10. Vehicle Analysis

The Vehicle Technologies Office (VTO) supports early-stage research and development (R&D) to generate knowledge upon which industry can develop and deploy innovative energy technologies for the efficient and secure transportation of people and goods across America. VTO focuses on research that industry either does not have the technical capability to undertake or is too far from market realization to merit sufficient industry focus and critical mass. In addition, VTO leverages the unique capabilities and world-class expertise of the national laboratory system to develop new innovations for significant energy-efficiency improvement. VTO is also uniquely positioned to address early-stage challenges due to its strategic public-private research partnerships with industry (e.g., U.S. DRIVE and 21st Century Truck Partnerships) that leverage relevant technical and market expertise, prevent duplication, ensure public funding remains focused on the most critical R&D barriers that are the proper role of government, and accelerate progress—at no cost to the Government.

The VTO Analysis (VAN) subprogram supports the planning and execution of technology, economic, and interdisciplinary analyses to inform and prioritize VTO research portfolio planning, including activities such as research target-setting and benefits estimation. VAN supports vehicle data, modeling and simulation, and integrated and applied analysis activities using the unique capabilities, analytical tools, and expertise resident in the U.S. Department of Energy's (DOE) national laboratory system. These activities explore advancements in vehicles and transportation systems and resulting energy impacts to inform early-stage R&D and offer analytical direction for potential and future research investments.

Subprogram Feedback

DOE received feedback on the overall technical subprogram areas presented during the 2017 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, etc.

Presentation Number: van999 Presentation Title: Overview of VTO Analysis Program
Principal Investigator: Rachael Nealer (U.S. Department of Energy)

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

Reviewer 1:
The reviewer responded yes, it was a great overview.

Reviewer 2:
The reviewer asserted that, overall, the program area and strategy were adequately covered. The pyramid describing the models and tools contributing to the ultimate "integrated analysis" was particularly helpful in revealing the overall strategy behind the stated goals of the vehicle analysis program.

Reviewer 3:
The reviewer was glad to see freight and goods movement as part of this. VTO is expanding to transportation systems, beyond its historic focus of components and vehicles.

Reviewer 4:
The reviewer stated yes, and observed a good overview of material to be reviewed.

Reviewer 5:
The reviewer commented that it was a very good overview of the various programs and activities. It provided a compelling case for more R&D in the transportation sector and established the links between the subprograms.

Reviewer 6:
The reviewer affirmed that the program goals and direction were clearly covered.

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

Reviewer 1:
The reviewer said yes, and highlighted the Systems and Modeling for Accelerated Research in Transportation (SMART) effort as a good way to move existing models into the future to meet emerging information needs.

Reviewer 2:
The reviewer indicated that the scenario analysis of success if all subprograms succeed/fail is a reasonable approach. The reviewer liked the organization of models and tools, and noted that the way these integrate and relate has been mapped to reduce overlap and ensure their complementarity.

Reviewer 3:
The reviewer responded yes, there appears to be a good variety of projects that span near-, mid-, and long-term objectives, although the future work could have been more clearly identified.

Reviewer 4:
The reviewer remarked that the portfolio appears to be well-balanced between near-term and long-term R&D objectives.

Reviewer 5:
The reviewer commented that a good balance was presented. The reviewer expressed interest in seeing more input on the economic or business case that can enable exploitation of the technologies being discussed. It was discussed in several projects that the technology deployment business case has yet to be understood, but examining this was not in the scope of the study. Perhaps more emphasis should be placed on the business case as an enabler for technology deployment and as a pathway for gathering stakeholders and partners.

Reviewer 6:
The reviewer commented that the funded projects span an appropriate range of focus areas. One potential missing area, however, is the development and consumer adoption of more near-term, conventional technologies that would reduce petroleum consumption (e.g., continuously variable transmissions, mild hybrids, etc.). The reviewer noted that incentivizing adoption of these technologies may actually be a more cost-effective strategy for the U.S. Department of Energy (DOE) than investing in some longer-term alternative fuel technologies. The reviewer suggested that at least including them in the analysis tools is warranted to determine whether or not this is the case.

Question 3: Were important issues and challenges identified?

Reviewer 1:
The reviewer responded yes, important issues were identified.

Reviewer 2:
The reviewer commented that the key questions presented at the beginning of the presentation were a good sampling of the types of issues facing VTO analysis program.

Reviewer 3:
The reviewer asserted that the program is well motivated by the need for analysis to inform DOE investments and effective means of reducing petroleum consumption.

Reviewer 4:
The reviewer commented that the primary issue is that mobility has the potential to change tremendously in the near future, so the traditional ways of looking at the problem will be inadequate. Implicit to the overall discussion was also that funding uncertainty makes program design and management difficult.

Reviewer 5:
The reviewer noted that data quality and robustness of the various modeling tools expected to be the main challenges. The reviewer encouraged the programs to constantly test and validate the results with real-world data, especially in a rapidly changing transportation landscape.

Reviewer 6:
The reviewer affirmed that important issues were identified, but it was unclear to the reviewer whether "protect human health" includes both safety and emissions/pollution. The reviewer recommended that both safety and environmental risks to human health be considered in the program.

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

Reviewer 1:
The reviewer replied yes, the SMART effort is intended to revise the approach to modeling mobility services.

Reviewer 2:
The reviewer said yes, and explained that the program recognizes that moving from a component and vehicle level program to a system level program will likely lead to challenges, and proposes greater coordination among the projects to meet programmatic goals.

Reviewer 3:
The reviewer affirmed that plans are identified for addressing issues and challenges.

Reviewer 4:
The reviewer responded yes. The program's pyramid model of developing capabilities in technology and market data, vehicle and market simulations, and overall impacts on energy, the environment, and consumers

is a very useful framework for organizing the funded projects. For future years, the reviewer suggested extending this framework to include a pyramid-type model for strategically planning the specific questions that should be answered by particular case studies using the developed models.

Reviewer 5:
The reviewer commented yes, information was provided on the specific models and tools utilized by the program in order to answer key questions. However, this reviewer pointed out that the specific plans could have been more clearly identified in the presentation.

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

Reviewer 1:
The reviewer said yes.

Reviewer 2:
The reviewer responded yes, to the extent this was possible in the context and time allowed.

Reviewer 3:
The reviewer asserted that milestones and progress were described relative to the previous year.

Reviewer 4:
The reviewer replied that the program budget was clearly benchmarked with last year and new outputs of this year were discussed.

Reviewer 5:
The reviewer noted that the presentation included a good sample of new reports and publications.

Reviewer 6:
The reviewer indicated that it was difficult to determine from the presentation if progress was 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?

Reviewer 1:
The reviewer responded yes, this program contributes important data, models and reports that benefit a variety of stakeholders while also making progress towards solving the fundamental problems identified by the VTO. The projects in this portfolio are filling critical data and research gaps in a world that is quickly moving towards new alternative fuels, vehicles, and technologies.

Reviewer 2:
The reviewer described the projects as well-scoped.

Reviewer 3:
This reviewer said yes.

Reviewer 4:
The reviewer also said yes.

Reviewer 5:
The reviewer replied yes, all the programs fit under the broad umbrella of the VTO with objectives addressing the different challenges and barriers.

Reviewer 6:
The reviewer affirmed that the four sets of models and tools are foundational to the smart mobility program. While the categories of models and type of analysis are clear, the contribution and complementarity of the tools within each category is less clear.

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, the program is both well-managed and well-structured to meet VTO's needs. It has been successful in developing models, tools, and analyses that represent both individual vehicles and the overall transportation sector and has been responsive to the changes occurring in this rapidly evolving sector.

Reviewer 2:
The reviewer said yes.

Reviewer 3:
This reviewer stated yes.

Reviewer 4:
The reviewer commented that the program area appears to be streamlined and well stewarded with clear objectives for each of the programs.

Reviewer 5:
The reviewer noted that the program does appear to be well-managed and producing valuable outputs relevant to VTO's needs. The determination of the program's portfolio using the pyramid model is a useful framework to strategically fund projects in a diversity of areas relevant to the objectives of the program while also ensuring synergies across projects.

Reviewer 6:
The reviewer replied yes, multiple collaborations and partnerships were discussed. It was not entirely clear to this reviewer, however, how the coordination of so many programs is being reliably carried out—it seems challenging to ensure they are all complementary and synergistic.

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 stated that the researchers and tools available to them constitute the key and critical strength of the program as a whole. The broad network with other national laboratories and external participants from academia and industry is another key strength.

The reviewer commented that the program on connected and automated vehicles appears to be particularly relevant. It has access to a suite of tools and leveraging them together could prove to be very beneficial in the study of mobility systems.

Reviewer 2:
The reviewer identified that the key strengths of this program lie in the broad selection of tools that have been developed to simulate the transportation sector with varying levels of granularity. These analyses are providing added value to both VTO and the greater field of transportation research.

Reviewer 3:
The reviewer referenced prior comments.

Reviewer 4:
The reviewer indicated that the program includes a number of strong deployment-oriented projects that consolidate connected and autonomous vehicles (CAVs), electrification, and environmental studies. While broad scope is a strength, not maintaining enough focus could become a weakness.

Reviewer 5:
The reviewer opined that the key strength of this program is that it covers the necessary breadth of modeling mobility services. A key limitation is clearly data—all of these models depend on data, and collecting primary data is expensive and time consuming. Data collection was discussed in side discussions, but it is clear that it is unlikely that the necessary funding will be made available to expand collection efforts.

