

9. Vehicle Analysis

The Vehicle Analysis (VAN) subprogram provides testing and analysis relevant to the U.S. Department of Energy (DOE) Vehicle Technologies Office (VTO). The subprogram mission is to plan, execute, and communicate technology, societal, economic, and interdisciplinary analyses for the U.S. Department of Energy (DOE), the Office of Energy Efficiency and Renewable Energy (EERE), VTO, and external stakeholders. Overarching activities within this subprogram serve to develop and deploy vehicle technologies that reduce the use of petroleum while maintaining performance, power, and comfort, and help people access and use efficient, clean vehicles that meet their transportation needs.

Along with work in individual technologies such as combustion engines, batteries, electric drive systems, and fuels, VTO funds research that explores how to connect these components and systems together in the most effective, efficient way possible. Much of this work uses specialized equipment and software that VTO developed in partnership with the national laboratories, including the industry-leading modeling software Autonomie. To inform its activities, VTO also collects and reports its research results, data on individual advanced vehicles, and information on the transportation industry.

Researchers use these approaches to combine multiple technologies within an overarching “vehicle systems perspective”:

- Benchmarking is the process of collecting a standard set of baseline data for a component or entire vehicle. Researchers can use this data to validate models that simulate vehicles or compare it to data from new technologies to see how much they improve on existing ones.
- Vehicle modeling and simulation tools allow researchers to save time and money by building “virtual vehicles” where they can simulate the use of different technologies before building actual components.
- Integration, validation, and testing tools and procedures help researchers combine and test multiple physical components as well as entire vehicles in consistent, cost-effective ways.

Along with improving vehicle technologies, other software packages developed by the national laboratories help researchers better understand consumer behavior, vehicles’ environmental effects, the societal benefits of different technologies, and trends in the transportation system.

Subprogram Feedback

DOE received feedback on the overall technical subprogram areas presented during the 2015 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.

Subprogram Overview Comments: Jacob Ward (U.S. Department of Energy) – van999

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

Reviewer 1:

The reviewer said yes, using the pyramid for technical topics along with the goal/objective/strategy overview provided a comprehensive picture.

Reviewer 2:

The reviewer said yes. Mr. Ward gave an appropriately clear presentation on his program area and the general strategy and approach. The reviewer thought the objective might benefit from some revision to align with addressing a concise problem or set of problem and provide actionable findings or results that can result in discrete actions by researchers, policy makers, legislators, regulators, etc.

Reviewer 3:

The reviewer said that the program area was well covered in a clear and concise presentation. The reviewer appreciated that the program manager gave this presentation at the beginning of the VAN session for those reviewers who were unable to attend earlier sessions in the week. This session set the context and tone for all subsequent project presentations successfully.

Reviewer 4:

The reviewer said yes, the goals, objectives, and strategy were adequately covered.

Reviewer 5:

The reviewer said yes, and detailed that the strategy was described, and that the traditional pyramid clearly laid out the relationships between projects.

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

Reviewer 1:

The reviewer said yes, there is significant near-term research and development (R&D) with respect to consumer choices (including in the past) as well as long-term prediction models that look out to 2050 and beyond.

Reviewer 2:

The reviewer said yes, and elaborated that this program supports data collection, modeling, and analysis. Data and model development activities needed to provide supporting program analyses were described. The reviewer noted that previous and future fiscal year activities were identified and discussed.

Reviewer 3:

The reviewer said maybe, and noted that there is lots of emphasis on consumer decision modeling. The reviewer suggested that there could be more coordination with the U.S. Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA), who are modeling actual policy for the mid-term review. The reviewer asked if there is there any possibility of integrating with the rest of DOE, such as with the grid folks from the DOE Office of Electricity Delivery and Energy Reliability (OE).

Reviewer 4:

The reviewer said that, given that many of the models span the horizon in question, the answer would seem to be yes. However, the reviewer thought more discrete segmentation for some of the research is warranted. The types of models, research, or questions that are asked for short-term, mid-term, and long-term are different. Consequently, different resolutions in the output and problem framing are seen or are needed. The reviewer noted that big, overarching models have potential value, as do discrete models that operate within a narrow framework or problem space.

Reviewer 5:

The reviewer said that this is not applicable to this program

Question 3: Were important issues and challenges identified?

