate Systems for EV Extended Range (ACSforEVER): John Meyer (Hanon Systems) - Vehicle Systems

Reviewer 3:
The reviewer stated that this is a very comprehensive technical approach. However, cost should be a factor in technology selection.

Reviewer 4:
The reviewer wanted to see the results of the thermal comfort simulation being presented in terms of a statistical confidence interval, given that in real life the fact that one person may find the thermal comfort acceptable by n means implies that another person would. Alternatively, it would also help if it were made clear that because the purpose is to improve EV range, the results of the simulations would imply an improvement provided we have ceteris paribus. And from that perspective, the reviewer wanted to clarify whether a simpler measure of comfort could not be used to quantify the benefits of the new systems

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer noted that the project team appears to have been able to provide greater understanding of the limitations of existing modeling tools and hopefully has improved on their limitations. The challenges of adding or taking away heat in rapid volume will be arduous for this team to overcome; hopefully, a human factors or psychology-based metric will be added to correlate the physical data to human comfort.

Reviewer 2:
The reviewer commented that the project appears to be behind by a couple of months, which is not a big deal. Separately, on Slide 7, the project team stated that "neither the Berkeley nor the Fiala models adequately predicted the effects of cabin temperature changes on thermal sensation." While the reviewer did not claim to be an expert on human physiological models, the reviewer presumed that the Berkeley and the Fiala models were developed to predict human comfort and had been peer-reviewed. The reviewer then asked on what basis the team concluded that they are not adequate and that some weighted average version of it was actually preferable. Presumably, much research has gone into developing the Berkeley and Fiala models, and it seems that the dismissal of these models is almost casual, and neither is any basis presented for the acceptability of the new thermal sensation metric. If this were based on feedback from one or more test subjects, then this calls into question the statistical validity of the conclusion.

Reviewer 3:
The reviewer pronounced the progress to be very good. For future reviews, the reviewer suggested some explanation or other notation on Slide 15 as the graphs are hard to interpret. The wall-to-wheels efficiency of the system should also be indicated somewhere.

Reviewer 4:
The reviewer commented that there was a good approach using several technologies simultaneously to achieve objective. There seemed to be no consideration apparent on $/mi of range extension. The project team, according to the reviewer, has not addressed the issue of starting trips without prior charging (trips not starting after residential or workplace charging).

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer commented that there was very good OEM participation.

Reviewer 2:
The reviewer noted that the appropriate partners are involved (OEM, supplier, national laboratories) to properly execute the project.

Reviewer 3:
The reviewer did not understand the coordination very well, but as the project does appear to be focused in the correct direction, the results are sufficient to state an acceptable e fort.

Reviewer 4:
The reviewer stated that it appears that NREL (which has had experience in the area) was not involved in the thermal comfort modeling. The different set of experiences that the NREL personnel would have had could have provided valuable feedback and ensured the best possible outcome.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer believed the objectives are well understood and support future work in this area.

Reviewer 2:
The reviewer commented that future work is to complete the remaining deliverables.

Reviewer 3:
The reviewer would like to have seen more justification for some of the decisions that were made and asked the project team to take a look at the reviewer's previous comments.

Reviewer 4:
The reviewer said that there was insufficient time allowed for vehicle testing and proposed that the project team may want to do a no-cost time extension.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer stated that research informs technology choices that can be made to improve EV range under real-world driving conditions. The impact of the environment on EV range is a barrier to more widespread EV adoption.

Reviewer 2:
The reviewer commented that, absolutely, the ability to maintain passenger compartment comfort with minimal energy used (lost) is critical to widespread acceptance of xEV technology and therefore petroleum displacement.

Reviewer 3:
The reviewer praised the technical accomplishments as excellent; however, cost must be a consideration.

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

Reviewer 1:
The reviewer said that the project appears to be adequately funded.

Reviewer 2:
The reviewer found that no information to the contrary was presented on resources.

ePATHS - electrical PCM Assisted Thermal Heating System: Mingyu Wang (Mahle Behr USA, LLC) - vs136

Presenter
Mingyu Wang, Mahle Behr USA, LLC

Reviewer Sample Size
A total of four reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer commented that the project team has been very thorough in attacking all aspects of the problem and was impressed by the team's going the extra mile to find a new phase change material (PCM).

Reviewer 2:
The reviewer noted that PCMs have been discussed for a long time for this type of application. It was, therefore, an advantageous study to promote the development of PCMs for thermal storage in vehicle space.

Reviewer 3:
The reviewer said that this is an ambitious, challenging project, and the approach being taken is excellent and increases the likelihood of success. The project directly addresses multiple barriers to meeting DOE goals, and the technical approach is sufficiently rigorous for a systems engineering project of this level.

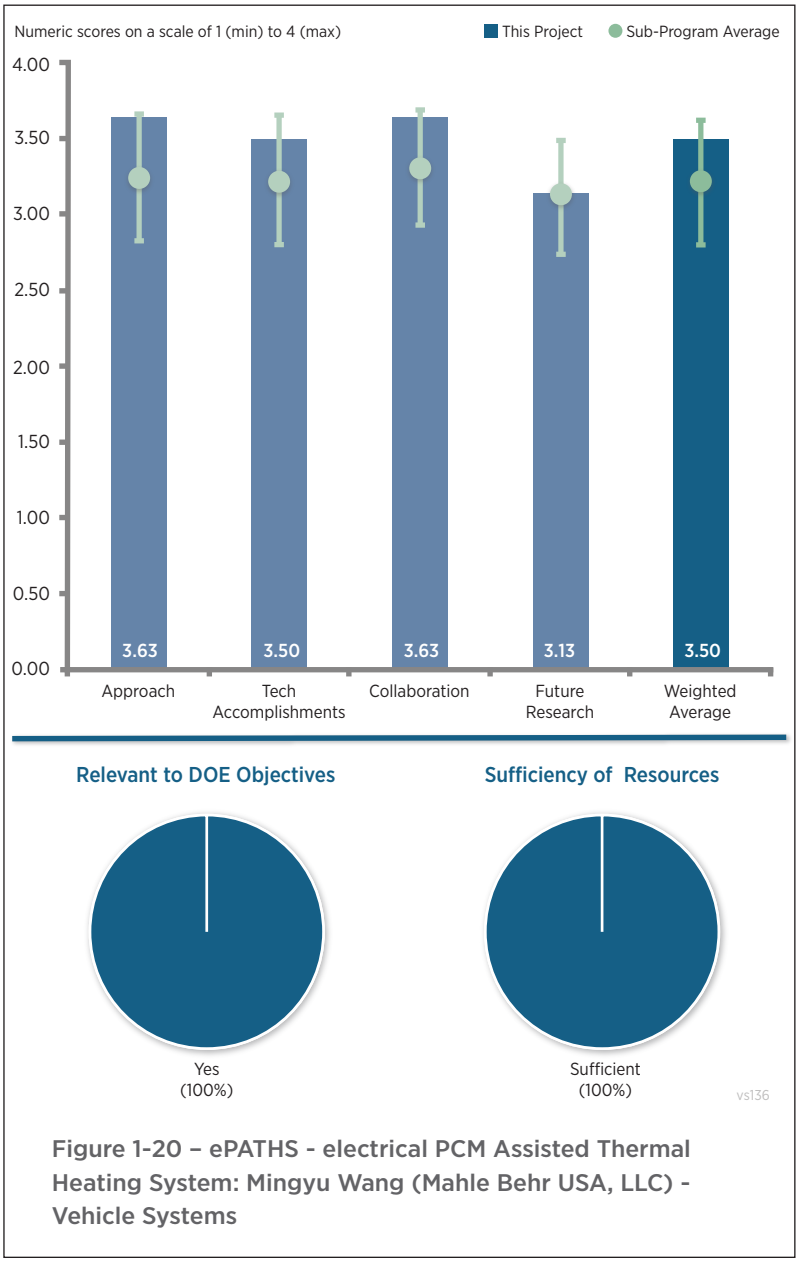

Figure 1-20 – ePATHS - electrical PCM Assisted Thermal Heating System: Mingyu Wang (Mahle Behr USA, LLC) - Vehicle Systems

Reviewer 4:
The reviewer found that the technical approach, with testing and validation, was well laid out.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer commented that the development of unique if not novel PCMs for this application is arduous and complex. The analysis of production feasibility was insightful and demonstrated a barrier of high quantity (technology widespread acceptance in terms of applications).

The reviewer asked what the vehicle mass and packaging volume tradeoffs are for this application and how these will affect commercial feasibility.

Reviewer 2:
The reviewer pronounced the execution of the work to be very good. Yet, the PCM packaging issue is a bit of a setback because it limits practical application of the technology. As suggested during the review, perhaps downsizing the thermal storage may be an available avenue. The reviewer proposed that the overall energy efficiency of the system from a wall-to-wheels perspective should be reported.

Reviewer 3:
The reviewer found a need to evaluate energy efficiency of the overall system and specifically compare cost agains adding a battery to recover range. The reviewer said that the assumption of a 1 million kg/year PCM manufacturing facility may be an overreach when trying to meet cost objectives.

Reviewer 4:
The reviewer stated that numerous accomplishments were identified and the project appears to be on schedule. Performance metrics were met in bench testing and prototype builds.

The results of the manufacturing cost study showed that a dedicated plant must be used to achieve sufficient scale to meet cost targets for the PCM material. This decreases the likelihood that this product will make it to production, but this determination is an accomplishment, nonetheless. The project team indicated that the grid-to-wheels efficiency of the system is better than using the battery to run the positive temperature coefficient heat . This should be quantified and communicated

The reviewer stated that the system must be superior to lithium-ion batteries on a cost basis. The project team indicated that the system is expected to achieve this. Cost targets and status to target should be specified

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer said that the project had an excellent team working well together.

Reviewer 2:
The reviewer found outstanding collaboration and coordination, with partners taking active roles in all major areas.

Reviewer 3:
The right partners are involved in the project to make it a success, according to the reviewer.

Reviewer 4:
It was unclear to the reviewer what the partnership responsibilities actually were, but the companies involved are high quality stakeholders.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer noted that the project team is focused on completing the project goals.

Reviewer 2:
The reviewer believed that the best evaluation will done at vehicle levels and the commercial salability will be accurately assessed there in the final months of this project

Reviewer 3:
The reviewer stated that vehicle-level testing is important and will be conducted, but timing is tight. The remaining

work must be accomplished flawlessly to be successfully completed. Volume (and presumably weight) must be reduced in order to be viable for production. Packaging the unit in the trunk can have a negative impact on customer satisfaction. The reviewer exclaimed that customers may care more about trunk space than EV range.

Reviewer 4:
The reviewer commented that the schedule to complete testing unrealistically assumes no issues revealed during tests.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer said that this project addresses the issue of reduced EV range due to occupant comfort considerations under real world driving conditions. Success of this technology will improve the chances of EV adoption by the average driver.

Reviewer 2:
The reviewer commented that any technology that improves efficiency and market acceptance of xEVs in transportation is directionally correct in the goals of petroleum displacement.

Reviewer 3:
The reviewer said that this project is highly relevant to DOE's goals of improving PEV performance and appeals to promoting PEV adoption and reducing petroleum consumption.

Reviewer 4:
The reviewer noted that a goal has been set to restore the equivalent of 3 kWh of battery at a cost of $200/kWh. The project presenter indicated that the current overall cost is $270-$300, or half of the per-kWh cost objective. If accurate, this is an excellent result and is very relevant.

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

Reviewer 1:
The reviewer said that the funds and personnel needed to complete the remaining milestones appear to be sufficient

Reviewer 2:
The reviewer noticed no obvious financial barriers in the discussion

Reviewer 3:
The reviewer stated that the funding level is reasonable, considering the scope of work, number of partners involved, and the technology readiness level of the technology at the start of the project. Additional time will likely be required for successful completion of remaining work.

SAE J2907 Motor Power Ratings Standards Support: John Miller (Oak Ridge National Laboratory) - vs144

Presenter
John Miller, Oak Ridge National Laboratory

Reviewer Sample Size
A total of five reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer noted that it is amazing that this has not been done before. The project is well structured and certainty needed in the industry.

Reviewer 2:
The reviewer commented that the project helps to promote a common language around the way we discuss electric traction drives, especially at the consumer level. This should help demystify technology for consumers.

Reviewer 3:
The reviewer remarked that the project approach conforms to a well-established SAE method of developing standards: the technical community builds a committee, which then works with the user stakeholders to find the technical solutions that fit the intent of the standard being established. It is a tried and proven method

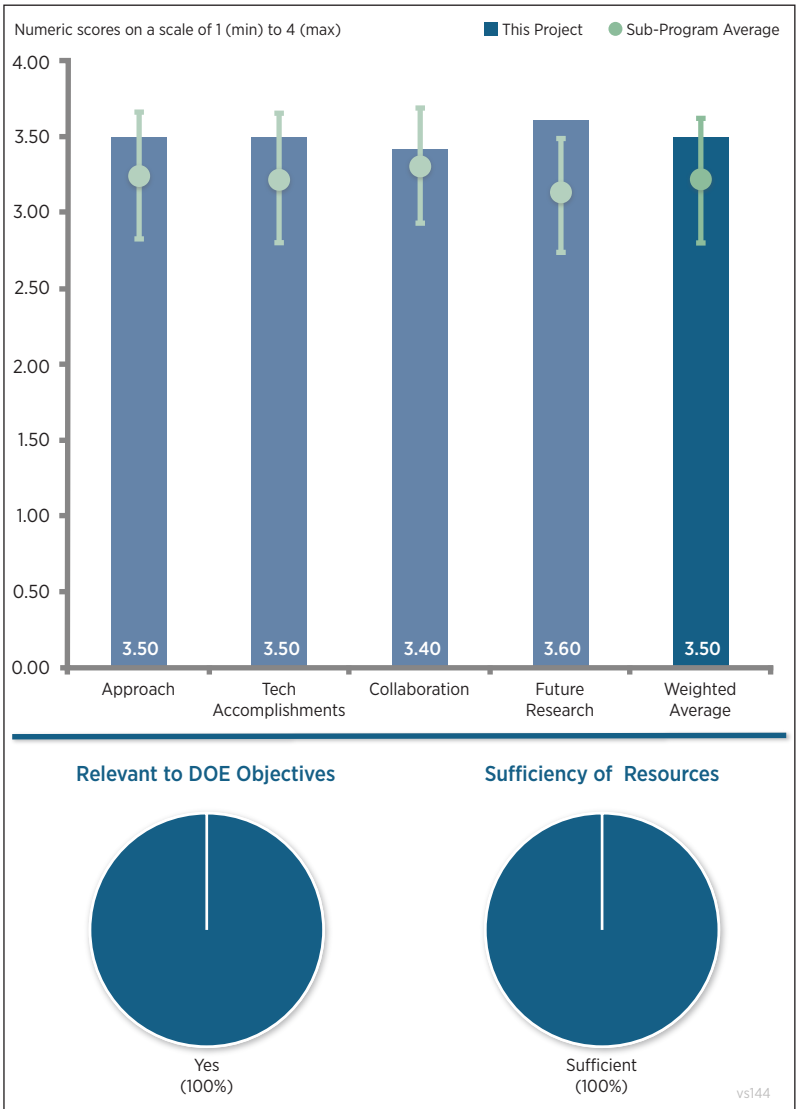

Figure 1-21 – SAE J2907 Motor Power Ratings Standards Support: John Miller (Oak Ridge National Laboratory) - Vehicle Systems

Reviewer 4:
The reviewer said that it seems that all the steps needed to develop the standard for ballot have been achieved.

Reviewer 5:
The reviewer stated that the project and its presentation did not effectively show why DOE is involved. The industry needs may be clear, but the need for DOE involvement is less clear. Also arguable is that this figure is important to vehicle buyers, who are unlikely to be very concerned with motor output levels when selecting which electrically propelled vehicle to purchase.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
Given the difficulty of reaching consensus among the many stakeholders, the reviewer commented that the project is progressing well and achieving basic accepted definitions around electric traction drive system characterization

Reviewer 2:
The reviewer noted the project is aligning with the normal progress of SAE standards, and parallel work on SAE J2908 is an important accomplishment as both standards are needed because of the way the drive motors are used in the market.

Reviewer 3:
The reviewer said that the project accomplishments have been reached through good technical work as well as a consensus with the target community for the standards, which is very tough to do.

Reviewer 4:
The reviewer stated that the project has a tight objective, and the result appears to be on track to achieve the consensus procedure for component-level peak and continuous power ratings.

Reviewer 5:
With the goal being a consensus based standard that meets the technical needs described, the reviewer remarked that the progression to a technical information report (TIR) is the accomplishment that matters the most. The subsurface technical issues that were debated have a lesser level of importance.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer noted that all appropriate institutions are involved in the effort.

Reviewer 2:
The reviewer stated that this project is clearly a collaborative effort as shown in the presentation.

Reviewer 3:
The reviewer pointed out that the partners are the members of the committee, and DOE is properly represented.

Reviewer 4:
The reviewer said that the project is collaborating with the appropriate organizations.

Reviewer 5:
The reviewer was not clear about what happens outside the United States. The reviewer asked about the breadth of global OEM participation, whether any other key markets are participating in this standard development, or if the European Union, Korea, and China continue independently.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer noted that the proposed future work involves the standard process of creating an SAE standard.

Reviewer 2:
The reviewer commented that future work shown and the schedule presented made clear that this project should be completed in 2016.

Reviewer 3:
The reviewer said that the future is to get the TIR out and the standard finalized. This is the original intent of the program.

Reviewer 4:
The reviewer found the proposed future work to be appropriate to reach the standards completion objective.

Reviewer 5:
The reviewer observed that the project appears to hit its objectives and the process will be concluded.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer supported this standard as it is certainly relevant to the objective of reducing petroleum consumption.

Reviewer 2:
The reviewer believed that a standardized measurement for power in the electric propulsion system arena is needed and that would give a reliable value to consumers to make a decision regarding the purchase of an EV. To the extent this comforts consumers as to the validity of marketing claims, it can foster adoption of electrified powertrains

Reviewer 3:
The reviewer stated that this project supports the continued use of EVs through a better understanding of the product by those outside these technical fields

Reviewer 4:
The reviewer found this project to be an industry enabler to measure EV drive systems appropriately and consistently.

Reviewer 5:
The reviewer agreed about supporting future research, if only weakly. Clarifying EV power requirements for consumers should promote better understanding of what is being offered and should provide a better basis for assessing products.

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

Reviewer 1:
The reviewer remarked that the resources appear to be adequate.

Reviewer 2:
The reviewer commented that this is a support activity with clearly qualified resources

Reviewer 3:
The reviewer noted that the current level of resources has kept the program on time so the resources are assumed to be sufficient

Reviewer 4:
The reviewer said that the resources appear to be sufficient

Reviewer 5:
The reviewer indicated that the project appears to be on track for conclusion with its current resource level. There is no mention of any exception to that.

Analyzing Real-World Light Duty Vehicle Efficiency Benefits: Jeff Gonder (National Renewable Energy Laboratory) - vs155

Presenter
Jeff Gonder, National Renewable Energy Laboratory

Reviewer Sample Size
A total of four reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer stated that the technical barrier is that the existing standard certification cycles cannot give credit to some new fuel saving technologies (e.g., start-stop, engine encapsulation, and connected and automated vehicles). A new model is being developed. The model is then calibrated using dynamometer data and validated by on-road testing. This is a standard and efficient approach to develop a new model and fuel economy evaluation tool.