Reviewer 6:
The reviewer remarked that a strength of the program is developing sophisticated modeling tools to represent a complicated system of consumer and producer behavior and energy and environmental impacts. Vehicle Technologies Analysis (VAN) appears to be focusing their efforts on a valuable set of tools and delivering interesting results with them. This reviewer suggested that one area for improvement is ensuring that the models are transparent, publicly available, and comprehensively documented. Several of the models are not currently publicly available or documented in a way that it is clear how the model inputs are translated to the presented results. The reviewer explained that others (particularly the Market Acceptance of Advanced Automotive Technologies [MA3T]) have produced many publications that very helpfully explain the methodology used by the models, but because the models are quite complicated, even for these models it is not apparent exactly what equations and input parameters are used to generate the results (e.g., a list of all alternative specific constants for every year would be needed to reproduce the MA3T results). The reviewer recommended that VAN work to ensure that the models are publicly available with input files at least by project close.

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

Reviewer 1:
The reviewer responded yes, these projects (particularly some of the newer additions) have adopted innovative methods to investigate challenging and complex systems.

Reviewer 2:
This reviewer believed the projects are deploying new ways to try and tackle the questions and challenges by combining multiple tools and methods.

Reviewer 3:
The reviewer indicated that the projects span a range of innovative approaches to analyzing the systems of interest.

Reviewer 4:
This reviewer said yes.

Reviewer 5:
The reviewer also said yes.

Reviewer 6:
The reviewer asserted that it does seem that new ground is being broken, such as mode shift for freight, which is something that Europe is far ahead of the United States in studying and deploying.

Question 10: Has the program area engaged appropriate partners?

Reviewer 1:
The reviewer replied yes, the program area engaged appropriate partners as far as this was discussed.

Reviewer 2:
The reviewer responded yes, the program has engaged a variety of partners and stakeholders from government, the national laboratories, and industry. The addition of Columbus, Ohio (U.S. Department of Transportation (DOT) Smart City winner), as a collaborator could prove particularly useful in the future.

Reviewer 3:
The reviewer responded yes, both internal and external partners. Great to see DOT collaboration, which seems worth strengthening as the emphasis on transportation systems grows for VTO—because co-benefits like safety, energy, environment, and public health will make energy-reducing technology more compelling.

Reviewer 4:
The reviewer stated that all programs appear to have multiple collaborators and partners.

Reviewer 5:
The reviewer replied yes, the program area engaged appropriate partners, but more input from industry stakeholders would be helpful to better understand the technology deployment strategy, and enablers (or barrier removal) associated with same.

Reviewer 6:
The reviewer commented that in general, the program has done a good job of engaging partners in relevant areas. A few projects are missing notable collaborations, particularly with original equipment manufacturers (OEMs) and universities that could help to strengthen their methods and results.

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

Reviewer 1:
The reviewer asserted that the program area is collaborating with partners effectively as far as this was discussed.

Reviewer 2:
This reviewer commented that it appears the program area is collaborating with their partners effectively.

Reviewer 3:
The reviewer replied yes, the program area is collaborating with partners effectively. For example, Urban Science is on the ground in Columbus where the Smart City Challenge activities with Vulcan, Mobileye, etc. are taking place.

Reviewer 4:
The reviewer referenced previous comments.

Reviewer 5:
The reviewer commented that it appears that the projects are collaborating effectively with partners, although it is difficult to tell from a short presentation whether these interactions are meaningful.

Reviewer 6:
The reviewer was unable to assess if the program area is collaborating with partners effectively.

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

Reviewer 1:
The reviewer observed no apparent gaps in this portfolio.

Reviewer 2:
The reviewer stated that there were no gaps identified.

Reviewer 3:
The reviewer commented that the main gap appears to be modeling of emerging mobility services, but this is being addressed.

Reviewer 4:
This reviewer noted that more urban freight and last-mile delivery would be good to address. For example, Federal Highway Administration (FHWA) and Volpe are tackling this in a twinning project with the European Commission, and there is a great deal to learn from European initiatives for urban freight electrification, mode shift, and policy. The 21st Century Truck Partnership project is highway-oriented, not last-mile oriented, so there could be an opportunity here.

Reviewer 5:
The reviewer indicated that no gaps were identified in the portfolio. The reviewer encouraged the researchers to seek validation of their assumptions and quality of the input data throughout the phases of the projects.

Reviewer 6:
This reviewer suggested that it is worth considering whether the evaluation/validation of the developed models should be performed as a separately funded project. Currently, it appears that most validation is done by fitting the model to historical data. However, because these models include many parameters (e.g., the alternative specific constants in ParaChoice and MA3T), this comparison is not a true validation but instead it is simply fitting these model parameters to mimic historic data. This could be addressed by requiring the projects to use hold-out samples to compare their model predictions after all the model parameters are specified. But, it also may be worth considering whether an independent examination or validation test of the models is warranted as an additional project to build confidence in their results.

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

Reviewer 1:
The reviewer said none.

Reviewer 2:
This reviewer identified none.

Reviewer 3:
The reviewer had nothing further to add to comments provided previously.

Reviewer 4:
Although not necessarily address this group, this reviewer suggested it would be useful, looking forward, to have a detailed cross-program look at costs for advanced vehicles. Even though this has been done many times, it usually gets to the level of "a motor costs $/kW." The reality is that things are getting to the point where this is not good enough, and many of the small components like chargers matter. DOE is one of the few organizations that could dig into this.

Reviewer 5:
The reviewer noted that the relatively recent addition of the SMART Mobility program has proven to be both a valuable and necessary change to the VTO analysis portfolio. It would be interesting to see this area expanded further by continuing to add alternative powertrains and fuels to their analyses and to think about future scenarios that move beyond the personal ownership model for vehicles.

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

Reviewer 1:
This reviewer identified none.

Reviewer 2:
The reviewer had no further areas to suggest.

Reviewer 3:
This reviewer said none.

Reviewer 4:
The reviewer observed that currently, it appears that the program is focused most on developing modeling capabilities. One area that is currently missing is conducting field experiments or estimation of consumer or producer parameters of interest. These types of studies could serve to address important questions for DOE and inform the parameters used in other projects' models. If the program managers believe that the program could fund teams with the necessary capabilities for conducting these types of studies, expanding the portfolio to include this work would serve as a valuable complement to the other VAN projects.

Reviewer 5:
This reviewer stated that given the limitations in funding, the emphasis will likely be on what to cut, not expand.

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

Reviewer 1:
The reviewer said no.

Reviewer 2:
At this time, the reviewer had no recommendations.

Reviewer 3:
The reviewer had nothing further to add to the comments made in Questions 2, 13, and 14.

Reviewer 4:
The reviewer referenced prior comments.

Reviewer 5:
The reviewer commented that certainly industry involvement can be helpful in this program, however, the reviewer thought that greater emphasis on partnerships with city agencies would be helpful—they are often looking for partners to implement innovative projects, and while they may lack the financial and technical means, they may have the desire and in-kind resources such as street network operations to offer and to demonstrate new vehicle network technologies. Additionally, many cities are committing to aggressive greenhouse gas and emissions reductions, so this program aligns well with these city missions.

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

Reviewer 1:
The reviewer had nothing further to add.

Reviewer 2:
The reviewer offered no further suggestions.

Reviewer 3:
The reviewer said none.

Reviewer 4:
The reviewer suggested more dissemination and awareness of the work with external stakeholders. The reviewer recommended to seek input and vetting of the models by third party to ensure continuous improvements. Also, the reviewer suggested testing the level of interest by tracking the use of the reports and publications by others.

Reviewer 5:
The reviewer commented that it is probably time to downselect vehicle choice models, or at least develop a methodology for determining which approaches are most worthwhile to develop further.

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 10-1 – Project Feedback

Presentation ID	Presentation Title	Principal Investigator (Organization)	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
van019	ParaChoice Model	Rebecca Levinson (SNL)	10-13	3.50	3.58	3.25	3.17	**3.47**
van020	Applied Analysis of Connected and Automated Vehicles	Tom Stephens (ANL)	10-18	3.50	3.50	2.92	3.00	**3.36**
van021	Transportation Energy Evolution Modeling (TEEM) Program	Zhenhong Lin (ORNL)	10-23	3.50	3.50	3.58	3.33	**3.49**
van022	Connected and Automated Vehicles	Aymeric Rousseau (ANL)	10-28	3.58	3.67	3.42	3.50	**3.59**
van024	Considerations for Corridor and Community DC Fast Charging Complex System Design	James Francfort (INL)	10-32	3.60	3.60	3.00	3.75	**3.54**
van025	Modeling Framework and Results to Inform Charging Infrastructure Investments	Marc Melaina (NREL)	10-36	3.38	3.50	3.38	3.25	**3.42**
Overall Average				**3.52**	**3.56**	**3.26**	**3.28**	**3.48**

Presentation Number: van019
Presentation Title: ParaChoice Model
Principal Investigator: Rebecca Levinson (Sandia National Laboratories)

Presenter
Brandon Heimer, Sandia National Laboratories

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 responder commented that convening stakeholders and getting feedback on the parametric analysis makes sense as the project develops inputs and calibrates the generalized cost function. Inclusion of both one-time and annualized costs and benefits is good given the different incentive landscape in different states. The reviewer noted that the ParaChoice model is distinct from other models in that it explores trade spaces and helps identify tipping points and sensitivities to inputs, for example, how policy decisions will affect the market uptake of different technologies.