Reviewer 1:

The reviewer observed an opportunity to explicitly identify challenges more clearly. The reviewer thought that some of this was stated verbally, but not highlighted in the slides.

Reviewer 2:

The reviewer said yes, and explained that key areas of analysis and associated issues and challenges were identified and discussed.

Reviewer 3:

The reviewer said that important issues and challenges were identified for each level of the VTO analysis program, including data quality, model fidelity and validation, and keeping models up-to-date with regards to timely topics.

Reviewer 4:

The reviewer said yes, and described that these include transition and infrastructure and integration of technology improvements.

Reviewer 5:

The reviewer described the identification of important issues and challenges as adequate, and explained that more attention could be given to specific areas in need of focus or that have fallen short. The reviewer suggested that work could improve by grounding in better identification and articulation of problems related to the topic space.

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

Reviewer 1:

The reviewer said yes, and described that data, analysis, and modeling elements key to addressing issues and challenges were identified and plans for addressing those needs were provided.

Reviewer 2:

The reviewer said that for each level of the program, future work was identified to address the challenges above.

Reviewer 3:

The reviewer said that, in general, plans for identifying issues and challenges were excellent. The reviewer detailed that in the analysis program, the survey project, while a small part of a strong research program, is somewhat ad hoc. While future work will make it more consistent and valuable, the emphasis on stated preference is still a challenge.

Reviewer 4:

The reviewer said somewhat, though the reviewer believed that that this could be improved to be more methodical.

Reviewer 5:

The reviewer said that plans were challenging to discern during the presentation.

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

Reviewer 1:

The reviewer noted that the program manager showed highlights of progress in each of the program areas versus 2014.

Reviewer 2:

The reviewer said yes, and that progress toward meeting key program elements was provided by fiscal year.

Reviewer 3:

The reviewer detailed that Slide 7 clearly showed progress at least in the market, though it was a bit of a leap to attribute this directly to work funded by VTO.

Reviewer 4:

The reviewer noted that for each level in the VTO analysis pyramid, the program manager presented achievements for fiscal year (FY) 2014-2015, but the reviewer was unsure that this was benchmarked against previous years explicitly. However, compared against the program overview from last year, it was obvious that significant achievements have been made.

Reviewer 5:

The reviewer said moderate, and commented that not all projects were reviewed last year. The presentation described illustrative examples.

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 said definitely, as there appears to be close coordination and integration with overall DOE and VTO goals.

Reviewer 2:

The reviewer said yes.

Reviewer 3:

The reviewer said yes, and commented that data collection and model development activities directly address the analytical needs of VTO.

Reviewer 4:

The reviewer said that the data, models and analysis supported by this program provide - information critical to understanding how VTO R&D investment can support DOE/VTO goals of reducing petroleum consumption as well as greenhouse gas (GHG) emissions.

Reviewer 5:

The reviewer said topically yes, but as the question and answer (Q&A) and the reviewer suspected, the suite of reviewer comments would show that several of the actual projects or their execution are falling short.

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

Reviewer 1:

The reviewer said yes, the focus and management appeared to be robust and effective. The reviewer noted that the program manager did a good job of presenting a confident front for the important work that is funded through him.

Reviewer 2:

The reviewer said yes, and detailed that there appeared to be excellent collaboration among the project participants. Program goals are well defined and understood by program participants and they provide a cohesive contribution toward the overall objective.

Reviewer 3:

The reviewer said that the program has a clearly articulated goal, objective, and strategy. Each project within the program has a logical place within this plan, with little redundancy.

Reviewer 4:

The reviewer said yes.

Reviewer 5:

In general, the reviewer thought the program is well-managed. The challenge for any DOE program manager is how to balance what should actually be done with the need or expectation to support various projects at national laboratories. This reviewer found it difficult to tell if some of the programs were by choice or out of forced obligation.

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 said that the Data Book and market report are well established products that are widely used and well received, and the reviewer cited the Google impact score. The Greenhouse Gas, Regulated Emissions, and Energy Use in Transportation (GREET) model is also a widely used, highly respected tool for industry.

Reviewer 2:

The reviewer said that while many of these projects address similar issues, each brings a unique perspective to addressing and analyzing the issue in question. All of these efforts stand out as providing a valuable contribution to better understanding issues related to VTO programs, estimating their potential impact in the marketplace, and measuring the associated energy consumption and GHG emission effects of their success.