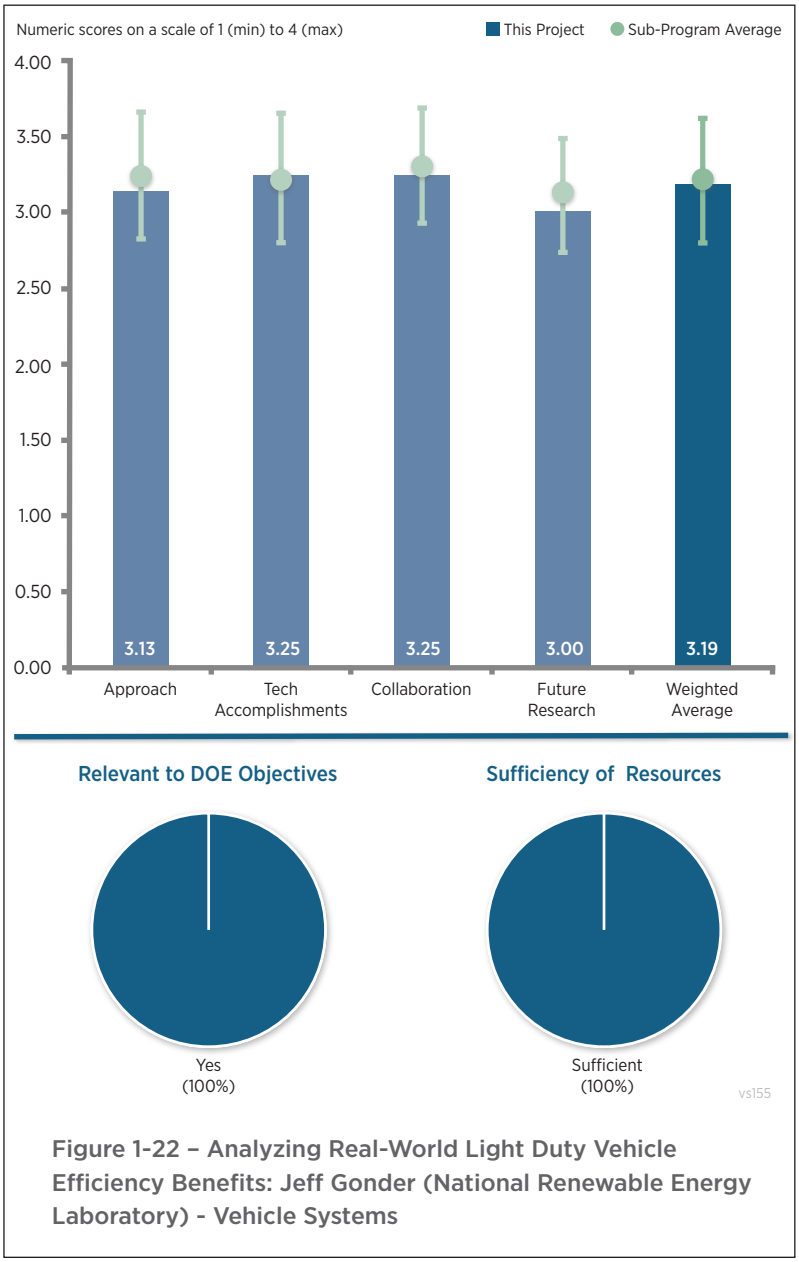

Figure 1-22 – Analyzing Real-World Light Duty Vehicle Efficiency Benefits: Jeff Gonder (National Renewable Energy Laboratory) - Vehicle Systems

Reviewer 2:
The reviewer commented that this is a great framework for studying the real-world benefits of efficienc improvement technologies. It would be useful to add the impact of air density with temperature and elevation as well as effective draft coefficient (Cd) changes with yaw-rate of cross-wind. This may be harder to get from the manufacturer, but cross-wind should be added as the project team suggested.

The reviewer asked that the project team please add the rate dependence of short versus long trips (based on 30 or 40 mile demarcation from NHTSA data) and alternative powertrain technology vehicles.

Reviewer 3:
The reviewer stated that the approach does a good job of being all encompassing, but now needs to focus on making the results practical and useful. As opposed to driving for more accuracy, the reviewer suggested focusing on why the current accuracy is good enough by showing that the effects on the output are not significant when singular points are improved or reduced in accuracy.

Reviewer 4:
The reviewer found the approach of this project to be confusing to a short term observer. The objectives say the

purpose is to evaluate nonstandard technologies for efficiency quantification, but the dynamometer approach i quite traditional. The project also appears to be spending quite a bit of time validating the modeling methods. It would be good to see a focus on the objectives.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer stated that the data seem very good and useful. The reviewer appreciated the data on the spread of customer in-use fuel economies and the effect of A/C and where the step change occurs. The project team mentioned solar loading skewing the A/C data, but variability in humidity is also a factor.

Reviewer 2:
The reviewer complimented the project team on its great technical accomplishments and progress made so far. From the comparison of model prediction and real-world on-road tests, it can be seen that the model can predict the mpg within ±10% with a root mean square error of 6.4%. It is good.

On Slide 15, when the real-world estimate is compared with other calculation approach, the reviewer suggested that it would be great to put the on-road test data in the table for comparison.

Reviewer 3:
The reviewer noted that the technical accomplishments for the first year are mostly results validating the models and dynamometer testing, which appear to be standard tests. The reviewer was not really sure where this is going.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that it can be seen that many institutes are involved in the project. This project cannot be done without extensive collaboration among different parties.

Reviewer 2:
The reviewer urged the project team to keep up the connection with EPA and try to create a workable alternative to using five cycle for o f-cycle credit determination. Tens of thousands of simulations depending on set-up may not be a workable solution for all technology cases.

Reviewer 3:
If the U.S. auto industry wants this evaluation to get the credit, then the reviewer pointed out that a more in-depth collaboration should be in order. At the moment it is only for project reviews. The EPA connection should be stronger as well. The reviewer said that a connection to NHTSA would be helpful as it is setting the standards for future vehicles.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer remarked that the project is near its completion and asked the project team to please focus on the arguments against the use of this technique. The reviewer's point of view was that adding accuracy to the modeling might not be needed to make the data useful. The reviewer encouraged the team to look to simplify the technique as much as possible while maintaining the usefulness of the output.

Reviewer 2:
The reviewer commented that the project is approaching its deadline of September 2016. The remaining three or four months may not enough for the proposed future work.

Reviewer 3:
The reviewer strongly and enthusiastically wanted to see this framework implemented for EVs. The reviewer asked the project team to please plot the energy consumption versus trip distance as EPA is hungry for this plot for both EVs and conventional vehicles.

Reviewer 4:
The reviewer observed that the proposed research is much like that of the past year as it appears unorganized and distant from the objectives.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer stated that the project is helping to describe the value of technologies in a way that has not been previously examined in depth.

Reviewer 2:
The reviewer believed that the project is on the border here, but with some better structuring, or clarification of the current structure, it could be strongly relevant to the DOE mission.

Reviewer 3:
The reviewer noted that many new fuel saving technologies are emerging while the existing standard certification cycles cannot assess them correctly. Giving credit to these new technologies will promote the adoption of these technologies.

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

Reviewer 1:
The reviewer stated that the project appears to be sufficiently resourced

Reviewer 2:
The reviewer said that the project has many collaborators and testing facilities to get the work done in time.

UTEMPRA - Unitary Thermal Energy Management for Propulsion Range Augmentation: Sourav Chowdhury (Mahle Behr USA LLC) - vs157

Presenter
Sourav Chowdhury, Mahle Behr USA, LLC

Reviewer Sample Size
A total of four reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer stated that much effort has been expended in preparing for future production of the multi-mode flow controller and flux-less brazin hardware.

Reviewer 2:
The reviewer commented that the design concept appears promising. Although the system complexity is high, it consolidates all thermal management into one unit to provide an overall vehicle system benefit. The reviewer commended the team for using a contemporary systems engineering approach, following the define/design/verify process that leverages state-of-the-art systems modeling capabilities. Project management appears adequate and capable of managing multiple concurrent efforts by multiple partners.

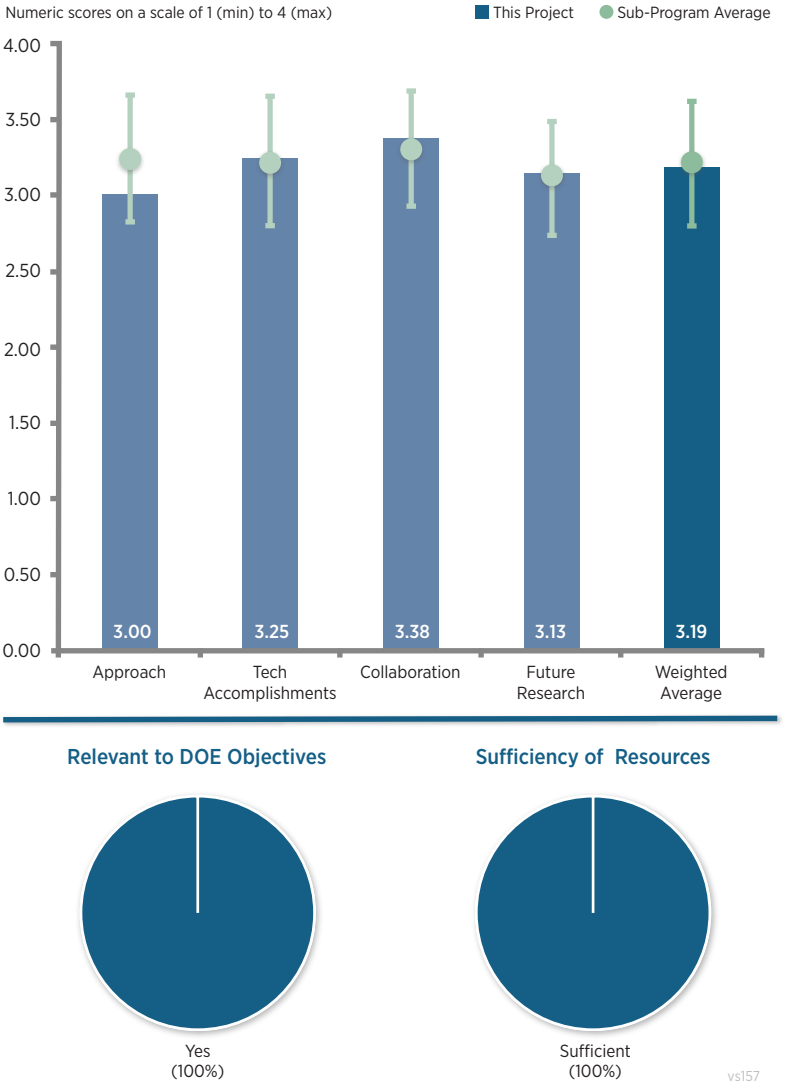

Figure 1-23 – UTEMPRA - Unitary Thermal Energy Management for Propulsion Range Augmentation: Sourav Chowdhury (Mahle Behr USA LLC) - Vehicle Systems

The reviewer noted that it will be challenging to meet the aggressive (but appropriate) cost target of zero delta cost while also ensuring adequate performance. The project team should establish a design verification plan with objective performance targets based on comparators (baseline Fiat 500e and/or conventional internal combustion engine [ICE] vehicle) to ensure targets are met at the component and systems levels. Performance targets should include energy consumption at the component and systems levels to ensure that the end goal of 15% vehicle range improvement at -10°C is met. Performance targets and verification must include operation below -10°C ambient temperatures in order to be commercially viable for the entire North American market.

Reviewer 3:
The reviewer stated that the Unitary Thermal Energy Management for Propulsion Range Augmentation (UTEMPRA) project follows a fairly classic project approach to establishing vehicle requirements and conducting

baseline testing, designing systems and component requirements, conducting modeling and testing, designing in durability and performing validation activities, conducting manufacturing and cost estimates, and finalizing vehicle build and testing. This approach addresses the traditional barriers to new systems design, integration, optimization, and validation. A lower temperature limit of -10°C has been targeted for the HVAC system as this is widely accepted as the lower limit of coolant capabilities.

A Fiat 500e BEV was chosen as the baseline vehicle for design and incorporation of the UTEMPRA system. This vehicle was chosen because the UTEMPRA system is compatible with Fiat's philosophy and Mahle Behr has a working history with Fiat. What was not clear to the reviewer is whether the choice of this OEM and vehicle type would in any way limit the potential broader commercial applicability of the UTEMPRA system with other larger vehicle OEMs. However, the project team did indicate that a vehicle battery that is cooled by coolant is the best approach for future industry flexibility and that other OEMs have expressed interest

Reviewer 4:

The reviewer stated that the schematic of the UTEMPRA system is not clear enough for understanding the concept.

The reviewer remarked that at mild ambient temperature, e.g., spring and fall, there is no need for cabin heating or cooling and only thermal management of power electronics and battery is needed. The reviewer wondered, under this condition, how the UTEMPRA system would help with the driving range extension.

In some places like Minnesota and Michigan, there are a few months when the ambient temperature is lower than -10°C. The reported driving range comparison is only to -10°C. The reviewer wondered how the UTEMPRA system outperforms the traditional system when the heat pump system is reaching its low end temperature limit.

When the ambient temperature is higher than 25°C, which is usually when A/C is needed in summer, it seemed to the reviewer that the UTEMPRA system performs worse than traditional systems. This reviewer observed the presenter argue that the project team's system can approach the traditional system by using PCMs. However, using PCMs will increase the vehicle weight, and the reviewer was unsure how efficiently PCMs will help

It seems to this reviewer that, over the whole year, the UTEMPRA system outperforms or underperforms the traditional system at different times at different locations. When driving range is compared between different systems, the reviewer recommended averaging over the whole year at different locations. The reviewer thought that the project target—"to increase15% BEV drive range at -10°C with equivalent cabin comfort"—should be changed. It would not make any sense if the driving range is increased by 15% at -10°C ambient temperature but decreases the driving range at lower or high temperature. The reviewer asserted that the driving range extension should be looked into over the whole year.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:

The reviewer enthused about the excellent accomplishments across the full range of project areas: baseline testing and target setting, systems model development, prototype build, component sizing and design, vehicle integration, and manufacturing process and equipment development.

Reviewer 2:

The reviewer noted that the project is on schedule and on budget. With 30% of the budget spent on brazing equipment, the percentage of budget completion is exaggerated at approximately 75%. The project seems to have sufficient funds to complete the scope

Reviewer 3:

The reviewer recounted a solid list of technical accomplishments that includes packaging studies, systems and component specifications and design, proof-of-concept of components and brazing equipment, and heat exchanger and compressor builds. Starting in late 2015 through the present, all milestones have been completed on schedule

with only milestone six (braze equipment installation and qualification) being slightly behind. There has been an extensive amount of vehicle baseline testing and system/component modeling and evaluation.

An area of potential concern to the reviewer was that while the UTEMPRA system shows respectable efficiency improvements at low and mild temperatures, it does show worsening performance at higher temperatures compared to conventional direct A/C systems currently in use. This could potentially limit the commercial attractiveness of the UTEMPRA system in warmer climates. The project team thought that this deficiency could be reduced/bridged by additionally implementing PCMs and other technologies in warmer climates. However, this would come with an additional cost barrier.

An additional area of concern to the reviewer was that the cost viability of the UTEMPRA system is really not discussed. There are no details as to the potential cost premium although the target is apparently to achieve cost neutrality with today's conventional HVAC systems. The presentation mentions towards the end the need for an update of the projected system cost to ensure its commercial viability. The reviewer remarked that it would be good to prioritize this effort sooner rather than later and to clearly define the parameters guiding this e fort.

Reviewer 4:
A lot of work has been done and the project is making progress as planned. The reviewer had a concern similar to comments on Question 1 about whether the proposed system has advantages over the traditional system in different seasons and at different locations. If the advantage is limited from -10°C to +10°C, then the OEMs may not consider adopting the new system.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer found the collaboration to be outstanding, with no noticeable shortcoming.

Reviewer 2:
The reviewer complimented the project team on its excellent partnership with Fiat Chrysler Automobiles (FCA).

Reviewer 3:
The reviewer remarked that this project has collaboration with an OEM and a national laboratory. Getting more OEMs involved might help.

Reviewer 4:
The reviewer acknowledged that the project has a respectable list of partners including FCA (OEM partner), Norgren (component design), and NREL (modeling). Several suppliers of flux-less materials are being considered and furnace specification and design are being reviewed by a la ge team of braze experts. However, the reviewer suggested that it would have been beneficial to have additional OEMs on board to increase confidence in the broa applicability of the technology at the consumer end.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer wanted to see future work include a cost and performance comparison with increased battery size.

Reviewer 2:
The reviewer stated that the presentation lacked specifics about future work in the remainder of budget period two and budget period three. However, based on current progress and the general plan communicated, future research is properly focused and the team is in position to overcome most barriers. A plan for recovering from the one-month delay is needed.

Reviewer 3:
The reviewer observed that the proposed future research and project plan for the balance of FY 2016 and all of

FY 2017 is relatively well detailed and focused on brazing technology development, further component design and build, testing, and vehicle build and validation. No major omissions appear evident. However, as mentioned above, a primary emphasis should be placed in the near-term on in-depth cost studies to assess the true commercial viability of the UTEMPRA system for vehicle OEMs.

Reviewer 4:

The reviewer reported that it seems the next step would be prototyping and testing. Before jumping into that, the reviewer recommended that the team go back to look into the yearly averaged driving range increase at different locations and with the cabin heating/cooling on and off.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:

The reviewer noted that, with cost evaluation, this project can set priorities for cold weather range recovery.

Reviewer 2:

The reviewer found the project to be completely relevant and in line with DOE VTO goals and objectives.

Reviewer 3:

The reviewer remarked that, yes, reduced EV driving range as a result of extreme temperatures is a significant challenge to mainstream consumer market viability of these vehicles. Overcoming, or significantly mitigating, substantial range reductions at extreme temperatures is critical.

Reviewer 4:

The reviewer stated that looking for a replacement for the traditional cabin heating and cooling system is very critical considering that the current system draws a lot of juice from the battery, which limits the driving range of EV.

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

Reviewer 1:

The reviewed stated that there are sufficient financial and company resources to conduct the scheduled projec activities.

Reviewer 2:

The reviewer commented that the first phase of the project seemed to use only 6% of the budget. The next phase would cost much more money, but the total budget should be sufficient. The team can get more OEMs involved and get their opinion on the system.

Zero Emission Cargo Transport II: San Pedro Bay Ports Hybrid and Fuel Cell Electric Vehicle Project: Joseph Impullitti (SCAQMD) - vs158

Presenter
Joseph Impullitti, SCAQMD

Reviewer Sample Size
A total of five reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer noted that the project has a reasonable and effective approach to achieving its stated goals, and it is technically sound. The reviewer would have liked for the project team to have included an analysis of where the H_2 will come from in the future. If it comes from CH4, there is not much GHG benefit. The basic idea of adding on something expensive to another expensive technology is not likely to be very favorable on economic grounds, either. The reviewer would have added a comparative economic assessment to the scope of the project.

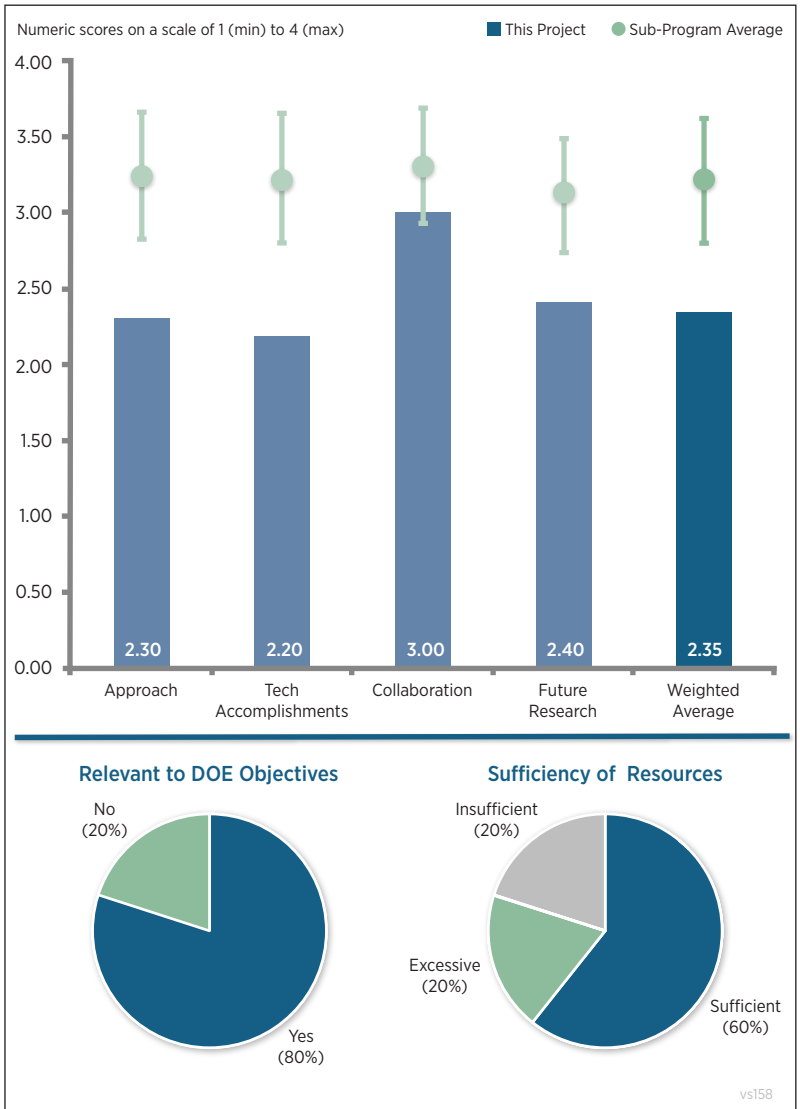

Figure 1-24 – Zero Emission Cargo Transport II: San Pedro Bay Ports Hybrid and Fuel Cell Electric Vehicle Project: Joseph Impullitti (SCAQMD) - Vehicle Systems

Reviewer 2:
The goal of the project is to help zero/near zero emission vehicles penetrate the fleet. The approach appears to be primarily building prototypes that extend the range of previous electric/fuel cell vehicles. The project team indicated the vehicles will be heavier than the incumbents, which affects load hauling capability. In order to penetrate the fleet long term, the reviewer encouraged the project team to benchmark against the range and load carrying capability of the incumbent fleet. The reviewer stated that the load hauling capacity is what should be compared. If the load capacity is the same as a Class 7 truck, use the Class 7 truck as the comparison because that is how a user would need to use it.