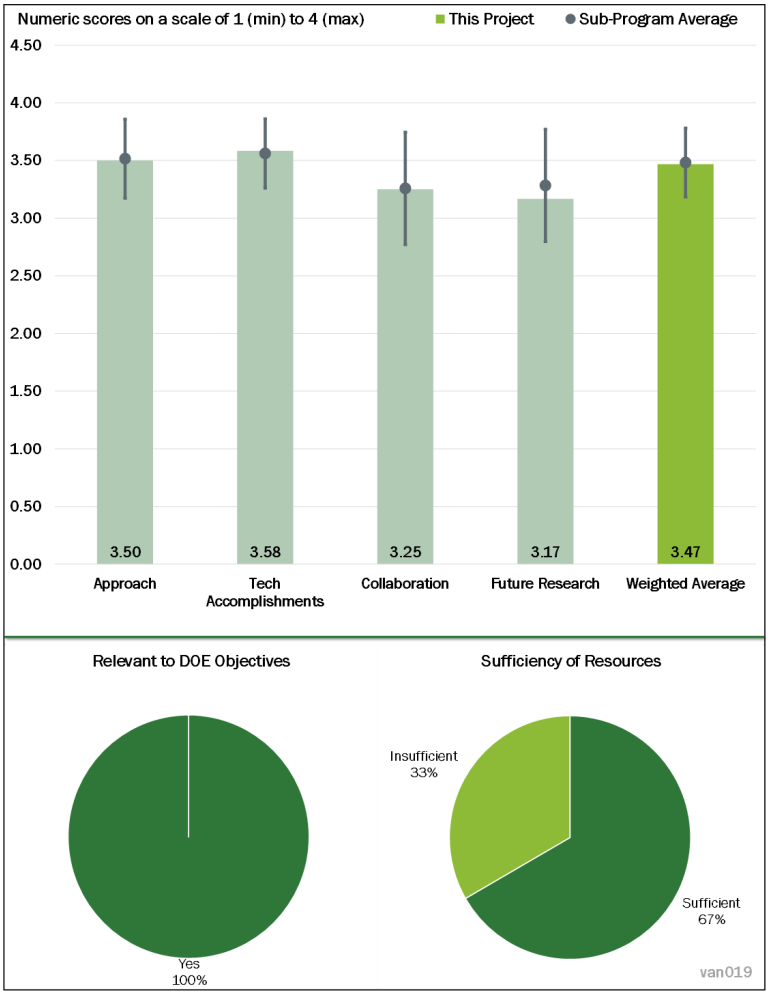

Figure 10-1 - Presentation Number: van019 Presentation Title: ParaChoice Model Principal Investigator: Rebecca Levinson (Sandia National Laboratories)

Reviewer 2:
The reviewer noted that the project uses a systematic approach to answer the questions that identify key parameters influencing light-duty and heavy-duty vehicle (HDV) choices as related to infrastructure and vehicle technologies.

Reviewer 3:
The reviewer commented that the project has a sensible approach and is well integrated with related projects.

Reviewer 4:
The reviewer commented that the project addresses technical barriers. The reviewer noted that there are business issues that may also be potential barriers and may be significant enough to be worthy of study. One potential business issue to study is under what economic model will the necessary type and number of charging stations be funded and by whom (such as private industry, government, utilities, automotive OEMs). The other business issue the reviewer thought worthy of study is the residual value of batteries and how that value factors into the economic model of electric vehicle (EV) adoption rates.

Reviewer 5:
The reviewer commented that the project is focused on important technical barriers for DOE, particularly issues of alternative fuel vehicle (AFV) infrastructure and the impact of the VTO investments on consumer adoption.

The reviewer had one comment on the details of the model. The reviewer was specifically concerned about the inclusion of several "free" utility parameters (e.g., model availability and alternative specific constants) in the nested logistic regression (logit) model. Including the number of different vehicles in each fuel type category (e.g., by either stock size or model availability) is justified to account for predicting shares of "representative vehicles" of different fuel types (see Daniel McFadden, "Modeling the choice of residential location." Transportation Research Record 673 (1978)); although this paper focuses on choices of residential locations, the methods are relevant and applicable to vehicles as well). However, in this case, there should be an additional term that accounts for the heterogeneity of consumer utility for vehicles within each fuel category. Furthermore, when dealing with future scenarios as this project does, it is difficult for modelers to determine what appropriate values for these terms are in the future and they sometimes become fudge factors for modelers to adjust the predicted scenarios to match their expectations. While the reviewer does not believe this project is making this error, additional documentation explaining what these parameters are, how they are used, and assumed values for them that have been used in the model would be very useful. A further suggestion given by the reviewer is to include a range of these terms in the parameterized scenarios to understand how their variation affects the results.

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 appears to have made excellent progress towards its goals.

Reviewer 2:
The reviewer commented that the project is on track and producing results.

Reviewer 3:
The reviewer commented that the program listed several milestones and decisions points for 2017 and that it is progressing towards meeting their stated objectives.

Reviewer 4:
The reviewer has no concerns about the project in this area.

Reviewer 5:
The reviewer noted that the results viewer tool is now showing the baseline analysis and allows user inspection of adoption outputs out to 2050 and modification of inputs. The reviewer commented that the ability to normalize to total emissions is valuable for quantifying the benefits. The reviewer believed the analysis has shown how range extension and workplace charging accessibility determine predicted petrol reduction, which starts to give actionable information for potential policy interventions. The reviewer suggested bounding information such as the maximum update of an alternative fuel given maximum incentive to provide maximum benefit information.

Reviewer 6:
The reviewer commented that the researchers demonstrated good progress, including the integration of AFVs for the heavy-duty sector and both parametric and scenario level analyses on the impact of charging infrastructure availability for EVs. The reviewer noted that it would be interesting to see the charging analyses expanded further and incorporate higher powered levels of charging (greater than 50 kW) for light-duty and alternative powertrains added for heavy-duty.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer commented that the project is working with several national laboratories and external partners (OEMs, trade associations), and other government agencies. The reviewer noted that the project appears to have the right level of participation.

Reviewer 2:
The reviewer commented that the project has collaborated with Mike Roeth and North American Council for Freight Efficiency (NAFCE), which is good, given NACFE's grasp on industry pulse. The reviewer noted that the project has also engaged OEMs, the energy industry, and other stakeholders.

Reviewer 3:
The reviewer commented that the project collaborated well with industry stakeholders including an OEM, but noted that the project may want to broaden its engagement with other national laboratories and universities.

Reviewer 4:
The reviewer noted that the project has listed collaborations with OEMs, national laboratories, and trade groups, which appear to provide meaningful input and constructive critiques of the work. The reviewer commented that the project has no university collaborators or technical critiques by academic researchers. The reviewer mentioned that several universities have established programs in electric vehicle charging infrastructure that would be useful to draw on for this work.

Reviewer 5:
The reviewer commented that the project appears to have good linkages to other programs, but noted this type of tool would be more valuable if a very wide range of external parties were able to use it.

Reviewer 6:
The reviewer commented that there should be more partner input to address the issues around funding of recharging stations and battery replacement cost, second life of batteries, etc. The reviewer noted that these economic considerations will have a profound impact on the adoption rate and economic viability of battery electric vehicles (BEVs).

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 projects future work is very pertinent and interesting to a variety of audiences. The reviewer noted that the research into which alternative technologies could gain market penetration in the heavy-duty sector could fill a current research gap. The reviewer encouraged the project to continue to explore how to incorporate challenging parameters into their generalized vehicle costs, especially those related to electric vehicles, such as the willingness to purchase an alternative vehicle, the fact an electric vehicle can be charged in your garage, the impact of the resale value of electric vehicles, etc. Lastly, the reviewer noted that the results viewer which allows public stakeholders to access the projects work is a worthwhile effort that could ultimately spur more collaboration with external researchers.

Reviewer 2:
The reviewer commented that the project appears to have a good plan for future work.

Reviewer 3:
The reviewer commented that the future work included measurable targets and a list of reasonable milestones. The reviewer further noted that there is also a plan to collect real-world data to validate the models and reduce uncertainty.

Reviewer 4:
The reviewer commented that the work plan is good, but noted that there is some suggestion that funding could be inadequate to complete the work plan as outlined.

Reviewer 5:
The reviewer commented that it would be helpful if there was more ability to perform sensitivity analyses to see how much intervention or which type would maximize benefits. The reviewer noted that in the future, including resale value of BEVs and other differently powered vehicles would be an important input for market acceptance given the impact on total cost of ownership. The reviewer also stated that the lack of electric trucks would be good to address in a future version.

Reviewer 6:
The reviewer commented that the planned future work to complete a journal article will help to document the model and receive feedback on results from researchers conducting related studies.

The reviewer noted that the proposed work to study the impact on VTO investments is clearly very well aligned with DOE goals and will be a valuable contribution.

The reviewer commented that future work on HDVs could be valuable, as it is important for DOE goals, and is an often-overlooked area of study. However, the reviewer stated that it was not clear how the current capabilities of the Parachoice model would help to identify promising HDV technologies. The reviewer noted that less choice modeling work has been done for HDVs and there is not much justification for appropriate nested logit parameters for this vehicle class. The reviewer stated that for VTO to be successful in producing meaningful results of HDV future sales scenarios, further work would be needed to estimate choice models for HDVs, either by the project directly or in collaboration with other organizations with experience estimating these models.

Question 5: Relevance—Does this project support the overall DOE objectives of petroleum displacement?

Reviewer 1:
The reviewer commented that consumer adoption of new vehicle technologies is critical to achieving the goals of increasing energy efficiency and reducing reliance on non-petroleum fuels.

Reviewer 2:
The reviewer commented that understanding how key parameters can impact the integration of AFVs into both the light- and heavy-duty vehicle sectors will aid in DOE's mission to reduce petroleum usage.

Reviewer 3:
The reviewer commented that by understanding the elements of vehicle choice, lower-consuming choices could be encouraged.

Reviewer 4:
The reviewer commented that the project addresses liquid fuels use through a better understanding of the impacts of infrastructure availability on consumer choices, adoption and market penetration of alternatives transport/mobility technologies.