Reviewer 3:

The reviewer said yes, and noted that VAN0014 stood out as particularly well-constructed and executed. In general, the project researchers seemed to understand how the team fits into the larger model and tool framework pyramid. The reviewer detailed that weaknesses will be included in the descriptions in the individual project reviews. The reviewer commented that, in general, in reflecting on the projects, there seemed to be heavy emphasis on deterministic outcomes that tend to be framed by or constrained with reaching pre-determined outcomes, and little analysis looking at stochastic processes that lead to divergent or undesired outcomes relative to policy objectives.

Reviewer 4:

The reviewer said that while redundancy with regard to market penetration modeling is a good thing (different approaches will yield different results), they do seem to make up the bulk of the program. The reviewer noted that this is especially obvious when examining the summary chart (Slide 21) of the presentation. The reviewer cited a project that stands out as a pillar of the VTO analysis program is GREET, and wondered if perhaps that is why this is the only model covering emissions and environmental modeling.

Reviewer 5:

The reviewer noted that GREET, the Transportation Energy Data Book, and Autonomie stand out as strong. Now that vehicles are in the market, the generic survey work seems less relevant.

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

Reviewer 1:

The reviewer said yes. In many ways, the data collection and model development projects/activities are innovative and provide insights critical to understanding the potential impact advanced technology vehicles could have in the market. The reviewer said that these projects are key to identifying and understanding consumer acceptance issues and developing tools/models to explore the potential implications associated with those issues. The reviewer commented that gaining this knowledge supports the VTO programs and other stakeholders that support the successful implementation of advanced technologies in vehicles.

Reviewer 2:

The reviewer said yes.

Reviewer 3:

The reviewer said yes, some do. The project led by Manley, in particular, stands out, while the others for the most part do not. The reviewer suggested that it might be worth considering the merits of continuing model development that has spanned more than 10 years in some cases, versus seeking alternative approaches to the scientific inquiry.

Reviewer 4:

The reviewer said there is a moderate amount of innovation being employed. The reviewer got the sense, however, there may be room for innovation, as most of these tools are more conventional data gathering, analysis, and synthesizing the data into graphs and conclusions.

Reviewer 5:

The reviewer said that this question is not applicable to this program.

Question 10: Has the program area engaged appropriate partners?

Reviewer 1:

The reviewer said that there does appear to be wide collaboration within DOE, with various national laboratories, universities, and other Federal agencies.

Reviewer 2:

The reviewer said yes.

Reviewer 3:

The reviewer said yes, both industry and laboratories.

Reviewer 4:

For the most part, this reviewer found that each project within the program area had very good partner engagement. This seemed to the reviewer to be a priority of all VTO analysis programs, such that no principal investigator is working in a vacuum.

Reviewer 5:

The reviewer said yes, some of the partners are appropriate, but there seemed to be a number of missing partners. The reviewer expressed concern that very few universities seemed engaged, which appeared to have led to a group-think mentality and approach as a diversity of approaches and educational backgrounds was lacking.

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

Reviewer 1:

The reviewer said yes, indications are that collaboration is effective.

Reviewer 2:

The reviewer said yes.

Reviewer 3:

The reviewer noted that the program has strong support from and collaboration among various national laboratories, including Argonne National Laboratory (ANL), Oak Ridge National Laboratory (ORNL) the National Renewable Energy Laboratory (NREL), and Sandia National Laboratories (SNL). In particular, the reviewer noted that van003 and van005 seemed to have made very good use of these collaborations in contribution to their accomplishments this year.

Reviewer 4:

The reviewer said yes.

Reviewer 5:

The reviewer said that effective collaboration varies.

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

Reviewer 1:

The reviewer said there appeared to be none.

Reviewer 2:

The reviewer said that the portfolio is comprehensive and covers issues of importance.

Reviewer 3:

The reviewer perceived that the nature of these tools would lend them to plugging into big data and other data streams as well as using tools such as geographic information systems (GIS) to significantly enhance the sophistication and output of the tools.

Reviewer 4:

The reviewer cited the survey of alternative fuel vehicle users. There are additional opportunities to partner with projects that track alternative vehicle owners or buyers. The reviewer saw projects that do this.

Reviewer 5:

The reviewer said yes.