Reviewer 3:
The reviewer commented that the team's approach to draw on the results and experience from previous projects is good in order to leverage experience from one to another and avoid reinventing technologies. The requirement to have an OEM for this work is absolutely critical—the technologies are unlikely to progress beyond a science project level if this is not the case. The system designs for the various truck projects appear to be technically sound. The reviewer said that the team members are using proven components in their designs (but as these are not always

production systems, proven is a relative thing). The project team has done some initial work to address the H_2 infrastrcture question for both the short- and long-term: the team will have tube trailer refueling for H_2 in the short term and wants a permanent H_2 station later in the long term. The approach to test all trucks on the same duty cycle is important to enable accurate comparison of performance among trucks.

Reviewer 4:

The reviewer remarked that the vehicle technical specification should have been based on a previous analysis of requirements. Instead, it looks like one of the main accomplishments of the project was to have found a contractor to build a truck. There was no consideration of the infrastructure as the H_2 is expected to be delivered by trailers.

Reviewer 5:

The proposed size of batteries and fuel cell (FC) systems seems extremely costly and unrealistic relative to what the market could bear. The reviewer asked whether there is any analysis regarding the cost feasibility of such an endeavor. The reviewer noted that batteries of more than 300 kWh would cost well in excess of $100,000 in the best case, cell cost scenarios. Additionally, the comment at the end of the presentation discussing the use of tools to analyze the vehicles needed to be done up front. The reviewer said that understanding the drive cycles, energy requirements, etc., would lead to a rational engineered approach to the system that could be more cost effective and optimized relative to the needs.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:

The project has made good progress towards its technical goals. The reviewer questioned how anybody can seriously evaluate a $20 million project in 20 minutes, and expressed being very uncomfortable with the whole review process [DOE Program Clarification: DOE will take under consideration in planning future AMR presentations.].

Reviewer 2:

Work seems to be progressing slowly given that the project award was at the end of 2014, but the project has now begun to move (and truck designs are now started). Kenworth is taking a larger role in vehicle builds/integration, and the reviewer hoped this means this OEM is interested in the technology.

The reviewer said it was good to see these are all range extended vehicles, as these might be more practical and appeal to a larger group of potential buyers than an electric-only truck. Despite this, the range limitations of the designs may still prevent wider interest beyond the port/drayage application. The TransPower truck will be able to be used beyond the ports, extending to warehouses, because of its somewhat longer range.

This reviewer explained that incorporating FC dominant and battery dominant designs will demonstrate which design may work better for the drayage/port application. The compressed natural gas ICE hybrid is interesting as it may be closer to a possible production design than the FC concepts. The reviewer noted that the team is looking at another FC concept to replace the International Rectifier project; since the team has several FC projects alread , it may be an opportunity to consider another architecture to expand the experience base of the project.

The reviewer stated that alignment of architectures with duty cycles is important. Team members have looked at drayage duty cycles, plus TIAX drayage cycles, to use as a basis for their designs, and this should align the architectures appropriately with the intended use. However, this person asserted that weight is still an issue, both with batteries and H_2 FC/H_2 storage.

Reviewer 3:

One of the manufacturers was lost, due to corporate restructuring. The project is working to find a replacement, and recover the schedule. It is unclear to the reviewer from the presentation what the overall project schedule really is other than to buy items before the two-year presentation period is over. A project schedule should be developed, tracked, and presented as part of the reporting, rather than just a history or an individual company projection. It was helpful to the reviewer to see the project reporting usable energy storage numbers for a valid comparison of

options. Quantifiable benchmarks and ta gets should be added to track the goals of the project (i.e., energy savings, cost savings, equivalent fuel savings, etc.).

Reviewer 4:
The reviewer said that it appears a year has passed with little more than some meetings. The reviewer asked whether anything is being done to manage the development of the relatively complex systems for FC range extender, which can take a significant amount of time and resources

Reviewer 5:
The reviewer commented that having a contract signed should not be considered as an accomplishment.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer noted that the project includes financial partners besides DOE, such as OEMs and national laboratories. It is a good mix.

Reviewer 2:
The reviewer stated that the set of collaborators is excellent.

Reviewer 3:
The reviewer said that two OEMs are involved (i.e., Kenworth and Navistar) as well as several electrified systems companies. It is important to engage the truck OEMs to ensure the technologies will move forward—a good collaboration activity would be to consider how the project will encourage the OEMs to include these trucks in future product plans. California financial partners are supporting this project, which shows commitment. The project team stated that the team will be looking at commercialization later, and hoped the trucks will be well-accepted and then pushed to commercialization.

Reviewer 4:
The reviewer remarked that several institutions are involved; however, it appears that there were no vehicle requirements defined before the start of the project. Prior studies to develop those requirements would certainly have led to different vehicles being designed.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
Given the scope as defined, the reviewer stated that the project plan should be e fective in carrying out the work as expected.

Reviewer 2:
Future activities are logical (build and test the trucks, collect information from a 24-month demonstration, and develop a project to replace the team that withdrew). All of this work makes sense to complete the project as described.

Reviewer 3:
The reviewer commented that the project plans to continue to acquire things and to test them, but did not address challenges. The project team indicated that the vehicle was heavier than the incumbents, which affects the load capability. The reviewer suggested that the project team should look at what the risks and challenges are and document a mitigation strategy.

Reviewer 4:
In the reviewer's opinion, the presenters do not appear to have any clear plan to quantify the impact or the potential of the technology behind building a couple of prototypes.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer pointed out that, by definition, an alternative fuel/E displaces petroleum.

Reviewer 2:
The project could certainly be relevant to DOE petroleum reduction objectives, to some degree, depending on how well these trucks will appeal to a market outside of the port and drayage application. The project appears to be focused more on local criteria emissions reduction at ports, which is a major concern in Southern California.

Reviewer 3:
The reviewer commented that there would of course be reductions in petroleum use, but the project's main purpose is emissions reduction in a highly polluted area. The technology combinations chosen are expensive and unlikely to find la ge markets; therefore, the long-term potential for petroleum replacement is small. The reviewer found it unfortunate that the project scope does not include a preliminary estimate of cost-effectiveness of the technology combinations. If it did, the reviewer opined that it would probably lead to the conclusion that the project made no sense, other than as a demonstration. The reviewer recommended that the project team return the uncommitted $800,000 [DOE Program Clarification: DOE will take this under advisement when looking at establishing similar projects in the future.].

Reviewer 4:
This is a lot of budget to assess the potential of a technology without any prior analysis.

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

Reviewer 1:
If the question is whether the sum is appropriate for the project as scoped, then the amount is reasonable. But, given the low long-term potential, the reviewer thought too much money is being allocated.

Reviewer 2:
The reviewer enumerated that the project lost one of the manufacturers, the project team is working to finding a replacement, and the resultant delay in the schedule still needs remediation.

Reviewer 3:
The reviewer’s comment was that the resources appear to be more than adequate to achieve the goals of the project.

Multi-Speed Transmission for Commercial Delivery Medium-Duty Plug-In Electric Drive Vehicles: Bulent Chavdar (Eaton Corporation) - vs161

Presenter
Bulent Chavdar, Eaton Corporation

Reviewer Sample Size
A total of five reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer stated that this project is an excellent idea, elaborating that it a relatively inexpensive and straightforward way to improve the performance of electric trucks. The reviewer added that the project as described seems to have developed an effective approach that will lead to a real product. The reviewer remarked being impressed by the re-thinking that led to an improved concept.

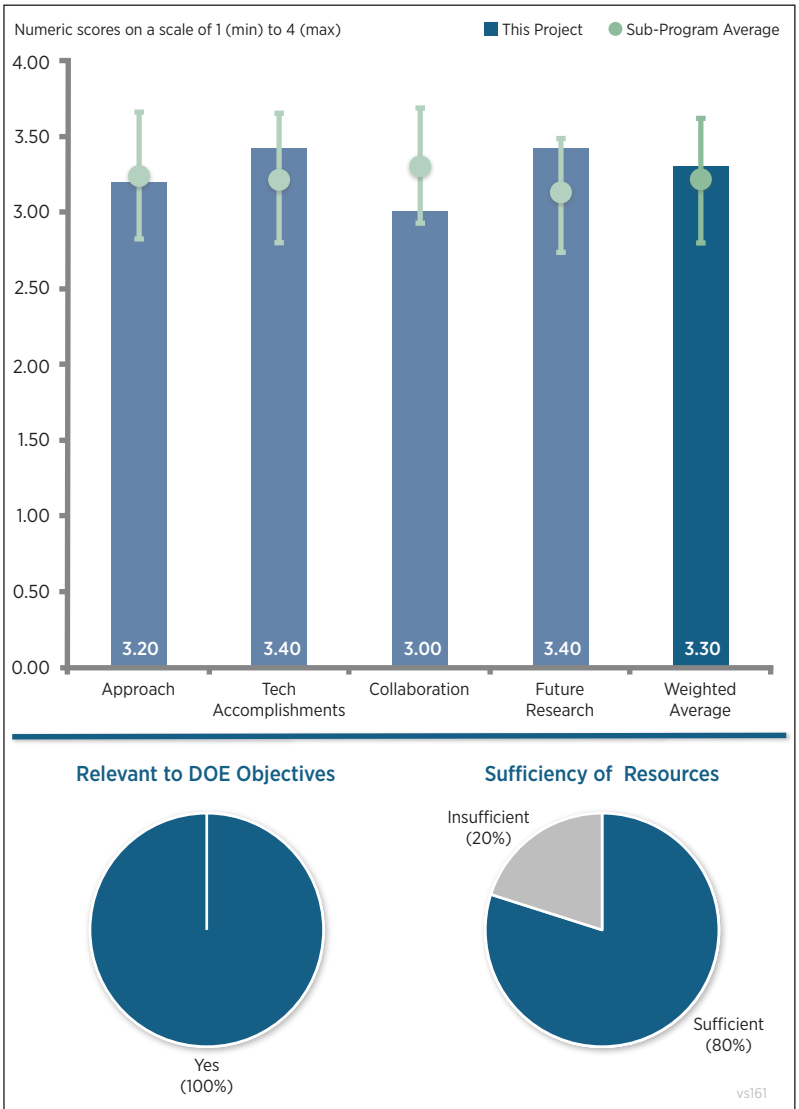

Figure 1-25 – Multi-Speed Transmission for Commercial Delivery Medium-Duty Plug-In Electric Drive Vehicles: Bulent Chavdar (Eaton Corporation) - Vehicle Systems

Reviewer 2:
The reviewer stated that the overall approach is good and observed that the scope for optimization of design for efficienc , cost, weight, and performance is limited due to constraints of the program. The reviewer concluded that some lack of total investment and implementation cost details need further refinement

Reviewer 3:
The reviewer commented that the timeline is not well defined with dates in a sufficiently detailed enough manne for the reviewers to understand how this re-scoping will be successful and that this does not provide enough confidence

Reviewer 4:
The reviewer warned that while the approach has been satisfactory at this project stage, not currently having an EV OEM partner going forward, and unidentified moto , inverter and battery manufacturers, puts the job of integrating the entire system at risk.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer affirmed that the technical accomplishments are proceeding, adding that there is a strong team that appears to have excellent resources for success. The reviewer said tools are being utilized well and that the team has used a solid process to select the 3-speed automated manual transmission over other possible solutions and then matching gear ratios with this setup.

Reviewer 2:
The reviewer agreed that the modeling and design efforts appear to be right on target in addressing the technical difficulties. The reviewer hoped to see something built next year.

Reviewer 3:
The reviewer offered that the technical development of the solution and verification of modeled results are very good.

Reviewer 4:
The reviewer stated that analysis and modeling has resulted in the proposed design and projected benefits and observed that CAD is complete for a modular multi-speed transmission and manufacturing to begin.

Reviewer 5:
The reviewer remarked that modeled results to-date suggest improvements in drivability and efficienc .

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer praised as excellent the collaboration with DOE laboratories, but cautioned that the challenge of not having Smith Electric Vehicles intimately involved is significant

Reviewer 2:
The reviewer stated there is sufficient modeling and design group presence but that the supplier for the E delivery truck is questionable and said there is a need to look into other partnerships.

Reviewer 3:
The reviewer concluded that there will obviously be more activity by the collaborators after something is actually built but that finding a new E OEM will be somewhat of a challenge.

Reviewer 4:
The reviewer commented that not having an EV OEM onboard significantly impacts the project's ability collaborate. However, the reviewer also remarked that ongoing collaboration with ORNL and NREL with these laboratories performing vehicle-level simulations based on historic duty cycles at this stage of the project is appropriate.

Reviewer 5:
The reviewer cautioned that lack of a vehicle partner leads to some uncertainty in whether the design will be optimized for a future OEM, or whether the work will need to be redone once partner requirements are provided.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer exclaimed that lightweighting is a big win by saving 240 pounds. The reviewer is excited for the project to move on to prototyping.

Reviewer 2:
The reviewer observed that the real test is building something that works. The reviewer is looking forward to very positive results.

Reviewer 3:
The reviewer judged that the decision points for future work are good.

Reviewer 4:
The reviewer stipulated that finding an appropriate E partner will be critical for this work. The reviewer cautioned that current pressures on EV development due to low gasoline cost could be problematic on the short term, adding that this is outside the control of the collaboration. That said, the reviewer concluded the multi-speed development is promising for performance and energy improvements in EVs.

Reviewer 5:
The reviewer warned that lack of an EV OEM places all future research at risk, adding that even if one can be identified, much of the modeling to-date may need to be repeated, significantly reducing the potential to succee within the designated timeframe. The reviewer also remarked that future presentations must spell out all the acronyms.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer stated that modeling results to-date suggest improved efficiency improved, which support DOE s petroleum reduction goals. In addition, the reviewer commented that the increased drivability, as measured by acceleration and top speed, may make the potential EV truck a more attractive choice, which would in turn support the administration's goal of getting more EVs deployed.

Reviewer 2:
The reviewer offered that successful completion of this project should do much to increase market penetration of EVs into the delivery truck market, which now relies heavily on gasoline and diesel.

Reviewer 3:
The reviewer commented that this technology is important to help reduce the barrier of entry MD EV fleets

Reviewer 4:
The reviewer remarked that EVs for personal use and work applications are a direct petroleum-displacing disruptive technology.

Reviewer 5:
The reviewer said that this is a key integration to make MD EVs more efficient and to provide a better overall payback.

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

Reviewer 1:
The reviewer concluded that the budget of this project is quite reasonable, especially given that the project team will need to actually build a product and test it on operating vehicles.

Reviewer 2:
The reviewer stated that it seems right, although the project needs an OEM for success, or at a minimum, an engineering firm who can perform like an OEM

Reviewer 3:
The reviewer indicated that resources seem to be appropriate, but added that it is unclear if further funding will be needed if scope changes after an EV OEM partner is on board.

Reviewer 4:

The reviewer remarked that it is difficult to rate the level of resources needed going forward without knowing the future battery, EV OEM, converter and motor integrator, and manufacturers, as well as the resources that will be needed. The reviewer concluded that given the unknowns, the risk is always that funding will be insufficient as excessive funding rarely occurs.

Integrated Boosting and Hybridization for Extreme Fuel Economy and Downsizing: Vasilios Tsourapas (Eaton Corporation) - vs162

Presenter
Vasilios Tsourapas, Eaton Corporation

Reviewer Sample Size
A total of five reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer praised an excellent project and presentation, elaborating that the hybridization of waste heat recovery and electrification of a supercharger demonstrates a more complete solution set of technology. The reviewer looks forward to seeing the final fuel economy optimization results next year.

The reviewer inquired if one only looks at the closed system of these two components, by what percent of efficiency does the electricity recovered compare to the energy needed to utilize the supercharger.

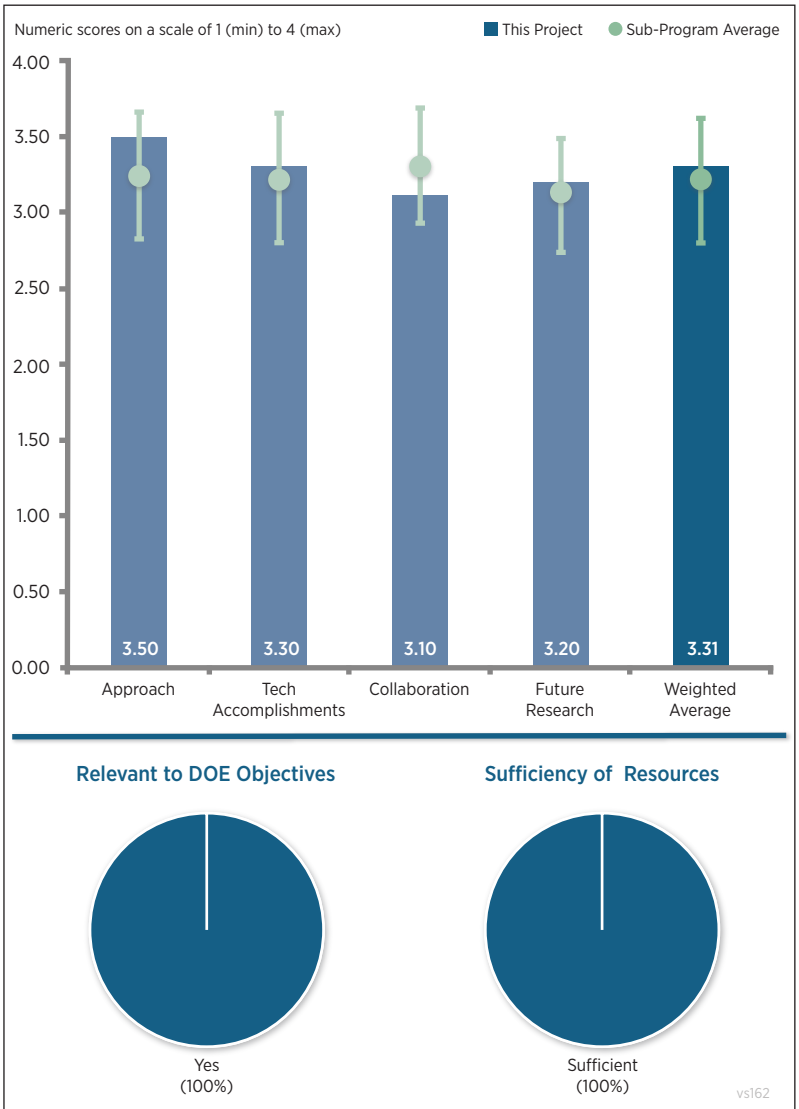

Figure 1-26 – Integrated Boosting and Hybridization for Extreme Fuel Economy and Downsizing: Vasilios Tsourapas (Eaton Corporation) - Vehicle Systems

Reviewer 2:
The reviewer observed that the project takes the approach of designing the new components for integration into the engine and then, once that is complete, of integrating them into the vehicle. The reviewer remarked that this incremental approach is good for the introduction of new components and trying to evaluate their impact on subsystems (the engine) and the overall system (vehicle).

Reviewer 3:
The reviewer stated that the plan is solid and progress is occurring.

Reviewer 4:
The reviewer affirmed that the approach described is sound and that the reference technology and the di ferent steps are well described.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer observed that the project made good progress over the last year with the models at the component level. The reviewer also noted that this second year is an important one for the project and that milestone slide (Slide 4) indicates the design of the electrically assisted variable speed supercharger and WHR were delayed. The reviewer remarked that because these are the primary components in the project strategy, it is important that they stay on schedule. However, the PI, when asked about his progress, felt that the project could meet the fuel economy targets.

Reviewer 2:
The reviewer stated that the project team should clearly find the best application and solidify for next steps to best demonstrate this disruptive technology, adding that it is good to tradeoff items to exploit the fuel economy opportunity.

Reviewer 3:
The reviewer recounted that Delphi used the model-based systems engineering approach by utilizing first modeling and simulation with GT-POWER and using higher fidelity models to design the di ferent components.

Reviewer 4:
The reviewer referenced prior comments.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that having both Isuzu and SwRI on board as partners is very helpful in order to follow the project approach, adding that the support required from each is well thought out.

Reviewer 2:
The reviewer urged the project team to stay focused with the few collaborators to complete this project on time and on budget and accomplish goals.

Reviewer 3:
The reviewer remarked that the addition of Isuzu would be beneficial to the project

Reviewer 4:
The reviewer regretted that Isuzu was the only partner willing to invest in this project, as opposed to a Ford or GM, which the reviewer suggested might have realized a more direct gain to the U.S. market, and in the case of Ford started with a baseline more-optimized system.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer remarked that while several issues still need to be addressed, the team appears to have a good understanding of the remaining challenges.

Reviewer 2:
This reviewer acknowledged looking forward to seeing the final results

Reviewer 3:
The reviewer stated that the proposed future work is to continue forward with the project approach, noting that this coming year the PI will be focused on durability, cost, and system control of the design and adding that these are all important activities prior to vehicle integration.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer observed that if the project team is able to demonstration newly designed components that take advantage of waste heat and variable speed supercharger, the design will allow for a smaller more efficient engine that results in less petroleum consumption.

Reviewer 2:
The reviewer commented that optimization and integration of this technology could show marked fuel economy improvement.