Reviewer 5:
The reviewer commented that emissions of fleet can be reduced if a system-level model like this is valid and can inform policy interventions or investment choices for charging infrastructure.

Reviewer 6:
The reviewer had no concerns in this area.

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 the presenter indicated that funding may be insufficient to complete the work plan as outlined. The fiscal year 2017 budget of $350,000 has only been funded up to $194,000 as of March 31, 2017.

Reviewer 2:
The reviewer said that it sounds as though a funding cut may not allow the project to complete the upcoming milestones.

Reviewer 3:
The reviewer commented that the resources and budget appear adequate given the current stage of the program.

Reviewer 4:
The reviewer commented that the budget appears reasonable given the scope of the work.

Reviewer 5:
The reviewer commented that the speaker indicated that funding levels are sufficient to meet current milestones.

Reviewer 6:
The reviewer commented that the funds received for fiscal year 2017 are considerably lower than the budgeted amount, but noted the project seems to be making good progress in spite of the lack of fully transferred funds. The reviewer commented that providing funding to document the model and results in a journal article or other venue where it can receive further technical critiques would be valuable.

Presentation Number: van020
Presentation Title: Applied Analysis of Connected and Automated Vehicles
Principal Investigator: Tom Stephens (Argonne National Laboratory)

Presenter
Tom Stephens, Argonne National 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 commented that the influence of CAVs on energy use is an important question that is critical to DOE goals. The project's approach to answering the question is sound.

The reviewer further noted that it is very helpful that this project has publicly available documentation of the sources of data and should be commended for this transparency. The reviewer thought it would be helpful in future AMRs, to document these in presentations, or provide a summary, particularly for the range of elasticity of vehicle miles traveled (VMT) demand.

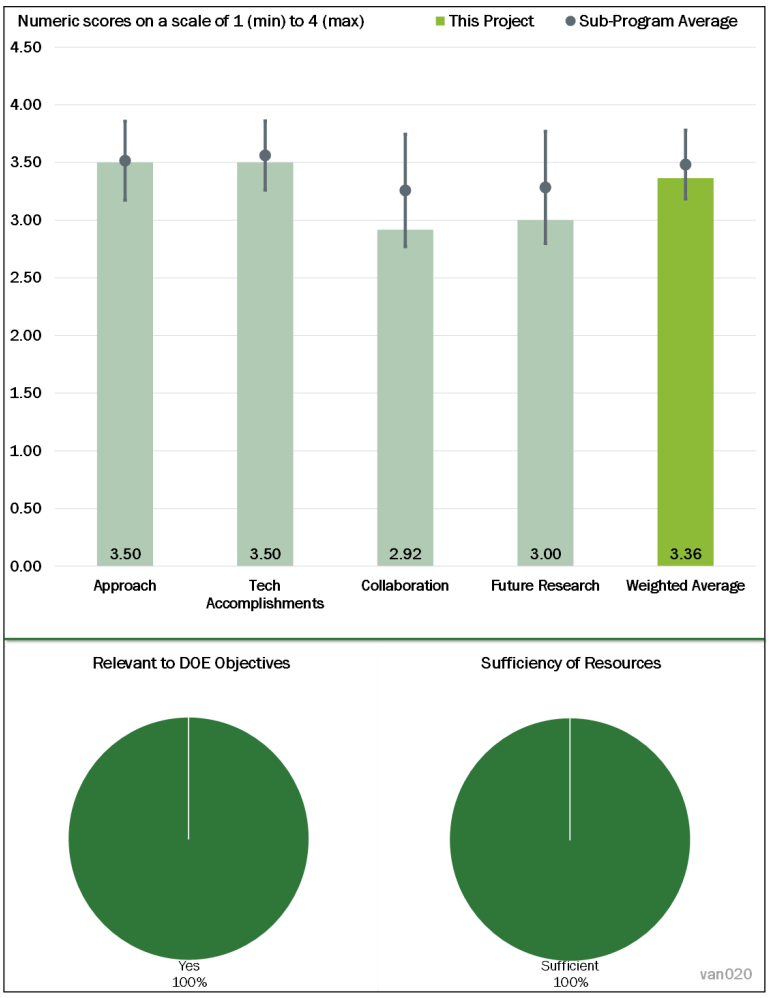

Figure 10-2 – Presentation Number: van020 Presentation Title: Applied Analysis of Connected and Automated Vehicles Principal Investigator: Tom Stephens (Argonne National Laboratory)

Reviewer 2:
The reviewer commented that the approach appears to be well-designed and appropriate.

Reviewer 3:
The reviewer commented that this analysis aids in filling a gap in our understanding of connected and automated vehicles by synthesizing the current assumptions for CAVs in the literature and establishing an updated framework to estimate their energy impacts. The reviewer noted that the project team built on previous research through identifying the most prominent gaps in information surrounding CAVs, of which there are many, and brainstorming possible analyses to narrow these gaps. The reviewer believed that this gap analysis is an important step towards modeling the full range of implications of CAVs on our transportation system, particularly in regards to the effects on VMT. However, the reviewer noted it would have been helpful for the project to have included alternative fuels and powertrains in the bounding analysis to avoid the need for caveats. The reviewer stated that the issue of caveats will be resolved in future versions of the analysis, per the question and answer session of the presentation. The reviewer noted that while it was understandable that the

author wished to separate systems level impacts from vehicle impacts, it would have been useful to have provided one scenario where these impacts were combined.

Reviewer 4:
The reviewer commented that the project is restricting scope to only light-duty, internal combustion engine vehicles with connectivity and automation (CAVs) and will attempt to bound fuel consumption and cost to consumers. The reviewer noted that the demand and efficiency factors considered make sense, although they were not sure if the direction of some of the arrows is qualitatively accurate or knowable, for example, the arrows for underserved and travel demand.

Reviewer 5:
The reviewer commented that the literature review approach is good, and an efficient way to assess a broad range of inputs. The reviewer commented that it was not clear if the literature that was reviewed was complete and covered all of the variables relevant to the assessment of CAV, or if additional literature or studies were needed in order to more fully address any gap areas, such as interaction between CAVs that are shared or not shared vehicles, or CAVs that are BEVs or non-electrified. The reviewer asked if all of these combinations were studied based on available literature.

Reviewer 6:
The reviewer commented that the project started in 2015 and that it appears that the project has run into several hurdles, mostly relative to data availability and quality. The reviewer suggested reassessing the approach and prioritizing the highest value tasks for the remainder of 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 commented that the project appears to have made excellent progress.

Reviewer 2:
The reviewer commented that the project has made very good progress toward the objectives.

Reviewer 3:
The reviewer commented that this project appears to have made steady progress towards hitting milestones.

Reviewer 4:
The reviewer commented that the early research provided a good insight on the impact automation and connectivity have on energy consumption.

Reviewer 5:
The reviewer commented that data and knowledge gaps were identified, and a detailed matrix of questions were provided to VTO as well as a proposed framework for understanding the uncertainty sensitivity. The reviewer stated that a plan appears to be in place to address these issues.

Reviewer 6:
The reviewer commented that the results should become available next year. The reviewer noted that preliminary results showing bounds of just partial and full automation, but not high-automation or high-automation vehicles, are useful for modeling the relative contributions of different demand and efficiency factors. The reviewer stated that the assumptions for ridesharing should be more robustly analyzed with bounds and a sensitivity analysis. The reviewer further believed that while the scope of the analysis was national, there is value in bounding how much the effects would differ in low-density rural versus high-density urban areas. The reviewer expected bounds would be significantly different in the two environments.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer commented that this project appears to have excellent collaboration, but mostly within DOE. The reviewer stated that it would be good for the project to pursue external collaboration.

Reviewer 2:
The reviewer commented that based upon the presentation, the project has good coordination and collaboration with several of the other national laboratories and more "informal" collaboration with the wider research community, such as universities. The reviewer encouraged the project to gather more formal feedback from external stakeholders in the future.

Reviewer 3:
The reviewer commented that the informal collaborations to date are good, but they could be beneficial to formalize and cross validate technology penetration models. The reviewer provided the example of working with the corporate average fuel economy program and the relationship between the U.S. Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration.

Reviewer 4:
The reviewer commented that the project has collaborations with national laboratories and a university, however noted that there is no apparent input or review from OEMs or other CAV companies. The reviewer stated that the project could benefit from receiving technical critiques from these stakeholders as well as universities and the national laboratories.

Reviewer 5:
The reviewer noted that additional partners may be needed to help address the previously described gaps.

Reviewer 6:
The reviewer commented that the project is 100% internal to DOE and believed it would have been beneficial to involve external experts and 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 commented that the next steps are reasonably well defined.

Reviewer 2:
The reviewer commented that the proposed future research appears to be well positioned to continue to advance our knowledge and understanding around CAV impacts. The reviewer encouraged the inclusion of heavy-duty CAVs into any future analyses in order to broaden national level estimates of CAVs. The reviewer noted that, when concerning CAV adoption, it is important to consider that these vehicles may be all part of fleets as opposed to consumers purchasing individual vehicles. The reviewer stated that, while this outcome is clearly uncertain, it is necessary to consider the impacts of a variety of futures.

Reviewer 3:
The reviewer commented that the proposed work would help to address DOE goals. The reviewer noted that because the estimates of key parameters, such as long-term VMT elasticity of CAVs, currently span a large range, the modeling capabilities that the project is producing may be most useful in the future once more precise estimates of these parameters are available. The reviewer believed it was critical that the project

produce a publicly available version of the model that others could use so that the model can be put to use even after the project is completed.