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

Reviewer 1:

The reviewer said no.

Reviewer 2:

The reviewer said yes. Additionally, the impact analysis area as presented was lacking. The inability to disaggregate gains toward objectives that would occur, or are occurring independent of DOE activity functionally makes the results useless. The reviewer said that investment by industry, advances driven from outside the United States, advances resulting in investment from other agencies, etc., are occurring. The reviewer said that taking credit for them, and making broad, but illogical, assumptions about technology deployment across multiple platforms simultaneously does not help inform where R&D needs actually exist or where resources can best be applied.

Reviewer 3:

The reviewer was surprised that there is only one model covering the important topic of emissions and environmental modeling, while there are six models covering market penetration.

Reviewer 4:

The reviewer noted surveys of alternative vehicle owners, rather than general consumers. However, the reviewer acknowledged that this is being addressed in one project.

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

Reviewer 1:

The reviewer could think of none.

Reviewer 2:

The reviewer had no suggestions.

Reviewer 3:

The reviewer said yes. The reviewer identified that alternative (i.e., non-life cycle assessment (LCA)) models to GREET should be an imperative.

Reviewer 4:

The reviewer suggested coordination with NHTSA and EPA on vehicle choice modeling.

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

Reviewer 1:

The reviewer had no recommendations.

Reviewer 2:

The reviewer said that the current approaches adequately address the barriers.

Reviewer 3:

The reviewer referenced prior comments regarding how employing GIS and plugging into big data sources and analysis tools would be a clear enhancement.

Reviewer 4:

The reviewer said yes, and preferred to have a direct conversation with the program manager.

Reviewer 5:

The reviewer cited transition models. The reviewer suggested working with the policy office or other agencies to look at policies to introduce alternative vehicles.

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

Reviewer 1:

The reviewer said that this is a good program with critical research thrusts.

Reviewer 2:

The reviewer had no additional suggestions.

Reviewer 3:

The reviewer was unsure if linking VTO investment directly to petroleum displacement is accurate. Certainly there is an effect, the reviewer acknowledged, but the free market itself as well as corporations are likely the major drivers here.

Reviewer 4:

The reviewer suggested continuing to solicit a wide variety of stakeholder input. In particular for the system-level integrated analysis, engage with industry to challenge modelers' assumptions and sanity check results.

Reviewer 5:

The reviewer explained that these comments will be expanded on in the individual review, and described reliance on the GREET model as the single model for GHG calculation as problematic. Each of the other areas have multiple models. This is an under-appreciated approach, as it gives a breadth of analysis to provide insight or understanding. The reviewer said that given that all models are wrong, and have limitations as imperfect representations of the real world, it becomes imperative to test and explore using different tools targeted at providing answers to discrete, but limited, problems and questions. The reviewer acknowledged that GREET has value, but it also has its limitations and, worse, is treated as providing an accurate and precise answer which is not the case, especially for several fuel pathways. The reviewer described that there are simply inherent limitations to lifecycle assessment (LCA) as a methodology that cannot be corrected by increasing the complexity of the model, or believing that improved input data is the solution. The reviewer said that the result is potentially, or as some legitimately argue, a history of a misinformed program or belief that some activities and technologies are reducing GHGs (for example corn ethanol, and other biofuel pathways) when credible (peer reviewed) alternative analysis suggests the answer is more neutral or perhaps an increase in GHG. The reviewer explained that this comment is not to argue which answer is right, but to help articulate the need for different types of models and approaches that can provide valid, but alternative insights and complement the findings of GREET.

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.

Presentation Title	Principal Investigator and Organization	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
Impact Analysis: VTO Baseline and Scenario (BaSce) Activities	Stephens, Tom (ANL)	9-12	2.58	2.75	3.08	3.00	2.78
Emissions Modeling: GREET Life-Cycle Analysis	Wang, Michael (ANL)	9-17	3.25	3.33	3.00	3.25	3.26
Consumer Vehicle Technology Data	Singer, Mark (NREL)	9-22	2.67	2.92	2.83	2.83	2.83
Unified Modeling, Simulation, and Market Implications: FASTSim and ADOPT	Brooker, Aaron (NREL)	9-27	3.42	3.42	3.08	3.33	3.36
Consumer-Segmented Vehicle Choice Modeling: the MA3T Model	Lin, Zhenhong (ORNL)	9-32	3.08	3.17	3.42	3.33	3.20
Parametric Vehicle Choice Modeling: ParaChoice	Manley, Dawn (SNL)	9-36	3.25	3.42	3.25	3.25	3.33
PEV Consumer Behavior in Practice (PCBIP)	Nicholas, Mike (UCD)	9-41	3.33	3.08	2.83	2.83	3.08
Overall Average			3.08	3.16	3.07	3.12	3.12