Reviewer 3:
The reviewer noted the following: big opportunity; big risk; and like to swing for the fences sometime. The reviewer expressed looking forward to next year's review.

Reviewer 4:
The reviewer remarked that an obvious question as it applies to this project, but major downsizing and optimization projects are, by definition, directly proportional to petroleum displacement

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

Reviewer 1:
The reviewer observed that the project is heavily funded in year two and that this should be sufficient to get the team through subsystem integration.

Reviewer 2:
The reviewer said there are no apparent issues noted in this project.

Advanced Bus and Truck Radial Materials for Fuel Efficiency: Lucas Dos Santos Freire (PPG Industries) - vs163

Presenter
Lucas Dos Santos Freire, PPG Industries

Reviewer Sample Size
A total of five reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

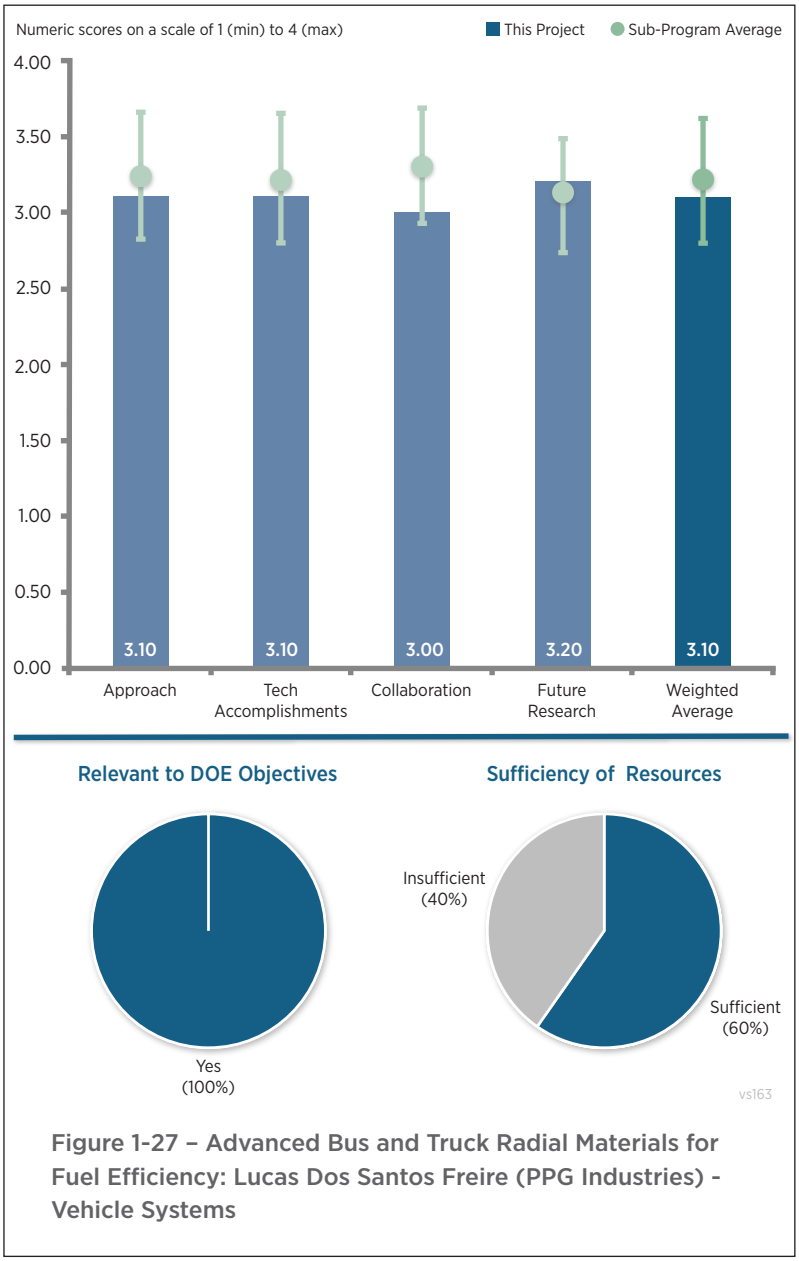

Figure 1-27 – Advanced Bus and Truck Radial Materials for Fuel Efficiency: Lucas Dos Santos Freire (PPG Industries) - Vehicle Systems

Reviewer 1:
The reviewer characterized the approach as reasonable and addresses a very important area for reducing fuel use in the commercial truck sector. The reviewer observed that the team is addressing the use of silica for commercial truck tires, which have different material characteristics because of the use of natural rubber. The reviewer elaborated that incorporation of silica should produce the desired rolling resistance effects, as the ability of silica to reduce rolling resistance has been proven in the LD market. The team is targeting higher-volume tire applications (Class 7-8) to improve market uptake. The reviewer concluded that the team's processes appear to be reasonable and analysis is thorough, adding that verification of the fuel economy will be done on real world trucks at Bridgestone, which is an important step.

Reviewer 2:
The reviewer observed that the project appeared to have an approach tightly focused upon achieving the very specific Budget Period One requirement. The reviewer remarked that the project team relied upon historical analyses to provide the tie between tire compound, then rolling resistance, and ultimately vehicle efficienc , all of which appeared to be clearly based upon extensive experience in the technology area.

Reviewer 3:
The reviewer commented that this project builds on previous work with Silica and offered that sooner, rather than later, the tires are needed to prove the results and see how they measure to the goals.

Reviewer 4:

The reviewer stated that the project is focused on developing a novel approach to tire manufacturing to significantly reduce rolling resistance and improve vehicle fuel economy. The reviewer praised as excellent the approach to tire compound design and process development, elaborating that elements of this work includes treatment of silica for increased dispersion, quantification of new compound properties, and comparison to properties of tires produced using existing state-of-the-art properties. However, the reviewer cautioned that the approach lacks the necessary rigor to predict and verify the relationship between tire material properties and on-vehicle performance.

The reviewer remarked that the presenter asserts there is an understood relationship between tire material properties tangent (tan) delta and rolling resistance and characterized this institutional knowledge as valuable, but that it seems insufficient to establish a link to on-vehicle tire performance and resulting vehicle fuel econom . The reviewer further explained that multiple targets for rolling resistance reduction were established for laboratory test of samples and on-tire measurements, and that it appears tan delta is being used as a measure of rolling resistance, but no transfer function between tan delta and rolling resistance is given.

The reviewer suggested the team should more clearly define metrics, test methods, and transfer functions to show the relationship between samples in lab, full-tire laboratory testing, on-road tire performance testing (if any), and vehicle fuel economy testing.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:

The reviewer observed that multiple silica prototypes have been developed and excellent test data has been gathered, which show that the compounds meet many of the material targets and manufacturability. The reviewer summarized that the project appears to be on track for timing and budget and the go/no-go decision was successfully passed in March.

Reviewer 2:

The reviewer agreed that the team has achieved its initial goal of gaining a scientific understanding of silica dispersion performance and increasing the dispersion of silica into the natural rubber material. The reviewer noted that the team has identified silica prototype systems that achieved the required 10% increase in dispersion, and are thus able to move forward with subsequent project phases. Furthermore, the team has demonstrated with both testing and microscopy that its prototype silica will be dispersed into the natural rubber. The reviewer concluded that initial results of the prototype silica system are promising for both rolling resistance and durability.

Reviewer 3:

The reviewer judged that overall, the silicas appeared to have significantly better dispersion that the baseline compound (carbon black), which seems to be the major focus at this point. The PI indicated that the project achieved the dispersion level required for the Budget Period One go/no-go decision, although it might not have been the full 10% and instead perhaps was closer to 9%. The reviewer concluded that this appeared to be the culmination of the efforts under this first phase of the project, along with greater understanding of the impact of surface area and chemistries on ultimate achievement of project goals.

Reviewer 4:

The reviewer remarked that the project looks to be behind schedule and asked what is being done to make up the time.

The reviewer said that improved dispersion with lower surface energy treatment for silica is a good result, but then added that tan delta of the LD0380-2 does not appear to be that much different from the Control 1. The reviewer wondered if more than one sample used. Finally, the reviewer indicated that the connection between dispersion and tan delta to rolling resistance is unclear and asked if this been experimentally correlated.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer observed the team has made strides in expanding (or clarifying the extent of) collaboration with a critical partner (i.e., the tire manufacturer). The tire OEM will provide the appropriate feedback on the benefits of the new compound for its tires and intended tire customers. The reviewer commented that a trucking fleet could add perspective, as noted, but Bridgestone Americas Tire Operations (BATO) should cover this, as the tire company will be the one to decide how to use the new silica in its tire products. Critical measurements at the molecular level are provided by a scientific laborator .

Reviewer 2:
The reviewer stated that the project partners seem to be working well together and have the required capabilities for the bulk of the work. However, the reviewer cautioned that it is not clear whether BATO is capable of performing the requisite on-road testing to verify the expected relationship between tire material properties, including tan delta, rolling resistance, other tire performance, and vehicle fuel economy. The reviewer suggested it may be necessary to bring in another partner with on-road testing expertise (auto OEM, test laboratory, or national laboratory), adding that perhaps this has already been defined with DOE and will be done as follow-on work with tires that will be provided to DOE for independent testing.

Reviewer 3:
The reviewer remarked that any OEM or large fleet interaction would have been helpful, commenting that they might differ in their opinions sometimes from what Bridgestone thinks and says.

Reviewer 4:
The reviewer observed that the project highlighted collaboration was with Bridgestone (advisor and ultimate manufacturer) and Augustine Scientific (measurement laboratory). The reviewer noted that the project team had considered including a user (fleet) as an advisor too, but it sounds as though Bridgestone may have convinced the team that was not necessary. An alternative may have been to include at least one knowledgeable bus and truck fleet to provide a check on Bridgestone's advice. The reviewer indicated that the PI felt Bridgestone had put together a sufficient a gument that Bridgestone knew the market, and had actually gathered letters of support from fleets for this project to take place. The reviewer concluded that it still would appear that the project could have benefited from greater collaboration, and may want to revisit this as the project moves along

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer observed that it appears that Phase Two will include a focus on additional tire properties, such as rolling resistance. The reviewer elaborated that additional compound work is planned, and then no more than two formulations will be selected for an experimental tire build (followed by a down-select to a single compound in Phase Three), adding that there were several interesting suggestions for research beyond the project. The reviewer stated that, in general, the proposed future research appears to be a rational approach to completing the project, and the project team has clearly given this subject a great deal of thought with regard to future directions.

Reviewer 2:
The reviewer described as excellent future work proposed for silica materials, rubber compounds, and manufacturing process development. Again, the reviewer cautioned, the project plan lacks a sufficiently robust design verification plan to connect material properties to on-road performance. Howeve , the reviewer concluded that the identification of research beyond the end of this project is admirable, in that it demonstrates how the prime contractor will continue to strive for a return on DOE's funding investment.

Reviewer 3:
The reviewer judged that proposed future work, as described, appears reasonable to complete the project and achieve the desired goals, adding that the team members are distributing the future work appropriately based on their respective areas of expertise.

Reviewer 4:
The reviewer stated that tires are needed and asked if the schedule and resources still allow the team to get them when needed. The reviewer agreed with a past reviewer that it would be helpful to have a truck OEM providing input. The reviewer pointed out that Bridgestone will get rolling resistance numbers but not fuel economy numbers which would be helpful. If the fuel economy cannot be tested, the reviewer assumes the rolling resistance numbers will be used to calculate the fuel economy.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer stated that the project is focused upon improving bus and truck efficiency through better tire technology, judging that this is clearly the type of project that is highly appropriate for inclusion in the VS R&D portfolio, in order to address overall VTO goals of greater heavy vehicle efficienc .

Reviewer 2:
The reviewer observed that the project offers the potential for increasing fuel efficiency for truck and bus tires, which are typically used and replaced more frequently than LD tires, giving the opportunity for faster market uptake. The reviewer also noted the team is looking at tires for the largest truck fuel users—Class 7-8 trucks—and that improvements in this market will have a large impact on petroleum displacement.

Reviewer 3:
The reviewer stated the goals are very relevant, adding that improvement in rolling resistance would decrease fuel use and at a relatively inexpensive cost.

Reviewer 4:
The reviewer said this project is highly relevant to DOE goals.

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

Reviewer 1:
The reviewer stated that resources for this project appear to be sufficient to complete the work as described

Reviewer 2:
The reviewer observed that there was no indication made that the funding was either high or low, so the assumption is that it is sufficient. The reviewer added that the only question here might be that it could have appeared to perhaps warrant more than a 25% cost-share on the part of industry.

Reviewer 3:
The reviewer offered that it is not clear that enough resources exist to accomplish all the goals of this project.

Reviewer 4:
The reviewer cautioned that there do not seem to be sufficient funds to perform sufficiently rigorous verificati validation testing, adding that no details are given as to how full-tire laboratory and road testing will be carried out. It is the reviewer's opinion that significant resources will be needed to design and implement a test program necessary to understand the relationship between prototype silica dispersion in multiple compounds, rolling resistance, and vehicle fuel economy; and verify that the chosen tire design(s) meet the rolling resistance and fuel economy targets.

Design and Implementation of a Thermal Load Reduction System in a Hyundai PHEV: Cory Kreutzer (National Renewable Energy Laboratory) - vs165

Presenter
John Rugh, National Renewable Energy Laboratory

Reviewer Sample Size
A total of four reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer praised the approach being used to estimate the range across the nation as very good. The reviewer then noted that since the project team is using Future Automotive Systems Technology Simulator to perform simulations, it should not be having a resource issue regarding computation power. That being the case, the reviewer asked if it is necessary to reduce the number of weather stations considered from 839 to 204. The reviewer would like to know what the basis is for choosing the most important weather environments.

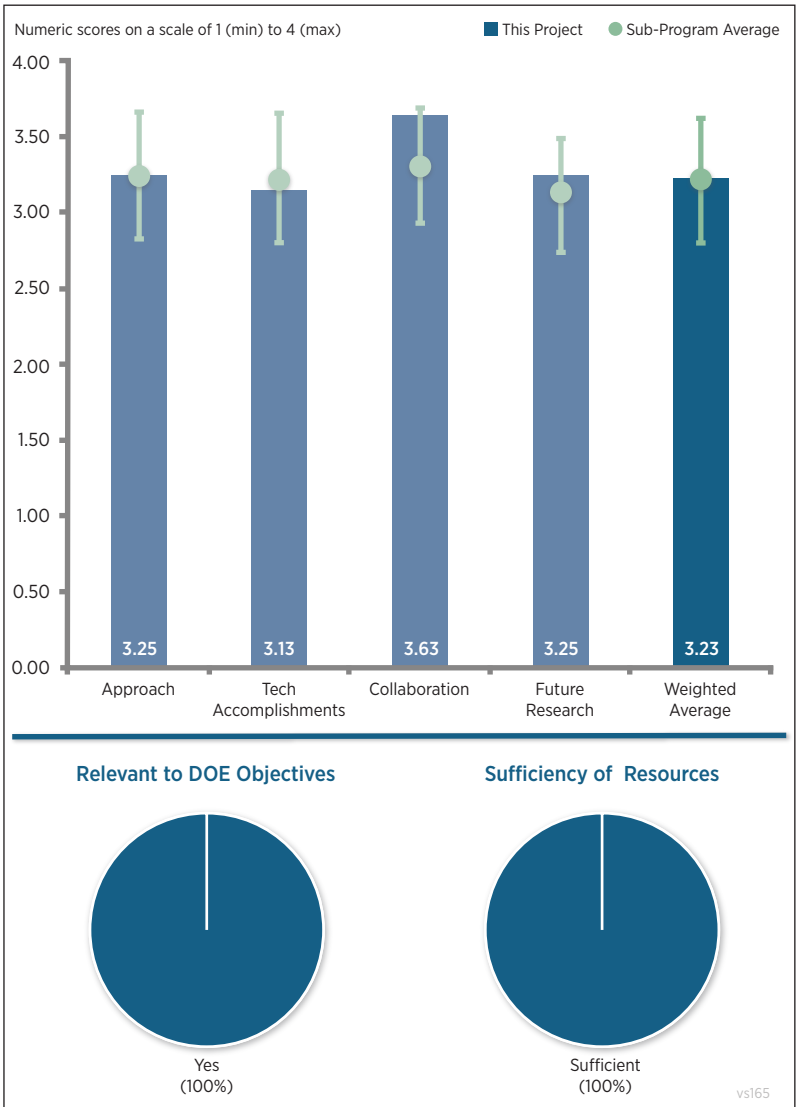

Figure 1-28 – Design and Implementation of a Thermal Load Reduction System in a Hyundai PHEV: Cory Kreutzer (National Renewable Energy Laboratory) - Vehicle Systems

Reviewer 2:
The reviewer remarked that this is interesting work, but added that the old barrier that does not appear to be addressed or referenced is a cost benefit to the customer. In the reviewer's experience, the fuel savings-to-insulation and heated surfaces initial cost does have a payback to the customer.

Reviewer 3:
The reviewer remarked that this project has a significantly compelling value proposition in seeking to increase grid-connected electric drive vehicle (EDV) range by 20% during operation of the climate control system over the standard vehicle configuration. The reviewer added that it follows a classic project approach with Phase One consisting of technology down-selection, specification, and development supported by modelling and analysis and evaluation. The reviewer explained that a broad range of technologies are considered including insulation, climate control seating, grid-connected preconditioning, and advanced vehicle shell approaches. Phase Two consists of technology/vehicle integration, testing, and validation. The reviewer concluded that there does not seem to be any significant omissions nor deficiencies in the project approac

However, the reviewer suggested that it is worth considering whether future projects similar to this should consider a somewhat different or more truncated approach. For example, there is a very strong tendency for advanced thermal control technologies (as well as other vehicular technologies) to be successfully demonstrated in prototype or production vehicles but frequently never reach the production line. This can be due to a myriad of commercial/business reasons from cost, to lack of compatibility with a changing vehicle system environment, consumer acceptability, and others.

The reviewer offered that it may be worth considering an approach that focuses much harder on extensive cost analyses for technology down-selection in the early phases of the project with heavy OEM input. Additionally, the project could be truncated to end after Phase One with a portfolio of potentially viable technologies merely tested and validated via simulation and bench top testing. In this way, the reviewer summarized, OEMs would have a broad portfolio of viable technologies from which to choose and further investigate if so desired. This would potentially lower project costs and offer more flexibility on the OEM side to account for inevitable vehicle system and commercialization vagaries as time progresses.

Reviewer 4:

The reviewer summarized that the project aims to evaluate the impact of different thermal load reduction technologies on the energy consumption of HVAC systems. The general research strategy is gathering available thermal load reduction technologies and down-selecting them by evaluating their individual impact. In the meantime, a predictive model is developed and validated by test data. The reviewer characterized this approach as typical and appropriate. The reviewer offered that one of the biggest barriers is OEMs' concern of the increased cost, and suggested that some analysis on the increased cost and payback period could be added to the project.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:

The reviewer cited a solid list of accomplishments that have been achieved including successful winter baseline testing demonstrating a strong correlation between vehicles at varying environmental conditions; insulation which demonstrates a 9.6% improvement at steady state (10.6% penalty in warm-up); and heated surfaces which show a 29-59% improvement in steady state heating with only a 2% penalty during warm-up. The reviewer pointed out that CoolCalc cabin modeling has been developed and validated for the Hyundai Sonata showing correlation within 3.6% to experimental data and that additional HVAC and detailed cabin modeling is in progress. The accomplishments the reviewer found most appealing, though, is the down-selection process established for meteorological data based on vehicle registrations because this helps simplify and focus the process in support of the nation-wide analysis.

The reviewer suggested it would be beneficial if a better understanding was provided of the level of efficienc improvement over the typical driving cycle (as just opposed to at-warm-up and steady state) and identification of the not so obvious customer/commercial barriers to potential implementation of these technologies.

Reviewer 2:

The reviewer noted that the presenter referenced delivering an "OEM Quality System" in his initial verbal framing of the project, but the project material never really discussed any barriers to a production quality system.

The reviewer commented that the energy savings look to be substantial and measurable and this reviewer looks forward to see that balance of energy saved from these driving conditions balanced against all driving.

Reviewer 3:

The reviewer observed that on Slide 12, the results for the transient warm-up showing a 10.6% penalty needs to be clarified. The reviewer explained that because any insulation is better than no insulation, the expectation is that there would be a decrease in energy input with added insulation, unless of course, the energy is coming in from the outside.

Reviewer 4:
The reviewer commented that the project started in FY 2015 and 40% of the work has been done, but from the presentation, it seems only the technologies of cabin insulation and heated surface have been tested. The reviewer asked if this means all the other technologies have reached a no-go decision.

The reviewer claimed that the impact of the insulation to the transient warm-up has some doubt, adding that the thermal capacity of the added insulation material should not have such a big effect. As the presenter mentioned, this part needs further investigation.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer characterized the NREL team has having a strong list of partners and seemingly well positioned to collaborate and coordinate appropriately. The reviewer observed that all the major areas of the project have another sub-tier industry partner, including at the OEM level and with regards to specific technology area development. The reviewer concluded there are no significant gaps with regards to project partners

Reviewer 2:
The reviewer remarked that there appears to be synergy between this project and two other projects in particular VS155 and VS134. The reviewer presumes this synergy is being exploited, but because there was no mention of it, the reviewer wanted to mention it here just to be sure.