Reviewer 4:
The reviewer commented that the highest priorities proposed make sense. The reviewer thought that scenarios for future CAV adoption need to be carefully chosen to understand what wedges to pursue further through this and sister projects. The reviewer thought that the heavy-duty area is a known gap in this project that would be good to tackle, given the fact that HDVs are a rapidly growing fraction of fuel consumption among the overall fleet. The reviewer commented that future differentiation of the VMT bounds by geographic location would be a worthwhile goal to be able to both validate the model as CAVs are implemented and to inform possible interventions at a more local or regional level to nudge CAV development in the "utopia" rather than "nightmare" direction.

Reviewer 5:
The reviewer noted that the presentation included a list of tasks and a number of challenges. The reviewer was not sure there will be enough resources (time and budget) to execute all of the tasks and suggested the project team prioritize and focus on the highest value activities.

Reviewer 6:
The reviewer noted that future milestones appear to be vague and far-off, but was confident that they are achievable. The reviewer thought it would be useful to be more specific about what will be done and why it will take the time it will.

Question 5: Relevance—Does this project support the overall DOE objectives of petroleum displacement?

Reviewer 1:
The reviewer commented that by looking at future energy use, the study should help reduce petroleum use.

Reviewer 2:
The reviewer commented that understanding the potential fuel impacts CAVs may have on our future transportation system can hopefully assist in avoiding undesirable outcomes and reduce petroleum usage.

Reviewer 3:
The reviewer commented that understanding the wedges that can either increase or decrease VMT the most may allow targeted CAVs research and policy in the future.

Reviewer 4:
The reviewer commented that the research is quite relevant to energy consumption and market implications of connected and automated vehicles.

Reviewer 5:
The reviewer commented that understanding the influence of CAVs on VMT and energy use is very important for DOE to accomplish its goals of petroleum displacement.

Reviewer 6:
The reviewer had no concerns about the project in this area.

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 funding seems appropriate for the level of effort.

Reviewer 2:
The reviewer commented that the funding should be sufficient to achieve stated goals.

Reviewer 3:
The reviewer commented that resources appear to be in line with scope and timeline.

Reviewer 4:
The reviewer had no concerns about the project in this area.

Reviewer 5:
The reviewer commented that the project scope may be too large for the resources.

Presentation Number: van021
Presentation Title: Transportation Energy Evolution Modeling (TEEM) Program
Principal Investigator: Zhenhong Lin (Oak Ridge National Laboratory)

Presenter
Zhenhong Lin, Oak Ridge National 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 commented that the project approach appears to be well-thought-out and makes incremental improvements to reduce risk.

Reviewer 2:
The reviewer commented that the project employs assumption-impact linkages using system dynamics model based on consumer surveys and other secondary sources, but also original stakeholder input, for example, on the "insurance" value of low-utility features like ability to tow. The reviewer noted that the Transportation Energy Evolution Modeling (TEEM) has multiple activities that could potentially inform one another. The reviewer also remarked that the model has informed other DOE studies, such as the Baseline and Scenario VTO model and any other models within the SMART Mobility program.

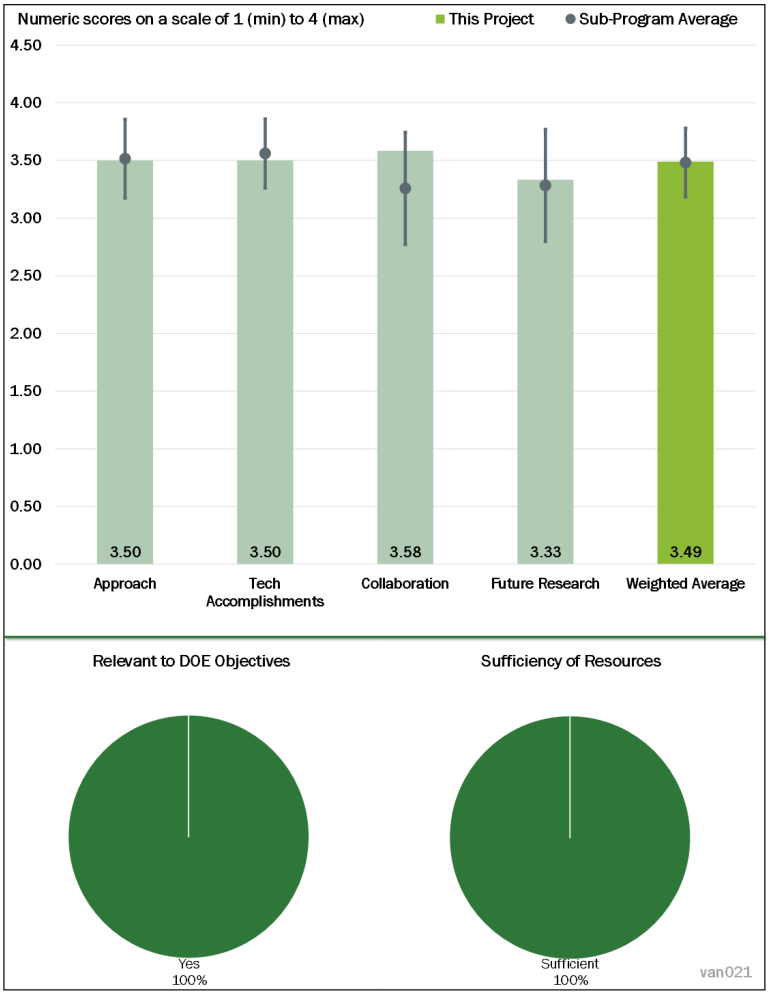

Figure 10-3 - Presentation Number: van021 Presentation Title: Transportation Energy Evolution Modeling (TEEM) Program Principal Investigator: Zhenhong Lin (Oak Ridge National Laboratory)

Reviewer 3:
The reviewer had no concerns about the project in this area.

Reviewer 4:
The reviewer commented that the project TEEM is linked to several other programs and tools. The reviewer believed the project team provided a good description of the goal and the milestones. Further, this reviewer acknowledged the need for resources.

Reviewer 5:
The reviewer noted that this project employs a comprehensive approach in evaluating market behavior and penetration of both vehicles and technologies via a consumer choice model. The reviewer believed that the overall method seemed coordinated with other VTO efforts and serves as a good complement to other work in

the portfolio. The reviewer said that validation and verification of the model was not discussed during the presentation and it was unclear to the reviewer whether this step is occurring or not.

Reviewer 6:
The reviewer commented that the project is focused on understanding producer and consumer behavior, which the reviewer believed is key to achieving DOE's goals. The reviewer found the work to be clearly integrated with related efforts in other agencies and laboratories.

The reviewer was concerned about the determination of future values of a couple "free" utility parameters, specifically, the make and model availability and the alternative specific constants, in the nested logit model. The reviewer believed that including the number of different vehicle alternatives available in each vehicle type category is justified to account for predicting shares of "representative vehicles" of different types (see McFadden, 1978). However, the reviewer believed in this case, there should be an additional term that accounts for the heterogeneity of consumer utility for vehicles within each type category. Furthermore, when dealing with future scenarios as this project does, the reviewer believed that it is difficult for modelers to determine what appropriate values for these terms are in the future and, as a result, they sometimes become fudge factors for modelers to adjust the predicted future scenarios to match their expectations. While the reviewer did not believe this project is making that error, additional documentation explaining exactly how these parameters evolve over future years, and what values have been assumed for them in producing the model results would be very useful.

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's progress appears good, including a number of interesting-looking papers.

Reviewer 2:
The reviewer commented that this project has made progress on several fronts, including modeling the synergy between shared and electric and beginning to probe what impacts that could have on the transportation sector. The reviewer also noted that the project had successfully completed other model upgrades, including adding vehicle automation, although less information or results were presented on these upgrades. The reviewer thought the linkage between shared and electric is particularly interesting as it appears few other projects presented as part of this subprogram's portfolio are currently investigating this link.

Reviewer 3:
The reviewer noted that about halfway through the project life, the team achieved several of its goals and have developed and integrated an approach to studying trends and adoption of new transportation technologies.

Reviewer 4:
The reviewer commented that the project is focused on producing a tool and scenario analysis of consumer adoption of vehicle technologies, which is clearly related to DOE goals. The reviewer noted that the project has made good progress so far, particularly in publishing articles that serve to bolster the rigor and transparency of the methods.

Reviewer 5:
The reviewer had no concerns on the project in this area.

Reviewer 6:
The reviewer commented that the new choice structure of the model now includes automation, shared mobility and transit, but does not appear to include non-motorized modes such as walking or riding a bike, as primary

transportation choices. The reviewer found the Initial scenarios of no automation versus no automation produced for 2030-2050, showing how automation improvements in fuel efficiency might affect uptake of BEVs, plug-in hybrid electric vehicles (PHEVs), hybrid electric vehicles, and internal combustions (ICs) to be very interesting. The reviewer commented that the assumption should be further examined through consumer segmentation to know what the energy and emissions implications are.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer commented that the project seems to have great collaboration within and outside of DOE.

Reviewer 2:
The reviewer commented that the project has a very broad set of collaborators, including industry, national laboratories, and universities.

Reviewer 3:
The reviewer commented that the project team has developed a broad collaboration with national laboratories, universities and internal institutions; a very good mix to gain more insights and make the projects models more robust.

Reviewer 4:
The reviewer commented that this project includes ample collaborators across national laboratories, universities, industry, and research organizations.

Reviewer 5:
The reviewer noted that the project identified good collaboration partners, with good variety both technically and geographically. The reviewer commented that there was a good range of stakeholders included, with exception of human powered transportation alternatives, such as bike or walking, which are especially relevant in urban settings. The reviewer further noted that electric bikes may be relevant as well, especially in Asia, but also in mature markets.