Impact Analysis: VTO Baseline and Scenario (BaSce) Activities: Tom Stephens (Argonne National Laboratory) - van001

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 noted that the project is fully relevant, and it is valuable to estimate effects of program goals, fleet level analysis. Benefits analysis of completely successful fully commercialized VTO. The reviewer asked if the project team uses the Vision model and then GREET. The reviewer added that the no program case and interaction with corporate average fuel economy (CAFE) standards are not clear. It looked like the counter-factual case is not integrated assuming model years (MY) 2017-2025 CAFE standards.

Reviewer 2:

The reviewer reported that the analytical approach provides an effective process for measuring potential energy and emissions impacts of fully successful R&D programs. Market adoption of technologies presented was very aggressive and may overstate the potential impact given financial investment needed to support production. The reviewer added that as stated by the presenter, the process could be improved through additional sensitivity analyses addressing uncertainties in consumer behavior and/or acceptance, fuel prices, and fueling infrastructure development.

Reviewer 3:

The reviewer commented that this project seeks to quantify petroleum, GHG emissions, and level cost of driving reductions that can directly be attributed to VTO program. By nature, this project must be well integrated with all other VTO analysis activities, according to the VTO portfolio pyramid. The reviewer added that one comment from previous reviews that still seemed to be an open issue is how the supply-side is modeled: for example, how to disaggregate improvements from VTO R&D versus regulation and consumer

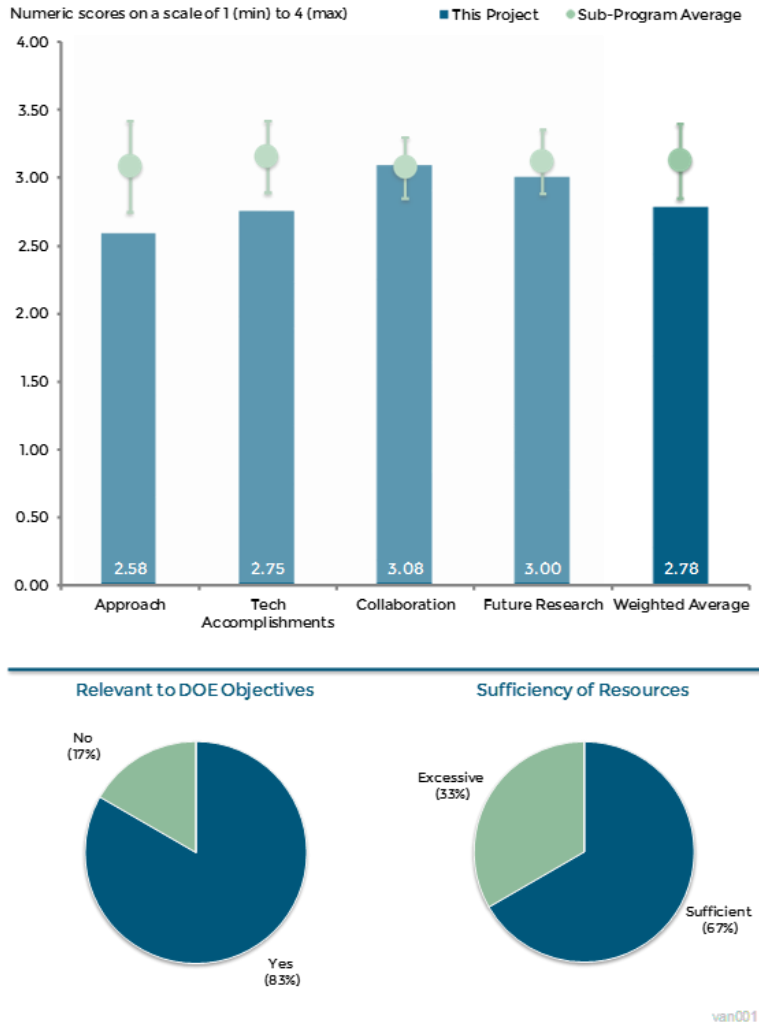


Figure 9-1 Impact Analysis: VTO Baseline and Scenario (BaSce) Activities: Tom Stephens (Argonne National Laboratory) – Vehicle Analysis

market demands. One suggestion is to refocus the model to address actual gaps (what industry is struggling with versus what they already have in hand) as a way to better overcome barriers.