Reviewer 3:
The reviewer stated that OEM partnership will help drive research to production use and that the tie-in with the Vehicle Systems Analysis Technical Team seem to have the program framed properly. The suppliers of the surface heated parts and insulation appear to be properly engaged.

Reviewer 4:
The reviewer indicated that this project has OEM and suppliers involved and the contribution of these institutions are clearly listed.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer praised the proposed future work for Phase One and Phase Two as seemingly comprehensive and logically sequenced, adding that there do not appear to be any major deficiencies. The reviewer remarked it would be useful though to have a clear definition of what criteria are being used to determine the go/ no-go technology milestone evaluation at the end of Phase One. Additionally, the reviewer suggested it may be worth considering a very minimal national-level analysis as this is predicated on a specific set of technologies penetrating a set number of vehicles over a given time frame, which is highly subjective and largely predicated on conjecture.

Reviewer 2:
The reviewer noted that the presenter mentioned during questioning that the tradeoff to mass and parasitic electrical loading for 100% of driving is balanced against the large savings in this subset of driving, but the current material did not show or discuss that overall balance. The reviewer said the presenter mentioned that it will be part of the final conclusions and the reviewer looks forward to seeing those results. Additionally, the reviewer remarked it would also be interesting to see if, as part of this testing, the project team identifies any production barriers to the surface heating of the new proposed surfaces not currently in production.

Reviewer 3:
The reviewer indicated a national level analyses that needs to be performed have a large degree of uncertainty associated with them, and that it is not clear that the chosen approach can provide the required level of confidence

Reviewer 4:
The reviewer cautioned that based on the listed future work, it seems there are still a lot to do. The reviewer is also unsure whether any other thermal load reduction technologies will be evaluated or only the two presented at this meeting will be considered for integration.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer noted that climate uses a measurable amount of fuel energy and that reducing the need to use energy to heat and cool the vehicle occupants will reduce petroleum use.

Reviewer 2:
The reviewer observed that significantly reduced driving ranges of EDVs in adverse weather (cold and hot) conditions is a major barrier to the widespread marketability of EDVs. The reviewer explained that if thermal load/climate control technologies achieving a 20% increase in vehicle range can be implemented commercially, it will go a long way to increasing the broad consumer acceptance of these vehicles.

Reviewer 3:
The reviewer stated that thermal load reduction is important for energy saving of HVAC systems and that this is one way to extend the EV driving range.

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

Reviewer 1:
There reviewer indicated there are sufficient resources both financially and from a corporate qualifications a facilities standpoint to conduct the project within the defined timeframe

Reviewer 2:
The reviewer said that it seems the budget is sufficient for the project

EV Everywhere Charging Infrastructure Roadmap: Donald Karner (Electric Applications Incorporated) - vs172

Presenter
Tom Garetson, Electric Applications Incorporated

Reviewer Sample Size
A total of five reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer characterized the project approach as a reasoned, rational one based upon evaluation of available data/studies, as well as input from stakeholders (i.e., users, manufacturers, etc.) and concluded that the approach could be seen as solid, if not necessarily innovative or novel. However, the reviewer added that the interesting part of the approach was really the input from stakeholders, and that it was unclear how much of this information was used for this analysis. The reviewer indicated the project used some interesting definitions to address specific elements of the analysis, including intra-urban charging, inter-urban charging, and different phases (early, transitional, and mature). These allowed the project to coalesce some ideas that may have been less than clear in some other studies.

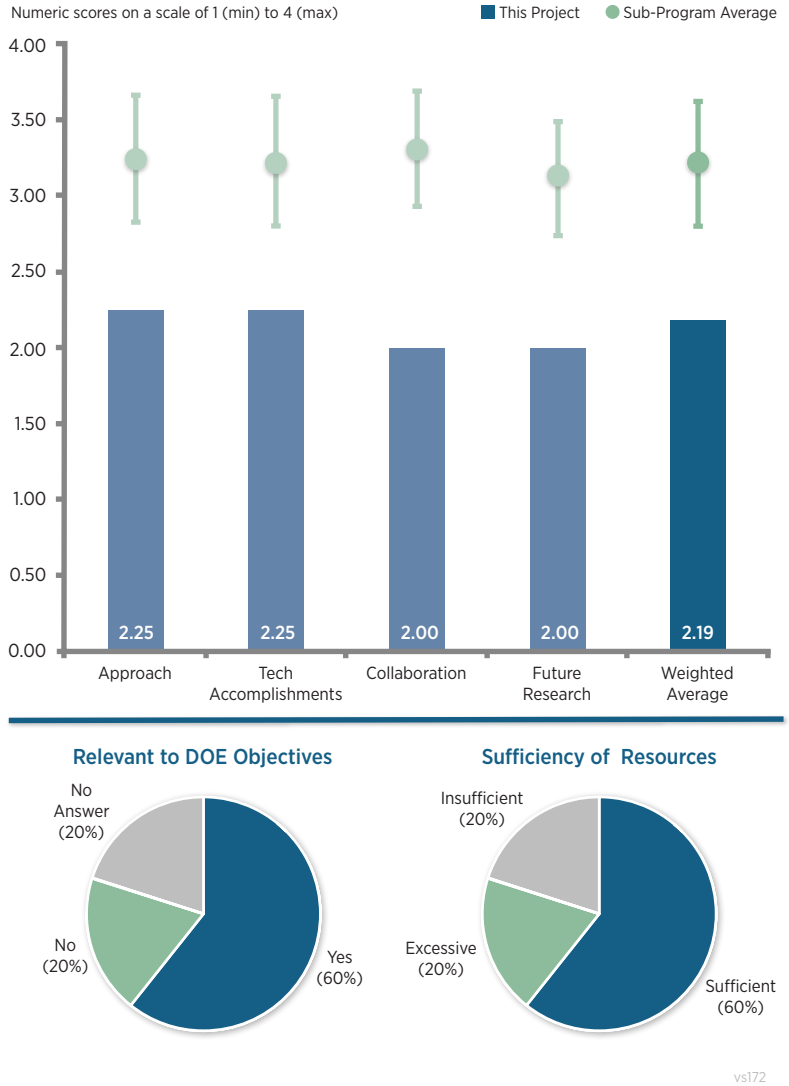

Figure 1-29 – EV Everywhere Charging Infrastructure Roadmap: Donald Karner (Electric Applications Incorporated) - Vehicle Systems

Reviewer 2:
The reviewer stated that the goal of the current project is to lay out the EV Everywhere charging infrastructure roadmap but noted that there are no technical barriers to complete the roadmap. The reviewer explained that the project team takes four approaches to identify and prioritize the next steps for PEV charging infrastructure: analyze DOE infrastructure studies; apply experience of the authors; use EV project data; and gather input from PEV industry leaders from OEMs, electric vehicle service providers, electric utilities, government, and PEV drivers. The reviewer concluded that the approach is generally effective considering it is only a one-year project, then commenting that the team could gather input not only from PEV drivers but also gasoline vehicle drivers who may have concerns and viewpoints that PEV drivers do not have.

Reviewer 3:
The reviewer indicated that it is not clear that this work can significantly inform any future decisions about build out of charging infrastructure or the best regional deployment of PEVs or all-electric vehicles.

Reviewer 4:
The reviewer noted that the approach was stated to be specified but this is not a roadmap in any way that this reviewer understands a roadmap, explaining that the concept of a roadmap in a technical realm needs to include projections of outcomes based on different scenarios and be based on the future that is not predetermined. What was reported here was anecdotal information that relates to past scenarios. The reviewer pointed out that the presenters stated that the approach was prescribed by those that sponsored the project, and if that was the case, the mistake was with them rather than the project operatives. Nonetheless, the reviewer concluded, the project does not result in a roadmap to any future set of conditions, which is quite unfortunate because such a roadmap is needed to support and promote adoption of EVs [DOE Program Clarification: To clarify the project's objective and scope, the investigators are identifying and prioritizing EV charging infrastructure actions that support an EV Everywhere objective, specificall , that charging infrastructure should promote PEV adoption and increase electric miles driven without compromising the reliability or performance of the electric grid. The approach is to identify and prioritize the next steps for PEV charging infrastructure, including analyzing DOE infrastructure studies; applying the investigators' own experience; evaluating EV Project data; and seeking input from PEV industry leaders from OEMs, EV service providers, utilities, government, and PEV drivers.].

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer pointed out that the project appears to have largely confirmed the expectations that have been identified many other places, namel , that the vast majority of PEV charging is done at home, with most of the remainder done at workplaces. Therefore, only a small amount of charging would need to be done publicly. The reviewer noted that the team's findings were likely a bit higher than previously postulated (85% home, 13% workplace), but likely not substantially different. Nevertheless, the reviewer characterized the project as providing some additional, perhaps more formal, analysis supporting these conclusions.

The reviewer concluded that the results presented appeared rational, although not that much detail was provided. The reviewer expressed the hope that the final report will provide more, noting in particular that very little of the input directly from stakeholders was clearly identified and presented. As indicated above, this was the part that would have set this project apart perhaps from a simple literature search. Without this information presented, the reviewer described the accomplishments as less than impressive.

Reviewer 2:
The reviewer commented that details of laying out the roadmap may have been technically met, but there is a lack of details needed for implementation.

Reviewer 3:
The reviewer observed that it seems the project is almost done at more than 90% complete, and that there were not many important findings based on the presentation. The reviewer is looking forward to seeing a more detailed report.

Reviewer 4:
The reviewer remarked that because this is a listing of anecdotal information rather than a roadmap, there was little, if any, technical progress. The reviewer noted that in questioning, the project participants have agreed to send the draft final report for review to some of the reviewers. The reviewer looked forward to seeing it and hoped that it includes some data or scenario-based roadmapping methodologies.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that it is great to see the program has collaboration between a national laboratory and industry with input from PEV drivers.

Reviewer 2:
The reviewer remarked that there seems to be very little collaboration on this project to assess the significant data and research going on in this field, and that the presenter instead seems to rely significantly on personal experience Little data was presented to justify recommendations.

Reviewer 3:
The reviewer noted that the project team worked with INL as well as representatives from industry, utilities, service providers, and users, adding that at least the presentation indicated that the project team contacted stakeholders. However, with none of the stakeholders' input clearly identified, the reviewer stated that it is hard to say what the level of collaboration on this was.

The reviewer highlighted as a glaring hole was that there was no mention of the project explicitly coordinating with Clean Cities. The reviewer pointed out that only a few years ago, Clean Cities awarded 16 EV Community Readiness Projects around the country, and the results of what these groups found, and the documents and solutions they developed, were very close ties to the future research needs identified in the presentation. The reviewer further observed that the Center for Climate and Energy Solutions prepared a lessons learned report for Clean Cities bringing together the results of the 16 projects and stipulated that this should have been a mandatory inclusion for evaluation within this project, but no mention of it was made. The reviewer summarized that what the project was left with was something that appeared to solely be a literature search done somewhat in a vacuum.

Reviewer 4:
The reviewer commented that there were many inputs that would have to have been investigated to determine the infrastructure needs of a future high level adoption of EVs, but that because none of those were investigated, not much collaboration existed. Hopefully, the reviewer said, something different will be seen when the report is drafted for evaluation.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer stated that almost all the investigation has been done and that the remaining future work is final editing and incorporating reviewer comments into the roadmap document.

Reviewer 2:
The reviewer indicated that no future efforts for detailing a roadmap were presented but only high-level findings of the study.

Reviewer 3:
The reviewer said that because project is 90% complete and ending at the end of the FY, with largely only final editing and input compilation remaining, therefore the score was left blank.

Reviewer 4:
The reviewer noted that the base work has been completed and a report is in draft, but that because what was presented was not what was described in the objectives, the lack of future work is a major shortcoming.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer remarked that limited charging infrastructure is one of the barriers to increase the number of electric

vehicle drivers and that development of a charging infrastructure roadmap is helpful to replace petroleum vehicles with PEV/EVs.

Reviewer 2:
The reviewer replied yes, this project ties to (and obviously supports) EV Everywhere activities and that the project has been focused on identifying and prioritizing EVSE actions to support greater use of EV technologies. However, the reviewer said the concern is with its approach and implementation.

Reviewer 3:
The reviewer stated that it is an obvious DOE priority to develop a roadmap for EV charging infrastructure build out, but that execution of this study lacked detailed data to back the conclusions.

Reviewer 4:
The reviewer commented that a well-conceived roadmap for EV infrastructure does need to be developed; however, this work does not satisfy that need.

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

Reviewer 1:
The reviewer stated that it seems that $150,000 is sufficient to conduct an investigation of and lay out a roadmap for the charging infrastructure.

Reviewer 2:
The reviewer said it is unclear if the lack of funding prevented the development of a more extensive roadmapping process.

Reviewer 3:
The reviewer stipulated that the project needed to have more and different resources from a variety of stakeholders to answer the question of what types of EV infrastructure were needed for a future of high volume EV penetration and concluding that a true roadmapping effort needs to be conducted.

Reviewer 4:
The reviewer remarked that to be honest, based upon what was presented, the funding appears excessive. As a caveat, the reviewer said assuming that a number of interviews with stakeholders took place, and that this input will be clearly identified and incorporated into the final report, then it may be sufficient, but based upon what w presented, this seems high.

Energy Impact of Connected and Automated Vehicles: Huei Peng (University of Michigan) - vs173

Presenter
Huei Peng, University of Michigan

Reviewer Sample Size
A total of five reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer described the project approach as crisply presented and significantly detailed with extensive milestones and go/no-go decision points identified over a define three-year project schedule. The reviewer said that there are five major tasks distributed amongst the three principal project participants: University of Michigan (UM), ANL, and INL. The reviewer explained that the approach leverages a significant amount of existing expertise, fleet operations (and drivers), and data sets to extend the funding mileage for the project, adding that there is a clear final outcome, specifical , the establishment of a portfolio of tools and test platforms for the evaluation of the energy impact of clean air vehicles (CAVs).

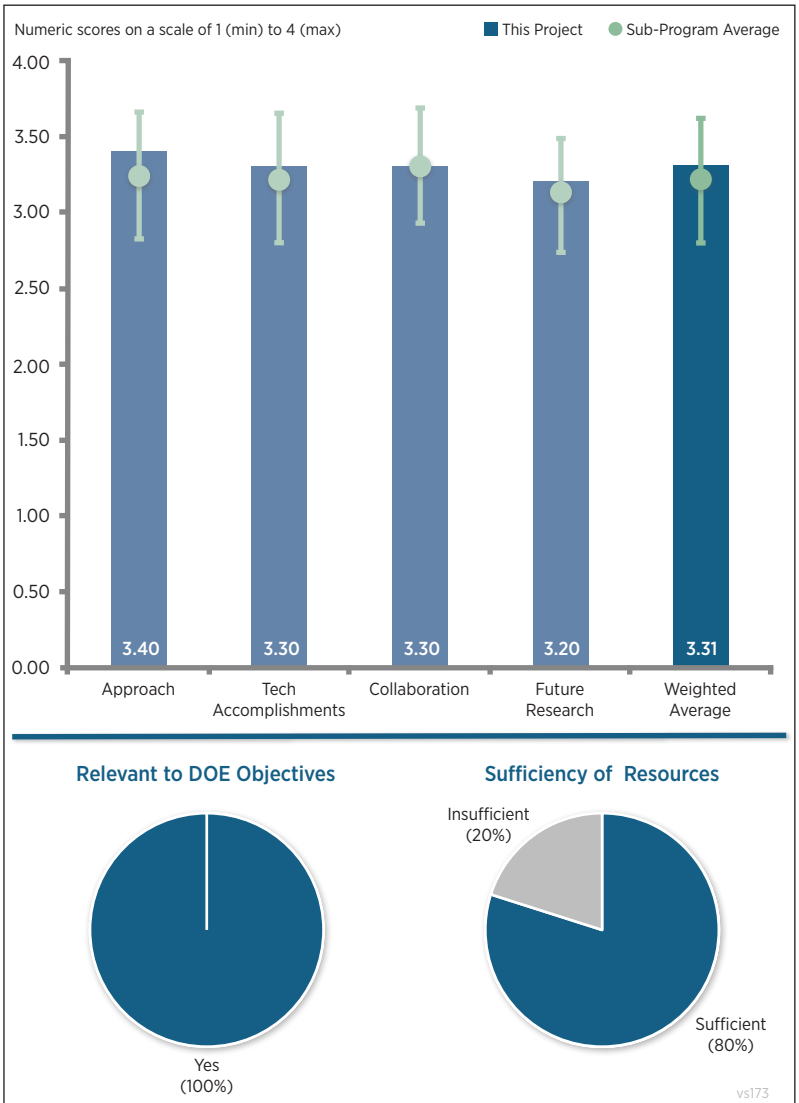

Figure 1-30 – Energy Impact of Connected and Automated Vehicles: Huei Peng (University of Michigan) - Vehicle Systems

The reviewer cautioned that a continuing challenge will be to appropriately frame and bound the overall project effort given it is breaking significant new ground and contains a lot of previously undefined or amorphous element which are likely to evolve over time.

Reviewer 2:
The reviewer stated that this project has a completely new research topic that aims to develop a model to study the energy impact of connected and automated vehicles at a large scale. The reviewer characterized the approach and strategy as sound but added that the work looks challenging because many human factors are involved, e.g., recruiting and training volunteer drivers, and effect of user behavior.

Reviewer 3:
The reviewer remarked that based on the presenter's reference to signal phase and timing data, the approach

appears to leverage extensive previous work by the U.S. Department of Transportation and numerous standards organizations that have established physical, functional, and data models as part of the connected vehicle reference implementation architecture. The reviewer characterized the project as having a good plan to collect real-world data to inform a baseline representation of vehicle energy usage in Ann Arbor, Michigan.

The reviewer suggested one idea that may improve the project approach would be to add a stakeholder review panel that would review the plans for simulation experiments, clarifying that this stakeholder review panel should include technical experts from industry, government, and standards organizations. The guidance that would be provided by the stakeholder review panel has the potential to increase the relevancy and value of the project's results.

Reviewer 4:

The reviewer described a generally sound approach on a challenging set of problems involving modeling of multiple fuzzy (behavioral) factors. The reviewer added that the choice of Ann Arbor is a convenient and appropriate starting-point, but that the team will need to take care to avoid sweeping national energy-use conclusions until more diverse demographic data-points can be added.

Reviewer 5:

The reviewer observed very interesting and relevant research. This person further noted that the project is to remain focused on small tasks as this could become so large in scope that it becomes an unmanageable amount of information and tries to answer too many questions that it is not designed to answer. The reviewer indicated that the presentation material did not clarify “driver behaviors.”

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:

The reviewer said that given the recent start of the project (Fall 2015), there has been in general steady progress on all fronts. The reviewer described as an especially attractive approach for the presentation the clear identification of the specific challenge(s) under each accomplishment area followed by assumptions and proposed solution pathways, adding that this is an effective way to address project challenges and present the approach to reviewers. The reviewer described ongoing activities and accomplishments to include a comprehensive variety of modeling/simulation, testing, device and software development, field experiments and data collection, and human behavior studies. The reviewer remarked that there is a significant element of uniqueness to many of these activities that cover a lot of ground.

Reviewer 2:

The reviewer stated there has been impressive progress and milestone accomplishment for less than a year into the project.

Reviewer 3:

The reviewer noted that the project has been going for less a year and is making progress as planned.

Reviewer 4:

The reviewer concluded that at 10% in to the project, it is too difficult to judge accomplishments and process, but added that it looks like the set-up to obtain the necessary data are in place and the scope is under control.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

The reviewer remarked that there is a strong and appropriate project team that includes UM, ANL, and INL, and other collaborators such as the University of Michigan Transportation Research Institute (UMTRI)/Michigan Mobility Transformation Center (MTC) (leveraging their connected fleet), Danlaw and Cohda Wireless (data loggers and dedicated short range communications, and the EPA for broad consultation on key signals to collect, model inputs, and CAV functions. The reviewer observed that the team has already met twice with EPA and added

that this seems to be significantly broad team well-positioned to address the project challenges, with no glaring partner deficiencies identifie

Reviewer 2:
The reviewer observed that a lot of collaboration is necessary for this project to move forward and that it seems there have been many parties involved (e.g., national laboratories, universities, suppliers, government, volunteer drivers, etc.).

Reviewer 3:
The reviewer stated that involvement on INL and ANL with UM is appropriate. The reviewer added that at some point in time there may be a need to involve an OEM to help discuss technical barriers that may be overlooked as a research project as it pertains to implementation of an end product.