Reviewer 6:
The reviewer commented that there was limited stakeholder feedback from industry being solicited to provide certain inputs for the model. The reviewer noted that there were not many other external partners engaged at this point, and suggested growing the collaborator pool.

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 project appears to have a good plan for continuing to produce interesting results.

Reviewer 2:
The reviewer had no concerns about the project in this area.

Reviewer 3:
The reviewer commented that the travel time valuation for the TEEM model should probably work with Tom Stephens. The reviewer noted that integrating mobility as a service could be challenging and uncertainty should be bounded, assuming vehicle sharing versus private ownership, as these could potentially affect the bounds by a lot.

Reviewer 4:
The reviewer commented that the presentation explained well the progress to date and next steps. The reviewer recommended that the program team take a broader view about modes transportation and include other possible scenarios such as shared ownership, non-motorized transportation such as bicycles and walking, especially with the observed trend of younger generations living in urban, high-density areas. In addition, the reviewer noted that the resale value of vehicles with alternative technologies is expected to be important factor as well.

Reviewer 5:
The reviewer noted that there was not much information presented on the project's future work plans, although it appears the project is pursuing a range of activities to better resolve the understanding between shared, autonomous and electric. The reviewer commented that this research, plus the completion of the linkage between the MA3T model and TruckChoice, could potentially shed some light on some of the complex questions raised in the development of their overall assumptions. The reviewer commented it would have been interesting to have seen information regarding how the project plans to address the numerous barriers identified throughout the presentation.

Reviewer 6:
The reviewer commented that the proposed work focuses on questions that are important for DOE goals. However, the reviewer was unable to determine whether the project could be able to meaningfully model the synergy between vehicle automation and electrification as proposed when key demand and VMT elasticity parameters governing whether or not there are synergies are not yet well understood. The reviewer further commented that using the range of parameters determined by the VAN020 SMART Mobility project, it is likely that the simulated MA3T results for a particular policy incentive would be swamped by uncertainty in the model input parameters. The reviewer noted that while this was not specifically addressed by the presentation it is possible the project may already have a plan in place to handle such issues.

In conclusion, the reviewer stated that the focus on modeling long-term and short-term consumer mobility decisions could potentially be very useful and is backed up with comparatively more research that the project could draw from.

Question 5: Relevance—Does this project support the overall DOE objectives of petroleum displacement?

Reviewer 1:
The reviewer commented that this project helps to understand alternative transportation options that will help to reduce petroleum usage.

Reviewer 2:
The reviewer commented that this model assists with both predicting AFV market penetration and understanding the ultimate barriers to their acceptance.

Reviewer 3:
The reviewer commented that an energy transition is required for petroleum displacement, and believed a market dynamics modeling tool and communications can influence this.

Reviewer 4:
The reviewer believed that the outcome of this research would help decisions makers of future R&D efforts as well as policies to address energy consumption and reducing emissions.

Reviewer 5:
The reviewer commented that the project focuses on building tools to understand scenario analysis of producer and consumer behavior that is clearly relevant to DOE goals.

Reviewer 6:
The reviewer had no concerns regarding the project in this area.

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 to date the resources appear adequate and have achieved a good deal of work. The reviewer noted the researchers have expressed potential need for more resources in the future, which the reviewer thought should be revaluated as the project progresses.

Reviewer 2:
The reviewer commented that funding appears to be adequate for this scope.

Reviewer 3:
The reviewer had no concerns regarding the project in this area.

Reviewer 4:
The reviewer commented that the funding for this project specifically seems insufficient, but given a number of related efforts that work to develop the same tools it seems sufficient.

Reviewer 5:
The reviewer commented that the funds for this analysis are much higher than most of the other projects in the portfolio but seem reasonable due to the large scope of modeling activities and research.

Reviewer 6:
The reviewer commented that the budgeted funds are higher than other projects, but understood this higher funding level enables the project to produce much more accessible tools and publications that serve to increase the transparency and rigor of the work. The reviewer found this is important as it helps to build confidence in the project outcomes.

Presentation Number: van022
Presentation Title: Connected and Automated Vehicles
Principal Investigator: Aymeric Rousseau (Argonne National Laboratory)

Presenter
Aymeric Rousseau, Argonne National 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 commented that the project appears to be well-designed and feasible.

Reviewer 2:
The reviewer noted that this is an important, scientifically robust project that will serve a variety of stakeholders well, especially as POLARIS is open source. The reviewer thought that the integration of CAVs into this framework is a significant step and adds value.

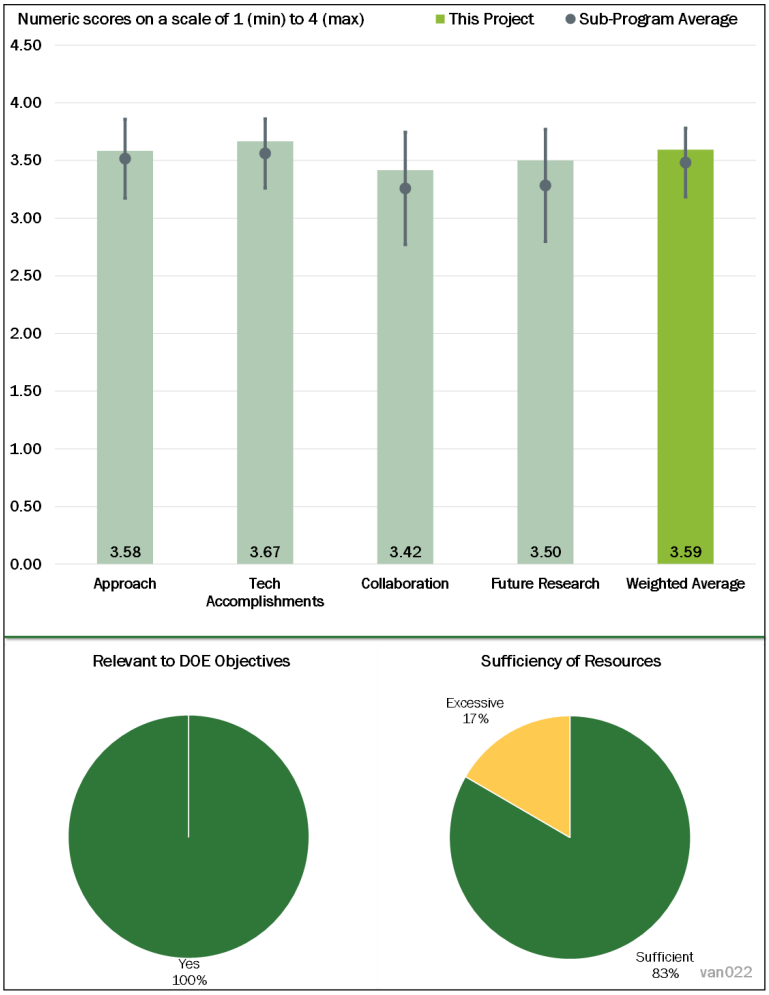

Figure 10-4 – Presentation Number: van022 Presentation Title: Connected and Automated Vehicles Principal Investigator: Aymeric Rousseau (Argonne National Laboratory)

Reviewer 3:
The reviewer commented that this project started in 2017 and has an ambitious goal of integrating information from various simulation and modeling tools to help understand barriers to market for new technologies. The reviewer believed the approach is sound and if executed well could lead to very useful insights.

Reviewer 4:
The reviewer had no concerns regarding the project in this area.

Reviewer 5:
The reviewer found there to be clear explanation of the four major DOE models, but now the models need to work for a metropolitan area. The reviewer noted that POLARIS will be used to process a range of inputs, be passed to Autonomie, and will output VMT and consumed energy. The reviewer found the largest uncertainty to be the decision modeling of individuals. The reviewer commented that the instead of using location specific agent data, the model is portable to different locations. The reviewer found the model to be closely linked with the TEEM project.

Reviewer 6:
The reviewer commented that the project is clearly relevant to achieving DOE goals in the SMART Pillars.

The reviewer found the general approach sound, but was not sure that the assumption that CAVs will be optimized for maximum energy savings will necessarily be the case. The reviewer noted that it could be useful to explore how much energy consumption changes if CAVs are instead optimized for shortest travel time, or include a scenario to tune the control logic between these two extremes.

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 given the early stage in the project, the team has done a good job testing the approach.

Reviewer 2:
The reviewer commented that the project is only 20% complete and there has been significant progress in this short time.

Reviewer 3:
The reviewer commented that project progress looks good.

Reviewer 4:
The reviewer commented that the project has made good progress, significantly improving the model and conducting several interesting analyses that align well with the objectives of the VTO.

Reviewer 5:
The reviewer noted that the efficiency bound of automation at the vehicle level for slope and speed has been modeled, showing up to about 3%-4% savings without vehicle interaction. The reviewer commented that the project has developed a framework for intersections and control theory to maximize energy savings, and applied it to highway vehicle following for several vehicles. The reviewer suggested reviewing a case study for the City of Chicago showing VMT and energy increases as a function of full automated vehicle (AV) automation, which breaks out fleet level from vehicle level energy impacts of AV penetration.

Reviewer 6:
The reviewer commented that the presentation covered the energy impact and the interaction of POLARIS and Autonomie in the context of evolving vehicle powertrain technologies. The reviewer requested to see a more through discussion of the implications of this work on the choices of future powertrain technologies, and those likely to more successfully support the objectives of Energy Efficient Mobility Systems.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer commented that the project has a wide variety of collaborators from both industry, government, and academia.

Reviewer 2:
The reviewer commented that the presenter mentioned FHWA funding of POLARIS. The reviewer further noted that many collaborations and coordination with government, bother federal and local, and private players appear to be underway, but little detail was provided.

Reviewer 3:
The reviewer commented that the list of partners looked good, although it was not clear what role they had.