Reviewer 4:

The reviewer noted that the project provides a method of analyzing the impact of VTO targets by synthesizing VTO analysis models. The analysis provides estimates of how VTO programs affect petroleum use and GHG emissions. However, without validation of the combined model, it is difficult to have any confidence in the results. Also, the reviewer said that the counterfactual, no program case is based on consultations with the VTO, which is welcome, but it is not clear that the assumptions for this case characterize the technological progress and purchasing and driving behavior that would result from additional factors external to the VTO program. The reviewer added that the project would benefit from considering the influence of regulations, incentives, demographic changes, and other factors that would affect petroleum and GHG reductions in the no program case, and making all assumptions and results from this case transparent.

Reviewer 5:

The reviewer said that how the research disaggregates the improvements from VTO research from improvements from industry and other research was unclear. The research does not seem to factor or consider technology path dependence. The reviewer added that there is no justification for aggregating all of the improvements as that is an unrealistic view of technology deployment. This would lead to investment in R&D that will have negligible if any end-use benefit.

The reviewer strongly emphasized that the lack of rational fiscal constraints in the model and analysis makes it hard to extract value. The comments from the prior peer review were spot on, but do not seem to be functionally addressed. The reviewer also said that when rational constraints are imposed it reveals the need to target investment and R&D. Unfortunately, the research fails to inform what areas should be prioritized and what should be diminished.

Reviewer 6:

The reviewer stated that although the approach seems reasonable in principle, in practice the reviewer was not sure how defensible any analysis is that estimates the impact of VTO investments versus no investments as there are so many other market driven, original equipment manufacturer (OEM)-driven, and other factors.

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 reported that the project has made good progress, but is behind on a couple of milestones.

Reviewer 2:

The reviewer stated that the analytical tools and models used are appropriate for this analysis.

Reviewer 3:

The reviewer said use vehicle choice models previously mentioned, and that this is an excellent use of these models.

Reviewer 4:

The reviewer noted that the fleet-level analysis is behind schedule but the explanation was that the scope of this task grew significantly in the interim. The results that have been shown meet the goals of showing petroleum, GHG emissions, and cost savings in the case of VTO program success versus a baseline of no further investment. The reviewer added that savings are broken down by technology area, which is useful. It is unclear what assumptions go into that baseline case and the reviewer would like to see some uncertainty analysis performed.

Reviewer 5:

The reviewer pointed out that the project team showed various graphs and results, but the reviewer did not feel the methodology was articulated well enough to build confidence in the results, for example, why any of these results should be believed. There also appeared to be a lack of validation of results, or at least no words paid to validation, which is an answer to the question of was the right thing built, as opposed to verification of was it built right.

Reviewer 6:

The reviewer said that the optimistic market penetrations are not given in context. This is not useful for informing tech development, as the results seem to be presented as likely or expected outcomes, which is very misleading

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

The reviewer said that the project team has excellent collaboration.

Reviewer 2:

The reviewer remarked that there is commendable collaboration and coordination across and between analytical teams.

Reviewer 3:

The reviewer commented that the project has a strong set of diverse collaborators from the national laboratories, industry, and research organizations. It could benefit from collaboration with OEMs.

Reviewer 4:

The reviewer stated that the project team's collaboration appears to be improved from the last review, and noted collaboration with Volpe should be beneficial to improving results and confidence. A number of collaborations were mentioned, or at least their emblems were shown, but the project team did not provide any depth to the collaboration, so it was hard to assess how well this was actually going other than the comment about the U.S. Department of Transportation (DOT)-Volpe.

Reviewer 5:

The reviewer said that on the modeling side, the project has strong collaborations with several national laboratories through use of other VTO Analysis models. The reviewer suggested expanding industry stakeholder input with regard to supply-side constraints in the model.