Reviewer 4:
The reviewer noted that in the Q&A session, the ANL collaborator spoke about the new DOE SMART Mobility initiative, which was helpful and should be elaborated in future reviews. The reviewer also recommended reaching out to the Unifying Control and Verification of Cybe -Physical Systems (UnCoVerCPS) project sponsored by the European Commission with its ongoing, overlapping research with emphasis on autonomous multi-vehicle cooperation, and provided the following address: http://cps-vo.org/group/UnCoVerCPS.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer commented that the proposed future work is sufficiently well outlined and detailed to understand future activities. Additionally, the reviewer said that broad barriers/challenges to the project are identified, including design of data logging equipment, recruiting of volunteer drivers, and mutual dependency of progress on test design and model development. This transparency helps provide reassurance that the project is being thoughtfully considered over the long term.

Reviewer 2:
The reviewer stated that as mentioned in the discussion, connected and automated vehicles have both the potential to save fuel and to overuse fuel. The reviewer suggested that this research should be able to describe those boundary conditions and help set a framework to begin algorithm development towards an end product. As the project progresses, the reviewer suggested that it would be good to see the steps of how to take or apply Ann Arbor to other regions. While Ann Arbor has a good variety of traffic conditions, the footprint is small and population density in relationship is large population basis. The reviewer wondered if those larger cities can reduce gridlock and benefit from this connected and automation, or whether their density is past a critical mass to have significan impact. Some description of barriers to production will be appropriate as the project gets closer to completion.

Reviewer 3:
The reviewer described it as a long list in the project's future plan. The reviewer is looking forward to seeing future accomplishments.

Reviewer 4:
The reviewer indicated the chief concern is that the plans seem somewhat rudimentary, academic, early stage, and possibly missing the bigger-picture context. For example, the presentation was unclear whether the research includes inter-vehicle cooperation, or drive-by-wire, other than simulated.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer remarked that this is a very relevant project given the potential energy and environmental benefits

of advances in the area of transportation as a system and CAVs/advanced vehicles While the potential magnitude of energy benefits (or possibly ene gy losses) is presently unclear, the reviewer surmised that there is a significant untapped opportunity here which needs to be explored in detail, adding that if successful, this project as outlined will enormously benefit the knowledge base in this regard and lay the foundation for further analyses and assessments.

Reviewer 2:
The reviewer stated that automated vehicles have a great impact on energy consumption looking from big picture.

Reviewer 3:
The reviewer observed the project looks to develop opportunities to reduce running losses for vehicles in operation, which would reduce petroleum consumption.

Reviewer 4:
The project will evaluate the potential for connected vehicles to reduce energy consumption which will result in displacement of petroleum consumption.

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

Reviewer 1:
The reviewer indicated that there are sufficient financial resources and project partner qualifications and facilities successfully achieve the project milestones and schedule as presented.

Reviewer 2:
The reviewer stated that so far it seems the budget and resource is sufficient to support the project

Reviewer 3:
The reviewer concluded that this project looks like it has a significantly la ge budget for a significantly la ge task.

Reviewer 4:
The reviewer cautioned that the main objective, if interpreted broadly as written in bullet two of Slide 4, is very ambitious and will require extensive leverage of time, budget, and effort beyond what is allocated here. The reviewer offered that writing this project's objective more tightly and specifically would be helpful

Methods to Measure, Predict, and Relate Friction, Wear, and Fuel Economy: Steve Gravante (Ricardo) - vs175

Presenter
Steve Gravante, Ricardo

Reviewer Sample Size
A total of six reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer praised the excellent overall work that has broad relevance to improving vehicle models.

Reviewer 2:
The reviewer explained that this project varies lubricants and coatings within an Isuzu 4H engine to achieve friction reduction, elaborating that the approach is an iterative one (model, test, revise model) to arrive at a best practice. The reviewer praised this as a truly scientific approach to meet the project objectives combining both modeling and empirical test data. The reviewer thinks this was a well thought out approach and, if successful, there will be a way to more accurately measure the friction between piston, skirt, and lining.

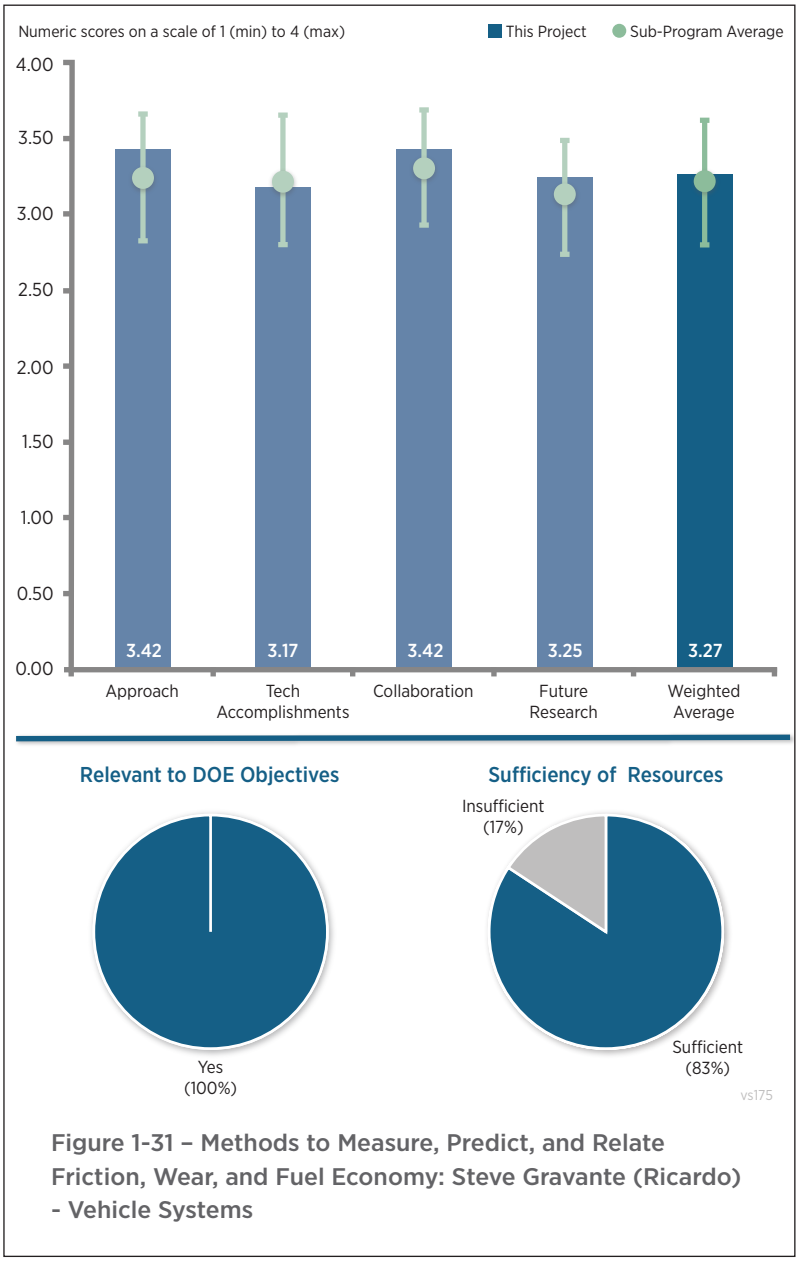

Figure 1-31 – Methods to Measure, Predict, and Relate Friction, Wear, and Fuel Economy: Steve Gravante (Ricardo) - Vehicle Systems

Reviewer 3:
The reviewer described the approach as good for developing an alternative test method and then validating it against the incumbent method.

Reviewer 4:
The reviewer characterized the objective as important and suitably ambitious. The reviewer noted the necessary focus on ring/skirt is a major source of risk of failure, because of the need to develop "an appropriate means to separate out the impact of lubricant changes on engine friction and fuel consumption realized through other components, e.g., main bearings, valve train, etc." However, the reviewer characterized as concerning that the approach to doing that was mentioned only vaguely and briefl , and even an understanding of the typical breakdown of the magnitudes of these components was not evident from the presentation.

A second major concern that the reviewer pointed out is the dependence of modeling on surface roughness. While the careful and methodical approach is good and was well summarized, the concern is that findings from one specific (Isuzu) engine and its peculiar surface manufacturing processes may not be broadly applicable; in other words, a more diverse experimental sample may be needed for robust conclusions.

Reviewer 5:

The reviewer explained that due to many factors, it has proven extremely difficult over the years to develop a means of predicting the impact of friction reduction technologies on engine fuel economy and wear. As a result, the progression and implementation of advanced lubricants into commercialized HD engines has proven extremely evolutionary. Nonetheless, the reviewer noted, the compelling reason to do so is strong because if successful, advanced tribological solutions could be applied to millions of vehicles, saving large amounts of fuel.

The reviewer further explained that due to the high cost of running dyno and fired engine tests, the project is looking to determine ways to understand key tribological factors that can be measured at the laboratory scale and accurately translate them to the engine-scale via simulation in order to predict the ultimate effect on fuel economy and engine wear and life. The reviewer said this project is incorporating a variety of approaches including extensive laboratory-scale testing, modeling and simulation, and dyno and fired engine tests in the hopes of achieving a means to accurately predict the impact of advanced lubricants, surface treatments, and materials.

The reviewer concluded that a detailed accounting of the approach along with comprehensive milestones for 2015/2016 is presented, providing a good understanding of the project scope and challenges. Additionally, a detailed listing of the critical assumptions and issues is provided which helps ground the audience to the realities of the task moving forward.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:

The reviewer remarked that overall, the progress is quite good on this effort. The reviewer added that there is some uncertainty in how to account for friction losses in bottom end system that could confound results and correlations and that more effort may be needed to assess these noise factors.

Reviewer 2:

The reviewer observed that the project appears to be progressing technically and that the deep dive into understanding the physics behind what the alternative test methods are saying is a good accomplishment. The reviewer indicated that programmatically, the project should report actual dates and percentage complete for milestones instead of just reporting to be on track. It is difficult to track progress without more information

Reviewer 3:

The reviewer characterized the project as having made good progress, noting it has picked 2 oils from 22 variants and tried them on the piston components. The reviewer noted that the RINGPAK modeling shows moderate correlation, clarifying that the project team can get the peaks but not the velocities. The reviewer surmised that the change in partners probably impacted the progress made.

Reviewer 4:

The reviewer stated that the project is somewhat behind schedule but is achieving a steady list of accomplishments, including successful down-selection of oil candidates which fulfills the first go/no-go requirement The reviewer also noted that extensive surface roughness characterization studies are being conducted to help find means to filter out or mitigate the e fects of noise and curvature to allow a reasonably accurate measurement of surface roughness. In addition, a RINGPAK model is being developed and sensitivity studies conducted looking at surface roughness, ring tension, oil film thickness, honing parameters asperity function, and so forth, and that resulting trends/observations from these studies are being assessed. The reviewer concluded that the presentation provides a reasonably modest assessment of some of the challenges and barriers moving forward.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer praised the project team as broad and deep with a major engine manufacturer, vehicle OEM, ANL, and two companies specializing in advanced lubricants and laboratory-scale testing, concluding that the team appears to be appropriately structured covering all the major requirements.

Reviewer 2:
The reviewer noted that this project is using ANL for the modeling and laboratory-scale testing and characterized that as great. The reviewer also thinks the project team was able to make a great recovery bringing on Isuzu when the main OEM pulled out of the project.

Reviewer 3:
The reviewer stated that this is a good team for modeling and testing, but added that there may be some benefit if academia were included in the effort as well.

Reviewer 4:
The reviewer replied there is good collaborations that supports the technical areas of this project.

Reviewer 5:
The reviewer replied it is an overall solid future plan for work.

Reviewer 6:
The reviewer referenced prior comments.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer stated that the PI showed a slide with the milestones for the project and the status of each and that they all appear on track, so the future work is a continuation of the effort funded. The reviewer concluded that this makes sense given project is in the second year of a three-year project and nothing in the findings indicates a reason to change course. The reviewer observed that some of the specifics are accelerated wear tests, test plans for motored, and fired engine friction tests

Reviewer 2:
The reviewer characterized as good the future research of validating the model through physical testing.
The reviewer suggested the project would benefit by expanding on the model to include non-power cylinder components (indicated as a challenge/barrier).

Reviewer 3:
The reviewer agreed that a fairly good accounting is made of next steps/future research, noting that these largely will focus on accelerated wear tests and development and execution of test plans for motored and fired engine friction tests. The reviewer suggested it would have been beneficial to have presented detailed milestones for 2017 as was done for 2015/2016.

Reviewer 4:
The reviewer replied that other components should have been included in the coating process to complete the test.

Reviewer 5:
The reviewer remarked that there were many unanswered questions, some of which were touched on in the live Q&A session including: constant-speed engine applications versus passenger vehicles with frequent cold starts; trade-offs between efficiency and durability; whether the oil-film hydrodynamics are important and, if so, wh these are not being studied; history effects and warm-up transient; and getting film temperature correct, noting that there was little discussion of hot versus cold day ambient effects.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer characterized this project as very relevant because the results could be applied to millions of vehicles in the HD sector and also potentially to the medium- and LD sectors as well.'

Reviewer 2:
The reviewer described this project as an enabler for quickly evaluating other technologies that may directly reduce fuel consumption and that the test methods being developed are expected to be a much quicker evaluation method then traditional engine testing.

Reviewer 3:
The reviewer noted that friction reduction is crucial to improving powertrain design for fuel economy improvement.

Reviewer 4:
The reviewer stated that this project works on reducing friction which equates to less losses and less fuel consumption.

Reviewer 5:
The reviewer replied that lower friction tools will help improve mpg.

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

Reviewer 1:
The reviewer thinks this project could have benefitted from more funds. There were several times during the presentation when the PI mentioned that work was out of scope, which led the reviewer to believe that the project team was unable to do the full suite of testing and modeling with the budget provided. The reviewer observed that the number of oils tested were down-selected and the number of components with coatings was fewer.

Reviewer 2:
The reviewer noted that the project is 20%+ cost shared and has strong industry participants that should have the expertise and facilities to potentially carry it out successfully. The reviewer concluded the project is sufficiently funded over its three-year duration.

Reviewer 3:
The reviewer stated that the budget is sufficient for this scope of work

Reviewer 4:
The reviewer replied that the project appears to have sufficient resources

Improved Tire Efficiency through Elastomeric Polymers Enhanced with Carbon-Based Nanostructured Materials: Georgios Polyzos (Oak Ridge National Laboratory) - vs176

Presenter
Georgios Polyzos, Oak Ridge National Laboratory

Reviewer Sample Size
A total of three reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer stated that the project's overall approach seems rational. The reviewer noted that the project is focused upon developing new materials with tailored properties, going down to almost a very elemental stage of tire design. The reviewer also noted the project team identified parallel paths to increase the chances of success, reducing risks associated with the limitations of restricting the approach to a single formulation. A key criterion for the project is cost-competitiveness, relying upon realistic manufacturing techniques.

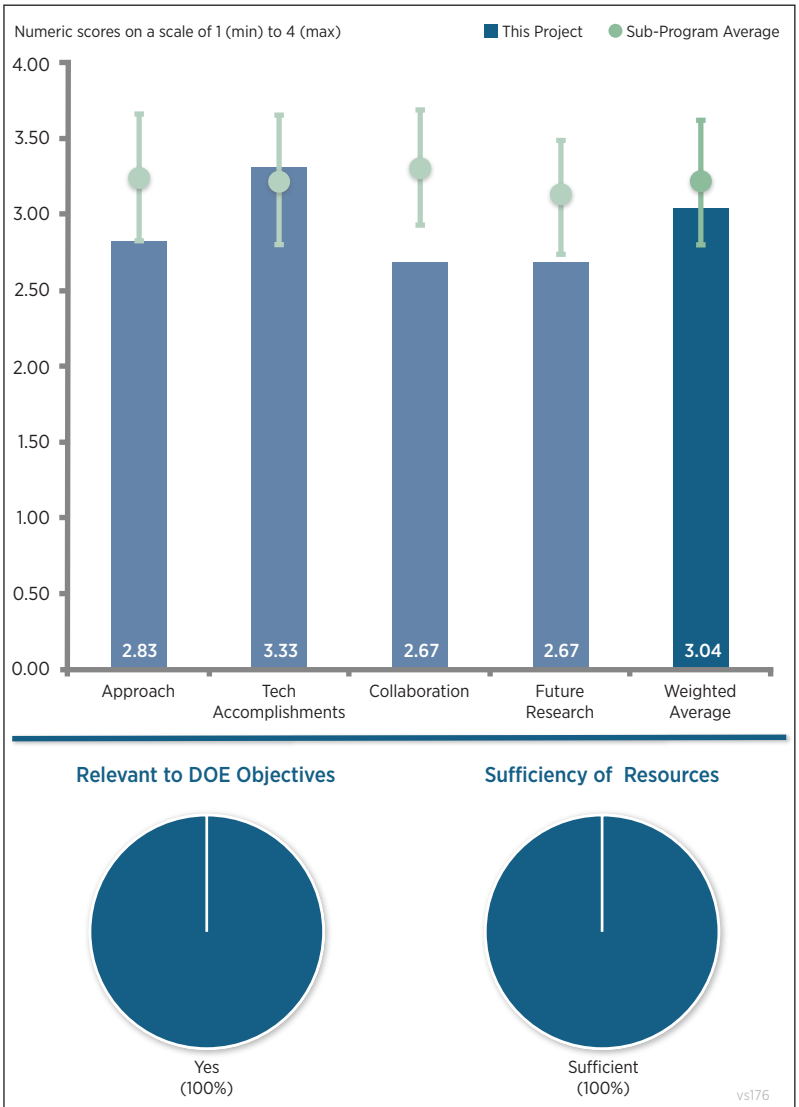

Figure 1-32 – Improved Tire Efficiency through Elastomeric Polymers Enhanced with Carbon-Based Nanostructured Materials: Georgios Polyzos (Oak Ridge National Laboratory) - Vehicle Systems

Reviewer 2:
The reviewer observed that no preliminary data or modeling work was presented to show that the approach taken would result in the claimed benefit of lower rolling resistance. The reviewer added, though, that it seems quite hopeful that scale up costs and needed durability and road grip targets could meet many OEM requirements.

Reviewer 3:
The reviewer indicated that the approach was not very well defined and that a description of the approach should be enhanced.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer noted that the project began in January 2016, so this presentation only includes the initial results of approximately 25% of the project but that it has already completed both of its scheduled milestones for this

period (first quarter of the project). The reviewer remarked that the results for exfoliated graphene do appear to be relatively dramatic. As for synthesizing silica nanofibers with diameters smaller than 100 nanometers (nm), the reviewer observed that the project achieved fibers with diameters in the 85- 10 nm size range and thus the average likely met the milestone, although there were some in the range above this level.

The reviewer concluded that given the recent start to this project however, these accomplishments have shown very rapid work and added that three milestones are scheduled for the second quarter of the project (during June 2016).

Reviewer 2:
The reviewer stated that the project appears on target to meet its agreed Phase One deliverables.

Reviewer 3:
The reviewer observed that the technical accomplishments milestones have been met already this year even though the project only started in January 2016.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that project team is coordinating closely with the industrial partner, but the agreements necessary are not yet in place to allow partner identification. Given the stage of activity of this project (materials formulation), the reviewer acknowledged it may be appropriate that there is not a large team of collaborators. However, the reviewer noted it is a bit surprising that there are no additional collaborators at all, such as perhaps a key fleet user or other o ganization to provide some level of additional/independent input. The reviewer also noted it was assumed that the industrial partner is a tire manufacturer. If it is not, and is instead another organization in the production/development chain (such as a materials supplier), the reviewer suggested then it may be appropriate to eventually move toward additional collaborators.

Reviewer 2:
The reviewer replied that the project indicates there is an industrial partner but the organization's name is not provided.

Reviewer 3:
The reviewer stated there is a lack of coordination to gain insight into the many OEM requirements and instead the focus seems to be fully on compounding and characterization of materials. The reviewer offered that a larger view could be taken by including industry.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer indicated that the project seems on track to meet its objectives as agreed by DOE.

Reviewer 2:
The reviewer remarked that ongoing work has been identified by listing the milestones to be met but that no discussion of future work in FY 2017 was provided.

Reviewer 3:
The reviewer commented that only a few elements of future research were identified, mostly those for completion this month. The reviewer concluded that while overall plan appears to be focused on moving toward testing rolling resistance by the end of the CY, the future plans appear a bit vague, at least according to what was presented.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer described the project's objective as improving tire efficiency to meet vehicle fuel consumption goals and that this is fully in line with DOE and VTO objectives. The reviewer explained that the project is using well-referenced estimates that a reduction of 25-30% in rolling resistance equates to a 4% improvement in fuel mileage, as well as California's estimate that 1.5-4.5% of gasoline use could be reduced if all replacement tires were low rolling resistance models. The reviewer also noted that an additional benefit of improving tire tear resistance is cited as resulting from this project.

Reviewer 2:
The reviewer stated that the project supports the DOE objective of petroleum displacement through improving fuel economy by reducing rolling resistance of tires.

Reviewer 3:
The reviewer observed that reducing rolling resistance will support improvements in vehicle fuel economy.

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

Reviewer 1:
The reviewer commented that the funding appears to be sufficient for the scope of the project

Reviewer 2:
The reviewer replied the project is on budget.