Reviewer 4:
The reviewer commented that the project includes extensive group of collaborators across several universities, federal and city agencies. The reviewer noted that some partnership or input from manufacturers could serve to further strengthen the project.

Reviewer 5:
The reviewer commented that more collaboration with industry partners would help in assessing the relevance of the evolving technology choices.

Reviewer 6:
The reviewer commented that a good mix of collaborators including an international institution were associated with the project. The reviewer suggested including OEMs and possibly more international participation, as mobility patterns may be different.

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 work, particularly the linkage with the SMART work, looks interesting and logical.

Reviewer 2:
The reviewer commented that the future selected enhancements are interesting, particularly the work proposed for new modes of travel, including transportation network companies (TNCs) and CAVs, and addressing problems that could result from these modes, such as zero occupancy vehicles. Additionally, the ability to scale these analyses to a national level will be very useful, although admittedly challenging. The reviewer noted these changes could narrow some presently existing model gaps and provides a good focus for future work.

Reviewer 3:
The reviewer commented that zero occupancy vehicles make up important unknown that is planned for future work. The reviewer noted that including other modes like transit, bike, TNC will be key, but ultimately the question of whether AVs will be shared or privately owned should be bounded. The reviewer believed that this question could be the single biggest determinant of VMT and energy, because it determines the value of travel time, whether it is marginally high or marginally low.

Reviewer 4:
The reviewer commented that it was stated in the question and answer session of the presentation that future work on other projects will more fully evaluate the relevance to understanding evolving powertrain technologies.

Reviewer 5:
The reviewer commented that this is a new project; the near-term goals are well planned.

Reviewer 6:
The reviewer commented that the proposed work is appropriate for the goals of the project. The reviewer suggested, given the high computational complexity of the model, to quantify uncertainty using scenarios that vary key input parameters rather than running a Monte Carlo analysis that may not be computationally feasible.

Question 5: Relevance—Does this project support the overall DOE objectives of petroleum displacement?

Reviewer 1:
The reviewer commented that by improving efficiency petroleum use will be reduced.

Reviewer 2:
The reviewer commented that this work allows the evaluation of technologies that fit squarely within VTO's objectives.

Reviewer 3:
The reviewer commented that this project helps calculate scenarios for fleet-level energy impacts of CAVs.

Reviewer 4:
The reviewer commented that the research is very relevant not only to liquid fuels use but to overall energy efficiency and reduction of environmental emissions.

Reviewer 5:
The reviewer commented that the project could produce valuable results on how connected vehicles and cities can reduce petroleum use.

Reviewer 6:
The reviewer has no concerns regarding the project in this area.

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 level appeared appropriate.

Reviewer 2:
The reviewer commented that the resources for this project seem appropriate given the scope of the tool and the amount of work being accomplished.

Reviewer 3:
The reviewer commented that the resources appear to be aligned with the project scope and milestones.

Reviewer 4:
The reviewer had no concerns regarding the project in this area.

Reviewer 5:
The reviewer commented that the budget and resources appear to be sufficient at this time.

Reviewer 6:
The reviewer commented that the budgeted funding levels are significantly higher than many other projects. The reviewer noted that the project may very well require this level of funding to support high-performance computing capabilities or development of significantly new models compared to the other projects. It was just not completely clear from the presentation what the reasoning was for this significantly higher level of funding.

Presentation Number: van024
Presentation Title: Considerations for Corridor and Community DC Fast Charging Complex System Design
Principal Investigator: James Francfort (Idaho National Laboratory)

Presenter
John Smart, 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 commented that the project has an excellent approach.

Reviewer 2:
The reviewer commented that this is an important study with a solid, robust approach. The reviewer noted that the estimates provided in this presentation are useful to a variety of audiences and will be a significant part of the growing discussion regarding high-powered direct-current fast-chargers (DCFC).

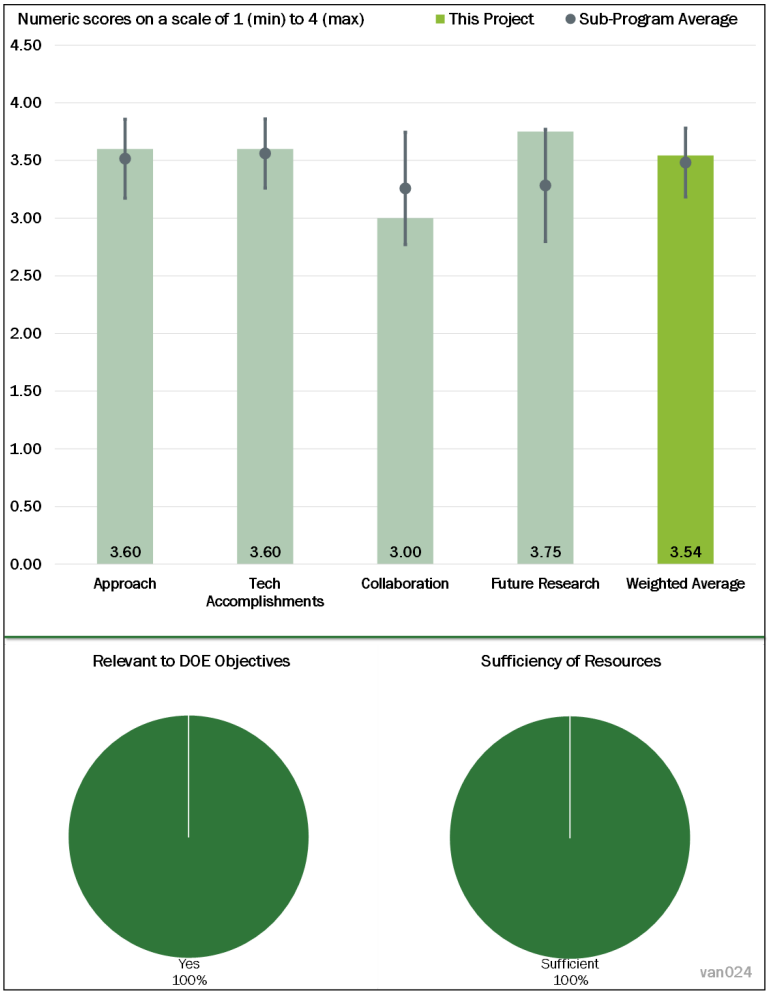

Figure 10-5 – Presentation Number: van024 Presentation Title: Considerations for Corridor and Community DC Fast Charging Complex System Design Principal Investigator: James Francfort (Idaho National Laboratory)

Reviewer 3:
The reviewer commented that the project focus is on providing faster charging for EVs. The reviewer noted that the project team has conducted a business case analysis for DCFC infrastructure by reviewing previous projects, including issues and lessons that were learned, and what the design parameters were. The reviewer mentioned that the project team convened working groups for industry and expert input. The reviewer thought that it made sense that this project did not model the parameters, but rather relied on consultation given what was probably a small dataset and a mostly prospective issue.

Reviewer 4:
The reviewer commented that the project was well scoped and executed and contained outputs that produced valuable insights.

Reviewer 5:
The reviewer commented that some gaps may exist in the approach regarding the understanding of the economic model for funding DCFC projects. The reviewer noted that the project mentioned that private funding is often not profitable under current market conditions, but did not present a clear method of addressing this concern.

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 results look great.

Reviewer 2:
The reviewer commented that the project was completed, providing some of the earliest available research on high-powered DCFCs.

Reviewer 3:
The reviewer had no concerns regarding the project in this area.

Reviewer 4:
The reviewer commented that the project was completed and written up. The reviewer noted that recommendations were produced, some highlighted recommendations dealt with onsite energy storage and generation and a phased upgrade strategy. The reviewer further noted that the major cost drivers making existing DCFC projects unfavorable in current market were identified, and concepts for charging complex architecture developed. The reviewer asked why above-ground distribution was not considered to reduce installation costs and if feasible options exist to reduce capital costs. The reviewer found the breakeven analysis is very interesting and suggested it be augmented with ancillary service revenue.

Reviewer 5:
The reviewer noted that the project was successfully completed. The reviewer commented that even though the project produced results that imply it will be difficult to provide EV charging infrastructure with a sustainable business model, the insights are valuable for DOE to be able to move forward on addressing this barrier.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer noted that the project consulted with industry and the Electric Power Research Institute, which was reasonable given the limited budget and proprietary information involved.

Reviewer 2:
The reviewer commented that it would have been good to have a wider base of contributors. The reviewer acknowledged that this area is competitive, and finding areas to collaborate and coordinate together is difficult.

Reviewer 3:
The reviewer commented that there were not a huge number of collaborators on this project, however, the study was limited in scope and Idaho National Laboratory (INL) is one of the few institutions doing this work currently.

Reviewer 4:
The reviewer commented that the project involved some partners, but did not include collaborations with OEMs, consumer behavior researchers, or other national laboratories or agencies. The reviewer noted that the work could have benefited from input from some of these other groups.

Reviewer 5:
The reviewer commented that the project may benefit from industry partners from the DCFC supply base and PEV OEMs to further explore under what set of conditions funding of public DCFC stations will be viable.

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 has ended.

Reviewer 2:
The reviewer noted that the project is complete.

Reviewer 3:
The reviewer noted that although this study is completed, the future work described a follow-on study that is very relevant given the barriers specified in this presentation. The reviewer commented that understanding what a viable business case for DCFC looks like going forward will be necessary for this industry to survive and investigating the components presented in this list, such as demand charges, will be important pieces of the solution.

Reviewer 4:
The reviewer commented that sophisticated optimization would be useful to validate these consultation-based findings, as well as revenue options analysis to help support the ROI of the complexes. The reviewer noted that vehicle-to-grid bidirectional charging might support peak shaving, though at the cost of high turnover.