Reviewer 3:
The reviewer pointed out there was no indication given as to the sufficiency of the current level of funding, so it was assumed to be sufficient

VTO Vehicle to Building Integration Pathway: Richard Pratt (Pacific Northwest National Laboratory) - vs181

Presenter
Richard Pratt, Pacific Northwest National Laboratory

Reviewer Sample Size
A total of three reviewers evaluated this project.

Question 1: approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer praised the preparation of Use Cases and support of project VS183 as providing an excellent structured and integrated approach to this work.

Reviewer 2:
The reviewer remarked that the project is a worthy effort but seems somewhat broadly defined in terms of goals

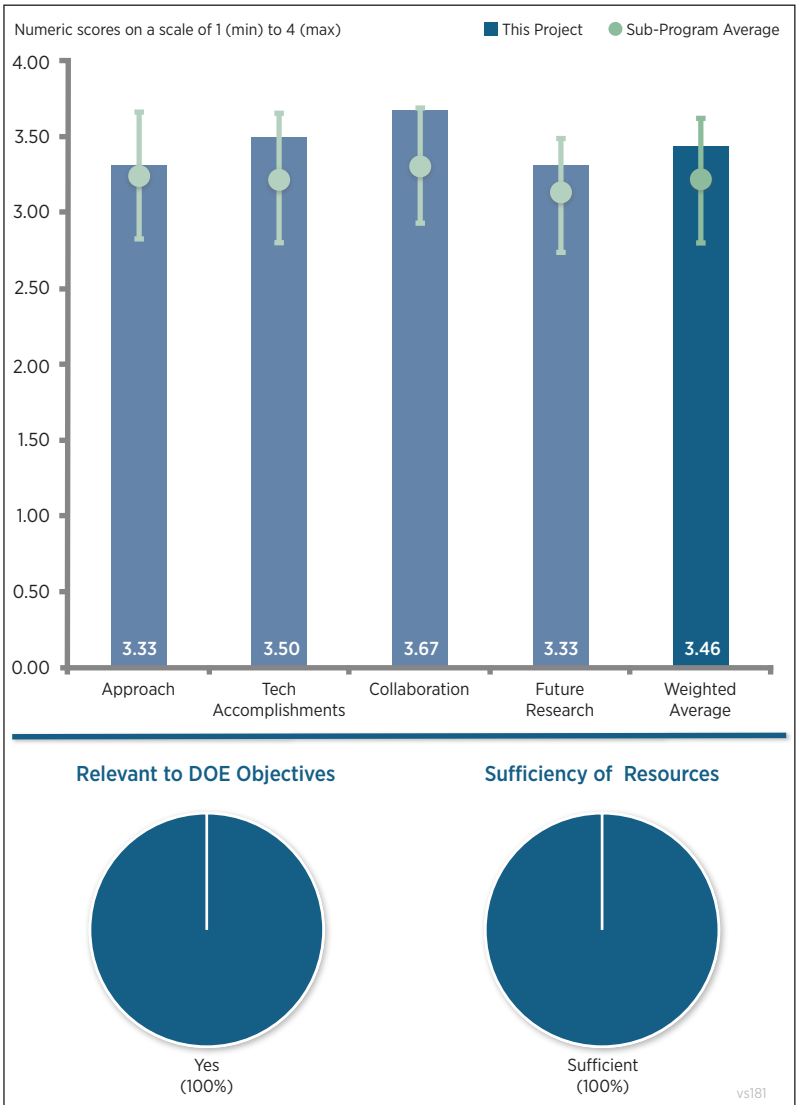

Figure 1-33 – VTO Vehicle to Building Integration Pathway: Richard Pratt (Pacific Northwest National Laboratory) - Vehicle Systems

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer replied there is a new start and that the anticipated October objective would be excellent progress.

Reviewer 2:
The reviewer commented it is early into the project; integration with the project VS183 has occurred; and an advisory group is being established.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer applauded the great integration with project VS183 and the cooperation across multiple laboratories. The reviewer also commented that the advisory group will provide excellent input from a wide variety of backgrounds.

Reviewer 2:
The reviewer observed that the primary stakeholders on the grid side are in place and confirmed that there is good communication with OEMs through the U.S. DRIVE GITT. The reviewer noted that the project is looking for additional stakeholders in EVSE and possibly additional OEM connections.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer evaluated as appropriate the proposed future work and the approach to executing, allowing for feedback from stakeholders.

Reviewer 2:
The reviewer indicated that the future work will quantify the cost and benefits of various vehicle-to-grid (V2G) Use Cases, thus providing a clear focus on where to apply resources in this area.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer replied that this work will satisfy both DOE EERE and DOE Office of Electricity Delivery and Energy Reliability (OE) objectives.

Reviewer 2:
The reviewer remarked that it promotes adoption of EV usage by better management of electrical energy supply and demand from various sources and sinks.

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

Reviewer 1:
The reviewer replied that there was no explicit detail but that the reviewers were told the project has strong backing.

VTO Systems Research Supporting Standards and Interoperability: John Smart (Idaho National Laboratory) - vs182

Presenter
John Smart, Idaho National Laboratory

Reviewer Sample Size
A total of four reviewers evaluated this project.

Question 1: approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer praised the excellent approach to this project, noting that while it is just beginning, the initial objectives are sound.

Reviewer 2:
The reviewer concurred that the approach and strategy identified by the project will be effective in overcoming barriers. The reviewer observed that this project is one of three projects that will demonstrate PEV charging as an integral part of the renewable electricity grid of the future. In addition, the reviewer stated that this project overlaps with other grid modernization laboratory consortium projects, which will aid in meeting DOE goals.

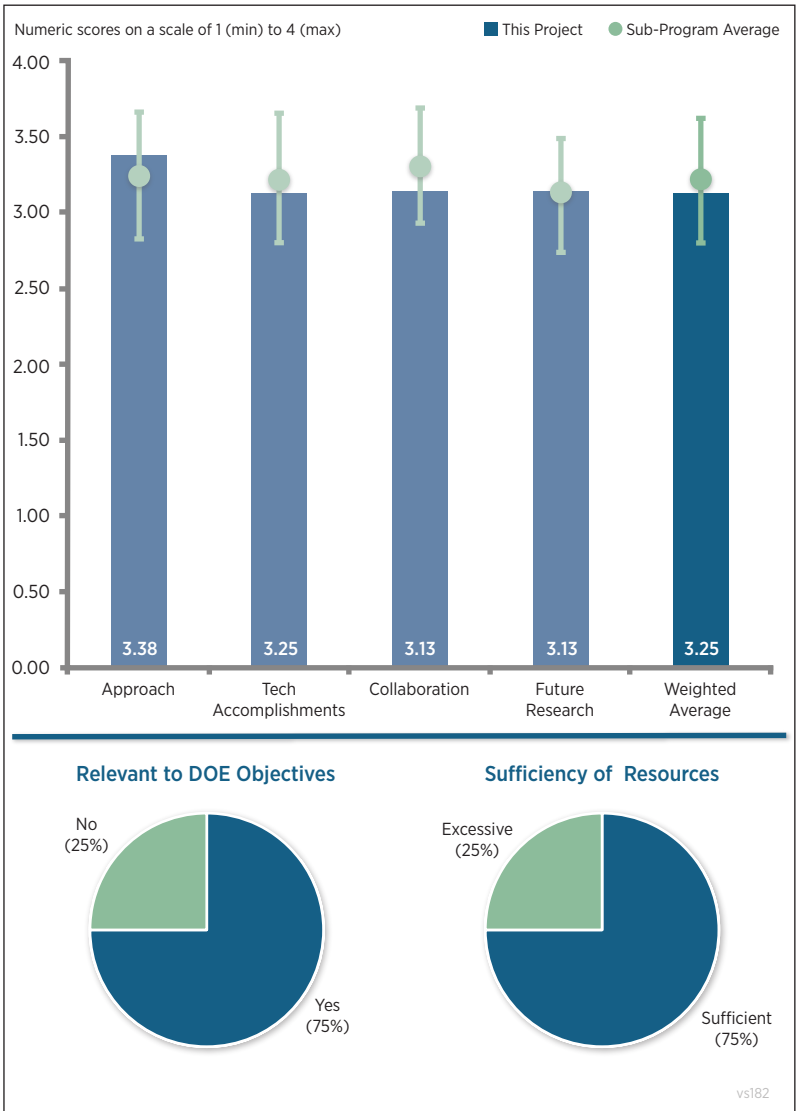

Figure 1-34 – VTO Systems Research Supporting Standards and Interoperability: John Smart (Idaho National Laboratory) - Vehicle Systems

Reviewer 3:
The reviewer remarked that emulating communications using hardware in the loop and performing dynamic real-time simulation seems like the best way to model these complex system interactions and help predict how integration of PEVs with the grid may take place.

Reviewer 4:
The reviewer criticized the approach of building hardware first to solve a standards issue in this area with many standards and configurations as an ine fective and expensive approach to the issue. The reviewer noted that the hardware-in-the-loop (HIL) system will come up with a single solution, and asked if it will apply to all of the potential variations. The reviewer said that the approach should have been preceded with a simulation that could be varied to cover widely varying applications followed by validation of one or two with the HIL route.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer thinks given the short time period since the start of the project that the progress on this effort is excellent.

Reviewer 2:
The reviewer remarked that even though the project only recently started in April 2016, there have been several accomplishments identified which indicates good progress thus far in the project

Reviewer 3:
The reviewer agreed that initial infrastructure and alignment efforts seem to be on track for a successful Phase One go/no-go decision.

Reviewer 4:
The reviewer stated that technically, the accomplishments are good if only looking at the project.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer applauded the project lead as having assembled an excellent set of partners including four additional national laboratories each with its own specific area of expertise. The reviewer also commented that the use of an Advisory Board consisting of energy companies, a U.S. DRIVE technical team and federal and state organizations will provide good guidance and review of the project.

Reviewer 2:
The reviewer characterized as excellent the collaboration between the laboratories, and added that it would be helpful to add more insight and feedback in a structured manner from utilities and grid operators.

Reviewer 3:
The reviewer stated that this is a highly collaborative project and the PI has the right people involved, adding that it is clear that the cooperation from the different laboratories will be there. However, the reviewer commented that it is not clear if sufficient incentive has been provided to the utility partners to have them as fully-engaged collaborators and suggesting it would be good to understand more about how decisions are going to be made in such a collaborative environment. The reviewer further remarked that the project is also linked to other laboratory projects, and thus it is important to align timelines and define success even if other laboratories projects fall behind

Reviewer 4:
The reviewer concluded that much more work could have been done here, adding that the project is much bigger than this is planned for.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer commented that the proposed future work in FY 2016, as well as the milestones identified to be accomplished in future years, will be effective in providing solutions to overcoming the specified barriers

Reviewer 2:
The reviewer replied that the initial plan is sound.

Reviewer 3:
The reviewer stated that this section is planned and well thought out but cautioned that it is still too soon in the project to understand if the planned research is appropriate.

Reviewer 4:
The reviewer said that the project should have a much bigger vision than it does, commenting that standards work for the utility industry is not effective with a single hardware set demonstration.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer characterized the project as relevant to the DOE objective of petroleum displacement through the overall objective of showing the feasibility of PEVs providing grid services and renewable energy integration at the electric utility distribution without negatively impacting PEV customer experience.

Reviewer 2:
The reviewer stated that the assessment of grid interoperability is a key piece to EV deployment.

Reviewer 3:
The reviewer remarked that understanding whether EVs can play in utility markets can assist with the market penetration of EVs. The challenge here is if the results will be useful to the grid community once they are available.

Reviewer 4:
The reviewer described the project as not well founded to reach the stated objectives, and suggested the approach should be reconsidered for a much bigger vision.

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

Reviewer 1:
The reviewer stated that funding seems to be sufficient to meet current objectives

Reviewer 2:
The reviewer indicated that resources appear to be adequate for the overall project but that it would be useful for the project lead to indicate what the funding allocation will be for each laboratory.

Reviewer 3:
The reviewer thinks the resources are good-to-high. The reviewer would have liked to have seen some of the funds going to the utilities if possible to give them more reason to be active participants in the project.

Reviewer 4:
The reviewer replied that this project should be reconstructed.

VTO Modeling and Controls Software Tools to Support V2G Integration: Samveg Saxena (Lawrence Berkeley National Laboratory) - vs183

Presenter
Samveg Saxena, Lawrence Berkeley National Laboratory

Reviewer Sample Size
A total of five reviewers evaluated this project.

Question 1: approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer praised the holistic approach to determining value as unique and will provide great insight into what makes sense to implement with V2G.

Reviewer 2:
The reviewer stated there are ambitious objectives with a detailed plan, adding that as a new start, it is very comprehensive.

Reviewer 3:
The reviewer said it is a well-documented approach and that the presentation shows the team is aware of significant challenges to the implementation of this approach. The reviewer remarked that the intent to effectively create a tool for use in evaluating feasibility seems a sensible approach for this simple concept with a complex application.

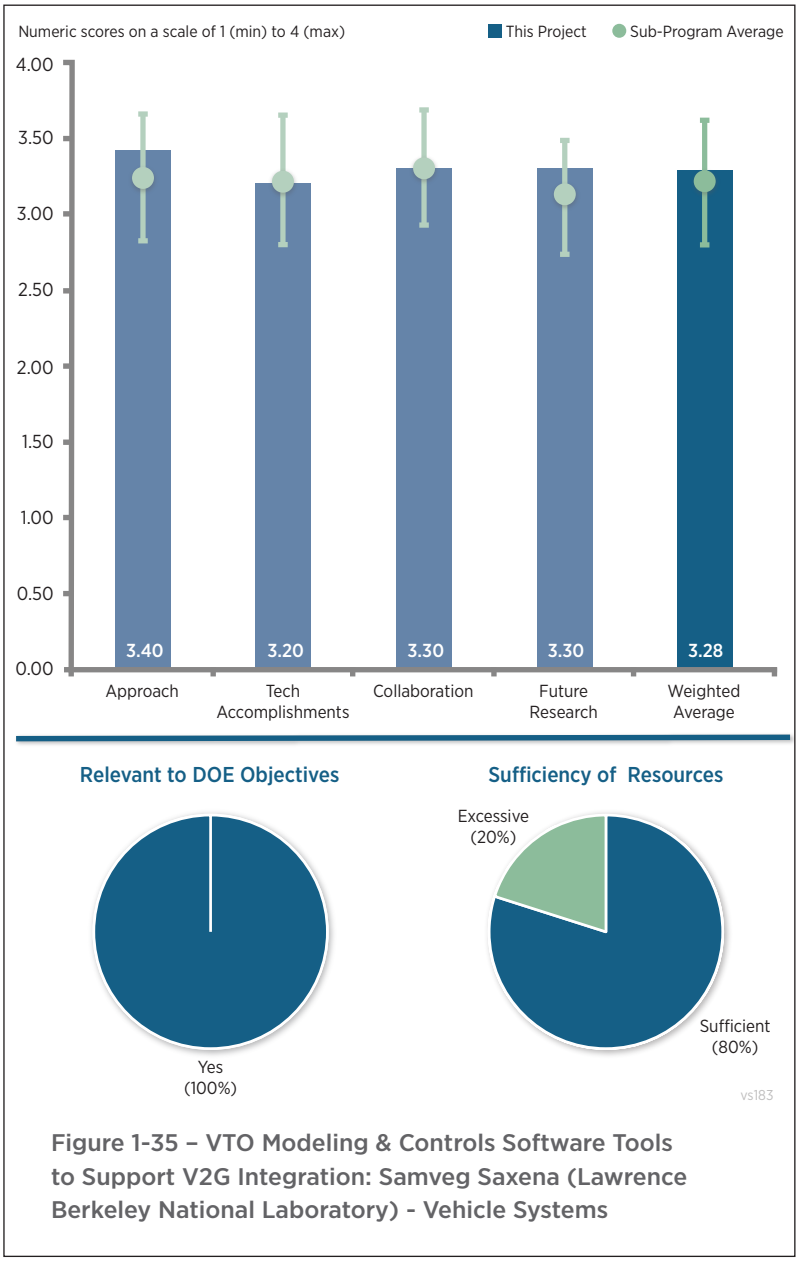

Figure 1-35 – VTO Modeling & Controls Software Tools to Support V2G Integration: Samveg Saxena (Lawrence Berkeley National Laboratory) - Vehicle Systems

Reviewer 4:
The reviewer replied that the proposed modeling and control tool will support V2G integration through considering various components such as battery calendar and life degradation, time of use, etc.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer noted the new start, and remarked that progress seems very good in terms of prior work to be leveraged and an explicit roadmap of deliverables.

Reviewer 2:
The reviewer stated that progress to-date has been to quantify possibilities, but implementation of the rest will provide the means to realize value from the modelling.

Reviewer 3:
The reviewer commented that while it is early in the project, a significant accomplishment already is the integration of multiple efforts to bring as much granularity to decision making as possible.

Reviewer 4:
The reviewer replied that it is just two months into the project and too early to confidently review progress

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer remarked that pulling multiple laboratories together with affiliated projects demonstrates excellent cooperation rather than competition for resources.

Reviewer 2:
The reviewer stated there is good collaboration between the California Independent System Operator (CAISO) and the California Energy Commission and noted that there are stakeholder advisors from automotive OEMs and EVSE suppliers.

Reviewer 3:
The reviewer commented that the project leverages other laboratories' work and is well connected with other projects.

Reviewer 4:
The reviewer replied that the multi-laboratory approach seems to be well supported. No named collaboration with electric utility(ies) might have been useful, but it may be unnecessary because this is a model. The reviewer expressed concern for effectively herding cats (when working with so many laboratories) that the objective is met in a timely manner.

Reviewer 5:
The reviewer recommended careful coordination with the large body of grid-side research by the DOE grid technical team and the results of the DOE Advanced Modeling Grid Research program for the period 2012-2016. The reviewer indicated that awareness of this foundation was not evident from the poster and cautioned that collaboration outside the VTO-managed EV working group seemed in need of strengthening.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer described the proposed work as ambitious and added that the tools being built should help various stakeholders to better answer the pressing questions around viability of V2G.

Reviewer 2:
The reviewer agreed that the future work will quantify the cost and benefits of various V2G Use Cases, providing a clear focus on where to apply resources in this area.

Reviewer 3:
The reviewer stated that it is early in the process, so that future research work is really work to be done on this new project. The reviewer added that results from this project may lead to future work being defined

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer replied that the project provides options for better understanding of EV impact on the electrical grid and vice versa.

Reviewer 2:
The reviewer stated that this supports objectives of both EERE and OE.

Reviewer 3:
The reviewer commented that the relevance is good, but that it is not a direct petroleum displacement benefit. Rather, the reviewer remarked, much of the benefit identified is in managing renewables and peak load

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

Reviewer 1:
The reviewer replied that the resources appear adequate.

Reviewer 2:
The reviewer stated that there appears to be significant e fort and sufficient funding available to support six laboratories but remarked that it could be clearer how coordination will be managed because an effective organization of the team and their respective responsibilities will be necessary to keep this project on track to deliver.

Reviewer 3:
The reviewer suggested that many compounding uncertainties involved in V2G integration are so large that a more cautious, incremental approach and budget may be worth considering. The reviewer added that a rush to optimize should be avoided as the EV market, battery, vehicle, internet of things, and grid capabilities continue to significantly evolve under commercial and regulatory pressures

VTO Diagnostic Security Modules for Electric Vehicle to Building Integration: Ken Rohde (Idaho National Laboratory) - vs184

Presenter
Barney Carlson, Idaho National Laboratory

Reviewer Sample Size
A total of two reviewers evaluated this project.

Question 1: approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer replied that the approach appears to be a logical step-by-step one that builds on previous steps and has appropriate go/no-go decision points.

Reviewer 2:
The reviewer stated that the approach to the project is good but added that the lack of OEM participation may be problematic in later phases.

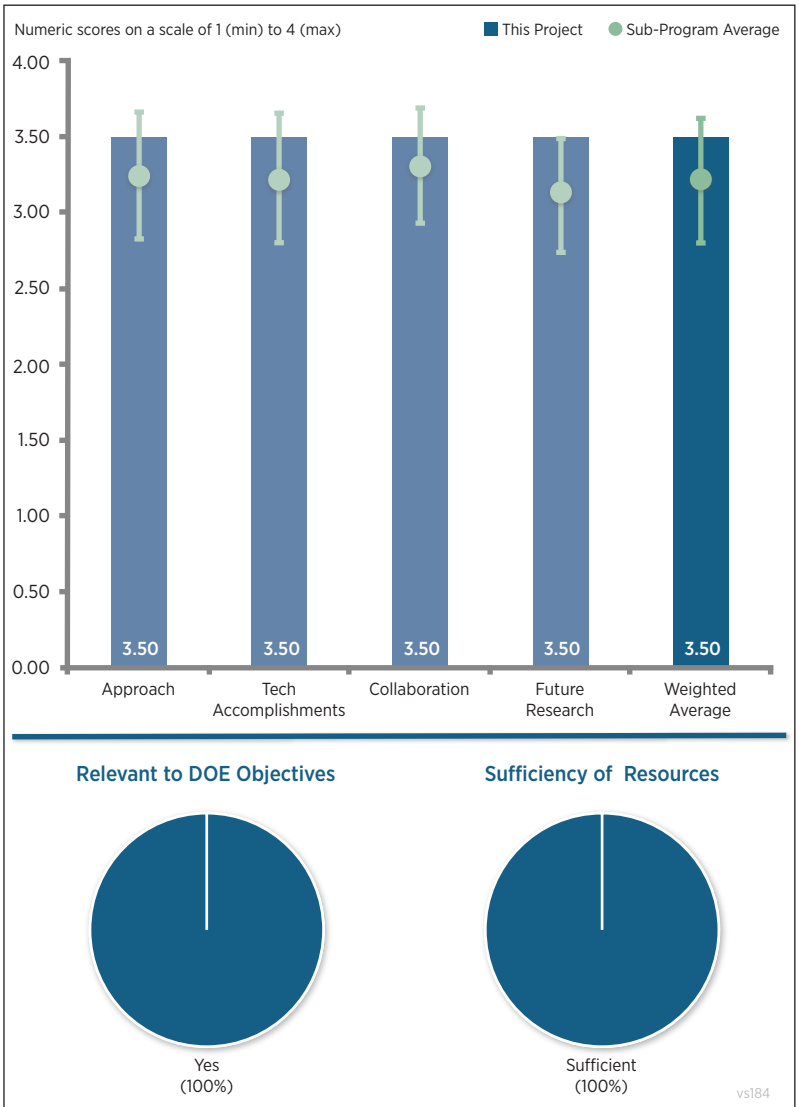

Figure 1-36 – VTO Diagnostic Security Modules for Electric Vehicle to Building Integration: Ken Rohde (Idaho National Laboratory) - Vehicle Systems

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer identified no issues in early phase of this project

Reviewer 2:
The reviewer stated it is very early in the project and progress is based on a sound plan and successful application for funding.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer characterized this as a project clearly based on collaboration, adding it should be especially productive by having partners from national laboratories, industry and academia.

Reviewer 2:
The reviewer remarked that what will be needed to ensure that the findings and results can be acted upon is broad industry collaboration through standards committees or other approaches for involvement of the ultimate implementers.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer replied there is a solid proposal for future work, and added that more industry involvement at later stages may be useful to inform findings and expected deployment of security countermeasures

Reviewer 2:
The reviewer stated that proposed future work is identified in approach

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer commented that security is a potential barrier to EV deployment and therefore this project is relevant to DOE objectives.

Reviewer 2:
The reviewer remarked that cybersecurity is an extraordinarily relevant area of study and a device is an unusual and interesting approach to addressing the concern.

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

Reviewer 1:
The reviewer responded that the initial requested budget seems to be consistent with meeting project goals.

Reviewer 2:
The reviewer stated that it is too early to know for sure, but there certainly does not appear to be a shortage of resources base on the list of collaborators.

Evaluation of Vehicle Technology Benefits on Real World Driving Cycles using Regional Transportation System Model: Aymeric Rousseau (Argonne National Laboratory) - vs185

Presenter
Ram Vijayagopal, Argonne National Laboratory

Reviewer Sample Size
A total of five reviewers evaluated this project.

Question 1: approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer praised the overall great approach for evaluating the benefits, but added that it would be good to see how the real-world cycles differ from standard cycles with some high-level metrics such as average speed, velocity ratio, and characteristic acceleration (reviewer suggested looking up the Ph.D. work of Andrew Simpson). The reviewer also added that it would be useful to see what technology benefits 2020 has over 2010 and asking what is causing consumption to improve.

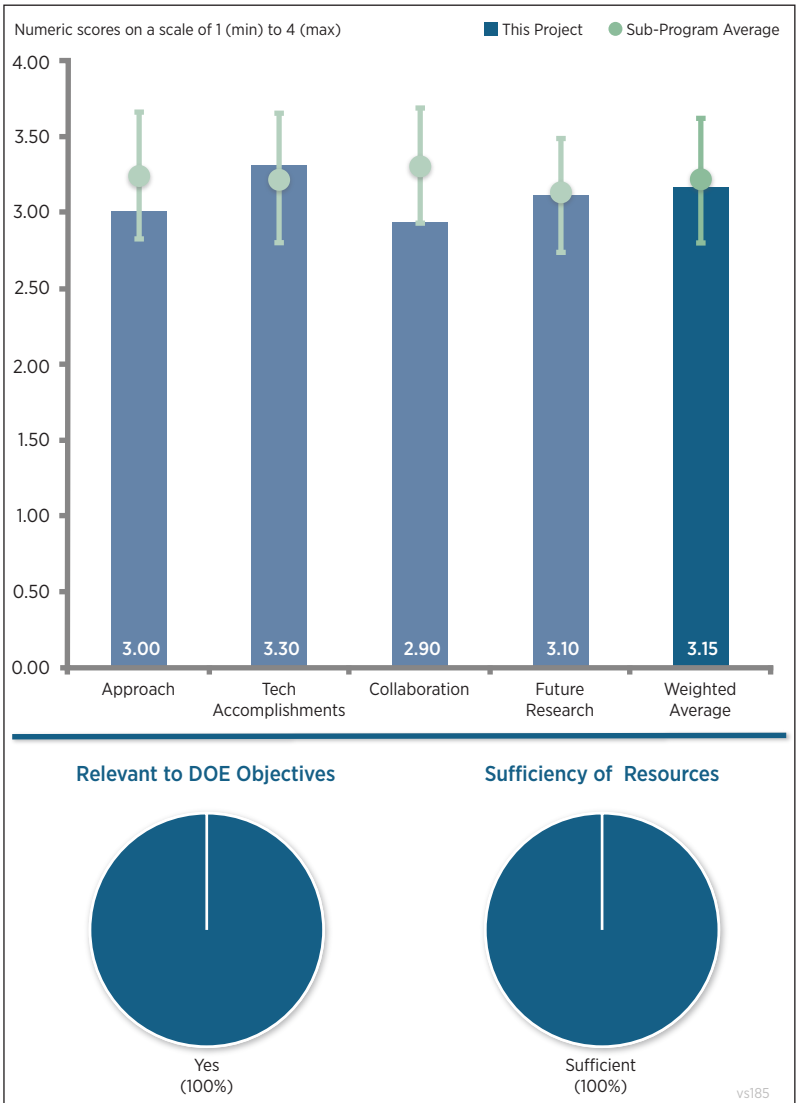

Figure 1-37 – Evaluation of Vehicle Technology Benefits on Real World Driving Cycles using Regional Transportation System Model: Aymeric Rousseau (Argonne National Laboratory) - Vehicle Systems

Reviewer 2:
The reviewer characterized the project approach as a step forward for producing fuel efficiency estimates for specific regional transportation scenarios because it includes real world information, such as road networks and elevation data in the fuel consumption calculations. The reviewer added that the approach focuses on quick production of aggregate fuel consumption estimates for sets of vehicles that employ a mix of technologies. However, the reviewer suggested the approach could be improved through more emphasis on providing quick insights into what are driving differences in the results. The reviewer stated that this additional capability would increase the value of the model to impart information and also provide mechanisms for sanity checking the simulation results.

Reviewer 3:
The reviewer stated that the approach taken in this project is aligned with meeting the key barriers; however, the approach has some challenges in that its assumption for future fleet mix and technology integration may not match current projections.

Reviewer 4:
The reviewer offered that by its very nature, this project has significant uncertainty associated with it (market penetration predictions, etc.). Given these uncertainties, the reviewer believed it would be worthwhile to consider lower fidelity vehicle driveline models to study the outcomes. Howeve , the reviewer acknowledged that using the higher fidelity models along with the la ge amount of data that it generates does have its advantages, adding that new processes and methods have to be developed to handle these data sets with minimal interaction and to generate consistent and accurate results. Nevertheless, the reviewer said, even if simpler approaches are not used, it may still be worthwhile to compare the results of lower and higher fidelity models to understand what the limitations are of each approach.

Reviewer 5:
The reviewer replied that the technical approach for this work is very good; however, the overall approach is to validate an ANL model in a vacuum.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer replied that the technical accomplishments in terms of validating the model are good.

Reviewer 2:
The reviewer stated that the project appears to be on track to meet the technical objectives laid out for this reporting period.

Reviewer 3:
The reviewer noted great progress but added that it would help if the labels and titles on the graphs were a little more descriptive. The reviewer pointed out that with the understanding that MA3T predictions are just that—predictions—the predicted 2025 figures (as was pointed out by another reviewer as well) appear to be unrealistic

The reviewer concluded it is good that assessing the impact of multiple market penetration scenarios will be addressed in the future.

Reviewer 4:
The reviewer emphasized that total energy consumption (for fleet level) needs to be shown as ene gy/mile (not as total energy) and that benefits of 2025 over 2015 vehicles need to be broken down by powertrain type. The reviewer wondered whether electric Watt-hour per mile (Wh/mi) was referring to only EVs and, if so, what technological benefits were considered for 2025 vehicles for this class

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer replied that the coordination with other organizations is good but added that more engagement from other agencies to improve forecasting could be beneficial

Reviewer 2:
The reviewer stated that there appears to be considerable synergy between this project and the work done by Jeff Gonder, Eric Wood, and others at NREL on evaluating the real-world benefits of various technologies such as thermal encapsulation, etc., with respect to fuel consumption. However, the reviewer noted, NREL does not appear to be a partner in this project.

Reviewer 3:
The reviewer indicated that it is not clear how this methodology will be used and commented that there needs to be a concrete example and use case, adding that a few suggestions were made for potential use cases, but one of these needs to be pursued in depth.

Reviewer 4:
The reviewer said that the collaboration on this project as very shallow, adding that the importance of its message should be getting out to other organizations such as EPA and NHTSA.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer stated that future modeling procedures to support off-cycle credits is a good proposed future step to support OEM incorporation of new technologies.

Reviewer 2:
The reviewer answered that the objective of providing a tool that can be used in assessment of off-cycle credits is worthy of pursuit.

Reviewer 3:
The reviewer referenced prior comments found in "Technical Accomplishments." The reviewer also remarked, if it were possible, that it would also be interesting to know whether the drive cycles generated by Polaris have statistical properties similar to the drive cycles available at the Transportation Secure Data Center website hosted by NREL.

Reviewer 4:
The reviewer replied that the proposed future work for this project is good but should be supplement with a much broader coordination.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer stated that besides being relevant in terms of evaluating the future petroleum displacement potential, this entire process will also likely develop procedures for handling large amounts of data and reducing them with minimal input to easily comprehensible packets.

Reviewer 2:
The reviewer judged that the relevance is weak here if the project continues to remain within ANL. The reviewer offered that DOE should be coordinating broadly with the other two agencies responsible for setting vehicle mileage standards.

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

Reviewer 1:
The reviewer stated that current project efforts are adequate to complete the current tasks.

Reviewer 2:
The reviewer replied that resources are sufficient

Evaluation of Dynamic Wireless Charging Demand: James Li (Oak Ridge National Laboratory) - vs186

Presenter
James Li, Oak Ridge National Laboratory

Reviewer Sample Size
A total of three reviewers evaluated this project.

Question 1: approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:
The reviewer affirmed that the presenter clearly listed out the technical barriers of dynamic wireless charging (e.g., lack of effective decision support tool for investment of charging infrastructure; lack of knowledge about en route EV performance regimes; etc.). The presenter also addressed the methods the project team adopted to approach the barriers (e.g., developing and validating representing traffic models, etc.).

Reviewer 2:
The reviewer commented it is interesting research, and added that while it is early in the program, it is not the best course to ignore the economic factors, and noting this concept seems like a very large infrastructure cost. The reviewer pointed out that many public transportation systems need to subsidized to continue to function and cautioned that if the cost of dynamic charging of the vehicle is significantly more per mile than to drive on gasoline per mile, it will be difficult to gain enough customer usage to warrant such a large investment.

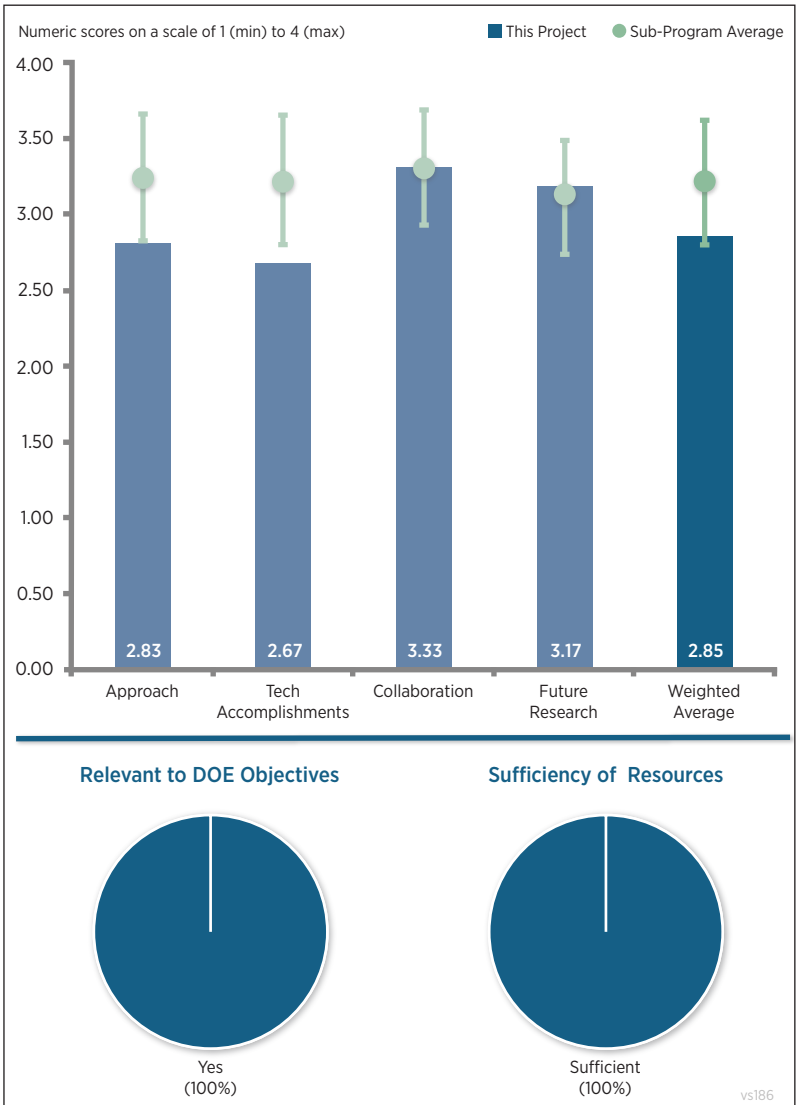

Figure 1-38 – Evaluation of Dynamic Wireless Charging Demand: James Li (Oak Ridge National Laboratory) - Vehicle Systems

The reviewer also wondered how many more EV miles are created by dynamic charging, and observed that at 40 miles of EV range, the Chevrolet Volt is already displacing 60-70% of gasoline miles with EV miles while the Nissan LEAF displaces approximately 80%, but still requires a second vehicle for those remaining 20%.

The reviewer asked how many more sales are possible; what percent of roads need to be electrified to reduce range anxiety; and if high-voltage batteries hit their cost targets, what is the cost difference between electrified roads and smaller batteries.

Reviewer 3:
The reviewer remarked that a lot of time was spent during the presentation just setting up the problem and the

approach and that it left no time to review the work progress and technical accomplishments or progress. The reviewer also pointed out that the slides indicate the approach taken, the models used, and so forth, but that very little data were shown. The reviewer urged the project team to share some of the modeling results to assure that work is being done. The reviewer exclaimed enough about the potential impact and the milestones.

Question 2: Technical accomplishments and progress toward overall project and DOE goals—the degree to which progress has been made, measured against performance indicators and demonstrated progress towards DOE goals.

Reviewer 1:
The reviewer indicated that it is too early in the project to make a strong evaluation of progress and accomplishments. The reviewer thinks there are so many questions to the adoption of this technology that it will be difficult to prove out the value

Reviewer 2:
The reviewer replied it was difficult to gauge this from the presentation given

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer affirmed that it is great to see that the program has collaboration between other national laboratories (i.e., ANL and NREL) utilizing their vehicle simulator and testing model to help with the study.

Reviewer 2:
The reviewer applauded the involvement of ANL and NREL as appropriate to this project at this stage. The reviewer suggested INL may have some useful data on plug-in behavior that could be leveraged to help describe need to electrify road ways.

Reviewer 3:
The reviewer replied that there seems like a lot of collaboration from the slides shown, but it is hard to see tangible progress because no results were shown.

Question 4: Proposed future research—the degree to which the project has 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.

Reviewer 1:
The reviewer replied that the project is going well so far and the future work is well planned. The reviewer is looking forward to seeing future results.

Reviewer 2:
The reviewer suggested that to determine how the vehicle will be controlled to please consider use EPA's data (namely, the draft MOVES2004) for speed-acceleration histograms for national driving. The reviewer also offered future questions to consider. The reviewer asked how this is advantageous over fixed point cha ging infrastructure. The reviewer pointed out that there are many stopping points for intercity trips and that this perhaps only makes sense for urban areas and, more specificall , intersections. The reviewer queried whether automakers would allow their products to be compatible with dynamic wireless charging, and how much that would add to the OEM system cost.

Reviewer 3:
The reviewer reiterated that the biggest barrier for adopting this technology will be with customer value, and said that this project does not address this barrier.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer referenced the presenter's remark that dynamic wireless charging is a promising technology to reduce electric car drivers' range anxiety and size of battery by providing capability of en route charging, which will increase the percentage of EV drivers, and that electrification of the nation s vehicle fleet o fers large potential reductions in energy consumption, criteria emissions, and greenhouse gases.

Reviewer 2:
The reviewer stated that this project does have an opportunity to provide additional EV miles displacing fueled miles.

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

Reviewer 1:
The reviewer remarked that at $180,000, it looks to be a low-cost research project to DOE that could identify some opportunity to displace petroleum and that this funding level seems appropriate at this time.

Reviewer 2:
The reviewer thinks that $180,000 is sufficient for this project considering there is no need for prototyping or experiment.

Acronyms and Abbreviations

A/C	Air-Conditioning
AMR	Annual Merit Review
AMT	Air Maintenance Technology
ANL	Argonne National Laboratory
AVTA	Advanced Vehicle Testing Activity
BATO	Bridgestone Americas Tire Operations
BET	Battery Electric Truck
BEV	Battery Electric Vehicle
BTE	Brake thermal efficienc
°C	Degrees Celsius
CAD	Computer-Aided Design
CAISO	California Independent System Operator
CAV	Clean Air Vehicles
Cd	Drag Coefficien
CFD	Computational Fluid Dynamics
CRADA	Cooperative research and development agreement
CY	Calendar Year
DOE	U.S. Department of Energy
EDV	Electric Drive Vehicle
EERE	Energy Efficiency and Renewable Ene gy
EPA	U.S. Environmental Protection Agency
EV	Electric Vehicle
EVSE	Electric Vehicle Supplemental (Supply) Equipment
FC	Fuel Cell
FCA	Fiat Chrysler Automobiles
FY	Fiscal Year
GDI	Gasoline direct injection
GHG	Greenhouse Gas
GITT	Grid Integration Technical Team
GSF2	Generic Speed Form 2

H_2	Hydrogen
HC	Hydrocarbons
HD	Heavy-Duty
HIL	Hardware in the Loop
HVAC	Heating, Ventilating and Air Conditioning
ICE	Internal Combustion Engine
INL	Idaho National Laboratory
kW	Kilowatt
kWh	Kilowatt Hour
LD	Light-Duty
LLNL	Lawrence Livermore National Laboratory
MD	Medium-Duty
MPG	Miles per gallon
MPGe	Miles per gallon equivalent
MTC	Michigan Mobility Transformation Center
NHTSA	National Highway Traffic Safety Administration
NM	Nanometer
NREL	National Renewable Energy Laboratory
OE	Office of Electricity Delivery and Ene gy Reliability
OEM	Original Equipment Manufacturer
ORNL	Oak Ridge National Laboratory
PCM	Phase change material
PEV	Plug-in Electric Vehicle
PHET	Plug-In Hybrid Electric Truck
PI	Principal Investigator
PSI	Pounds per Square Inch
PTO	Power Takeoff
Q&A	Question and Answer
R&D	Research and Development
ROI	Return on Investment
SAE	Society of Automotive Engineers

SMART	Systems and Modeling for Accelerated Research in Transportation
SwRI	Southwest Research Institute
TIR	Technical Information Report
UM	University of Michigan
UMTRI	University of Michigan Transportation Research Institute
UnCoVerCPS	Unifying Control and Verification of Cybe -Physical Systems
U.S. DRIVE	U.S. Driving Research and Innovation for Vehicle efficiency and Ene gy sustainability
UTEMPRA	Unitary Thermal Energy Management for Propulsion Range Augmentation
V2G	Vehicle-to-Grid
V	Volt
VS	Vehicle Systems
VTO	Vehicle Technologies Offic
Wh/mi	Watt-hour per Mile
WHR	Waste Heat Recovery
WPT	Wireless Power Transfer