Reviewer 5:
The reviewer commented that the project may benefit from industry partners from the DCFC supply base and the PEV OEMs to further explore under what set of conditions funding of public DCFC stations will be viable.

Question 5: Relevance—Does this project support the overall DOE objectives of petroleum displacement?

Reviewer 1:
The reviewer commented that increasing transportation electrification will reduce petroleum usage.

Reviewer 2:
The reviewer commented that this project is incredibly relevant to the ultimate market acceptance of AFVs, and will hopefully aid in addressing what is currently a major roadblock.

Reviewer 3:
The reviewer commented that the project results are valuable for DOE to consider whether EV fast-charging is a viable and cost-effective path forward to reducing petroleum use or whether alternative technology pathways are more preferred.

Reviewer 4:
The reviewer commented that this project supports DOE objectives to the extent that fast-charging is important to petroleum displacement.

Reviewer 5:
The reviewer had no additional concerns regarding the project in this area.

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 adequate to complete the project as expected.

Reviewer 2:
The reviewer commented that the project produced meaningful results with a relatively small budget and a very quick timeframe. The reviewer noted that the investigators should be commended for their efforts.

Reviewer 3:
The reviewer commented that the resources seemed sufficient for the project size.

Reviewer 4:
The reviewer commented that the project has been completed.

Reviewer 5:
The reviewer had no concerns regarding the project in this area.

Presentation Number: van025
Presentation Title: Modeling Framework and Results to Inform Charging Infrastructure Investments
Principal Investigator: Marc Melaina (National Renewable Energy Laboratory)

Presenter
Marc Melaina, 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 review commented that the project's approach looks great.

Reviewer 2:
The reviewer commented that the project included a good range of studies in studying the electric vehicle supply equipment (EVSE) role in supporting PEV growth requirements.

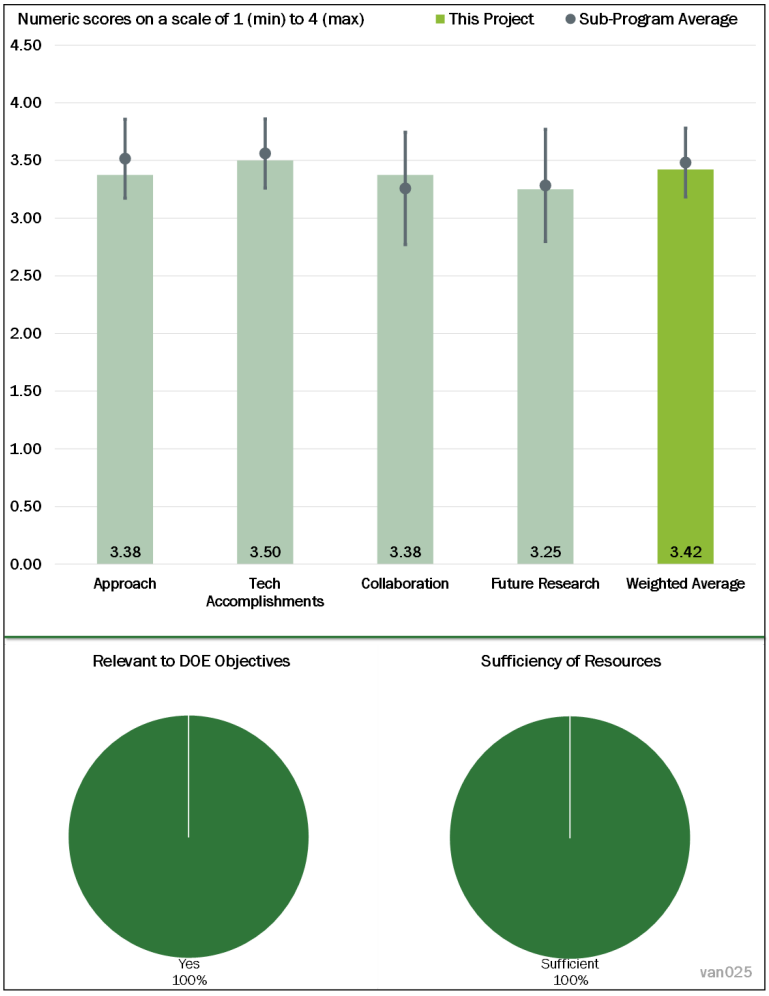

Figure 10-6 - Presentation Number: van025 Presentation Title: Modeling Framework and Results to Inform Charging Infrastructure Investments Principal Investigator: Marc Melaina (National Renewable Energy Laboratory)

Reviewer 3:
The reviewer commented that this project informs electric vehicle EVSE planning at the state, local and utility level by taking account of uncertainty through scenario analysis for future vehicle fleet and their requirements. The reviewer noted that five separate analyses feed into the research goal of the project, including a Massachusetts-wide EVSE needs planning study.

Reviewer 4:
The reviewer commented that the aim of the project on understanding the role of vehicle technology adoption on increased electric miles is a useful goal that has synergies with other VTO projects. The reviewer noted that because the National Economic Value Assessment of Plug-In Electric Vehicles (NEVA) results rely on optimistic trends for PEV cost and performance, it is difficult to know how meaningful the results are. The reviewer suggested that scenarios of parameters be proposed and carefully reviewed by multiple individuals with expertise in consumer behavior and electric vehicles, perhaps in a workshop format. The reviewer further commented that comparing the model results with other estimates of the private and social benefits of PEVs in published articles and reports would be useful. The reviewer sensed that the project's results are much more optimistic than other estimates. The reviewer suggested including a scenario of non-plug-in hybrids as a comparison to determine whether or not the social benefits of hybrids outweigh the social benefits of PEVs.

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 progress to date looks excellent.

Reviewer 2:
The reviewer commented that the NEVA basic cost and benefit estimates for national scenarios combined wedges and showed both VMT and fleet displacement by BEVs, PHEVs, etc. The reviewer noted that the Massachusetts analysis, an infrastructure projection tool, mapped out necessary infrastructure to meet state's EV goal by 2025. The reviewer noted that net costs and benefits for national deployment scenarios are nicely captured by stacked bar charts, but should clarify whether the societal benefits are based on tailpipe or lifecycle greenhouse gas emissions. The reviewer commented that the national corridor work also uses scenario-based analysis, which makes sense to bind the costs and benefits. The reviewer wondered how this project interacts with the DOT Alternative Fuels Corridors (AFCs) that were designated very recently.

Reviewer 3:
The reviewer commented that while the project seems mostly on track, it is ending in a few short months and has only completed 75% of the work planned for the full 3 years. The reviewer noted that it would have been helpful to see a timeline of project goals indicating which ones have been completed and the plan for completing the remaining work.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer commented that the project had a solid set of partners in industry, states, cities, and other federal agencies. The reviewer was curious what the DOT collaboration is, given DOT's Fixing America's Surface Transportation Act's statutorily required AFC program, which is very relevant to charger investment.

Reviewer 2:
The reviewer commented that there appears to be good collaboration, although it seemed to be an area for improvement.

Reviewer 3:
The reviewer commented that the project includes partners from several federal agencies as well as stakeholders relevant to the Massachusetts and Ohio case studies. The reviewer noted that the project would have benefited from collaboration with OEMs and university researchers, particularly in selecting appropriate input parameters for PEV cost and performance.

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 future plans seem to be appropriate and logical.

Reviewer 2:
The reviewer noted that uncertainty around future EV markets will require sensitivity analysis to the model. The reviewer suggested incorporating MA3T as an input and exploring greater DOT coordination as well as collecting data from large charger deployments in New York City.

Reviewer 3:
The reviewer commented that the proposed questions for future work are the right ones to focus on, particularly regarding acquiring market data to understand the relationships between increased EVSE availability and consumer demand for PEVs and electric VMT. The reviewer noted that from the presentation, it was not clear how the project anticipates acquiring these data.

Question 5: Relevance—Does this project support the overall DOE objectives of petroleum displacement?

Reviewer 1:
The reviewer noted that improving infrastructure will increase electrification and reduce petroleum usage.

Reviewer 2:
The reviewer commented that because electrification is largely limited by charging infrastructure, this type of model is a necessary part of the EV chicken and egg solution.

Reviewer 3:
The reviewer commented that the project is relevant to the DOE goal of petroleum displacement, particularly in how it relates to understanding the relationship between PEV availability and electric miles driven.

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 funding appears to be sufficient.

Reviewer 2:
The reviewer commented that resources appear adequate and consistent with the project scope.

Reviewer 3:
The reviewer commented that the budgeted funds are appropriate for the scope of the project.

Acronyms and Abbreviations

AFC	Alternative Fuel Corridor
AFV	Alternative fuel vehicle
AMR	Annual Merit Review
ANL	Argonne National Laboratory
AV	Automated vehicle
BEV	Battery electric vehicle
CAV	Connected and automated vehicle
DC	Direct current
DCFC	Direct-current fast charging
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
EV	Electric vehicle
EVSE	Electric vehicle supply equipment
FHWA	Federal Highway Administration
HDV	Heavy-duty vehicle
kW	kilowatt
MA3T	Market Acceptance of Advanced Automotive Technologies
NACFE	North American Council on Freight Efficiency
NEVA	National Economic Value Assessment
OEM	Original Equipment Manufacturer
ORNL	Oak Ridge National Laboratory
PHEV	Plug-in hybrid electric vehicle
R&D	Research and development
SMART	Systems and Modeling for Accelerated Research in Transportation
TEEM	Transportation Energy Evolution Modeling
TNC	Transportation network company

VAN	Vehicle Analysis
VMT	Vehicle miles traveled