Reviewer 6:

The reviewer noted that the project team's collaboration is largely limited to national laboratories which significantly limits the perspective. It was noted that component level attributes seek industry experts, but does not explain how, or address potential biases in this stage of information collection.

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 work to compare results of different vehicle choice models as well as to conduct sensitivity analysis is sensible. The reviewer recommended to also prioritize improving supply-side constraints.

Reviewer 2:

The reviewer stated that the areas of future work, sensitivity analysis, etc., were defined and discussed.

Reviewer 3:

The reviewer reported that future research addresses vehicle choice model assumptions, sensitivity to other variables, and the scope of benefits analyzed. The project would benefit from performing several validation tests of the full model, particularly by comparing predictions of a program success case from past years with historical data of market penetration of various vehicle types.

Reviewer 4:

The reviewer stated that sensitivities against parameters are needed, but was not sure how much relevant ownership costs will substantively change results considering other uncertainties. The reviewer added that there definitely needs to be a fuel price sensitivity case, and that a comparison between vehicle choice models would be useful.

Reviewer 5:

The reviewer said that the proposed future research seems adequate, but not outstanding. The project team seemed to lack a vision of incorporating innovation into the future plans.

Reviewer 6:

The reviewer observed that at a macro level, the proposed future work seems to touch on relevant areas, but it is not fully clear how it will be executed or how it will address the barriers.

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

Reviewer 1:

The reviewer observed that the work is assessing the impact of the VTO program on petroleum and GHG reductions and related impacts (e.g., externalities and social costs), and is an important contribution to achieving the program's goals.

Reviewer 2:

The reviewer pointed out that evaluation of the impact of VTO programs is a critical requirement in estimating their impact on petroleum displacement.

Reviewer 3:

The reviewer reported that analytical activities and models used to examine potential impacts are appropriate for intended evaluation.

Reviewer 4:

The reviewer commented that a well-developed, robust model to estimate VTO's potential petroleum use and GHG emissions reductions, is a key tool to ensure all VTO projects support the DOE objective of petroleum displacement.

Reviewer 5:

The reviewer stated that the goal of assessing the value of the VTO program whose goal is also petroleum displacement, should, in theory, reduce petroleum use.

Reviewer 6:

The reviewer described the relevance as unclear. Failing to disaggregate the accomplishments that industry and others are bringing to market in response to regulatory (e.g., CAFE, etc.) and consumer demand from VTO contributions does not allow for informing targeting R&D by VTO to address gaps that exist in the broader universe of R&D.

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

Reviewer 1:

The reviewer stated that the budget seems to be a reasonable allocation given the current and proposed scope of work.

Reviewer 2:

The reviewer commented that the financial resources are not the limitation on the project.

Reviewer 3:

The reviewer observed that the funding level for this project is large compared to other VTO analysis projects of similar scope. The project's simulations are largely based on existing models. The reviewer added that the current and proposed future work is worthwhile, but the contributions do not merit the full magnitude of the funds provided.

Reviewer 4:

The reviewer said that based on the presentation, the funding level seems high compared to the results. It was difficult to discern if the issue was simply that the benefits were not well articulated, or if the benefits, themselves, did not really exist, particularly as compared to the level of funding.

Emissions Modeling: GREET Life-Cycle Analysis: Michael Wang (Argonne National Laboratory) - van002

Presenter

Michael Wang, 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 noted that GREET provides a valuable service as an open-source database and transparent LCA methodology. It is particularly helpful that stochastic modeling is built into GREET and that sensitivity analysis can be readily performed.

Reviewer 2:

The reviewer said that the project work is a standard tool for static estimation of GHG emissions, which now includes a stochastic option and is used by major regulatory agencies using open and transparent data.

Reviewer 3:

The reviewer noted that the approach seems the most reasonable to building the model.

Reviewer 4:

The reviewer stated that the project had a very detailed approach to examining trade-offs of GHG emissions.

Reviewer 5:

The reviewer observed that over the past 20 years, the GREET model has established itself as the standard platform for agencies, research institutes, and industry, and it continues to expand pathways and make modeling improvements each year, all in accordance with International Organization for Standardization (ISO) standards.

Reviewer 6:

The reviewer said that the work only marginally addresses environmental sustainability. System boundary factors and considerations limit the ability of the model to accurately answer some fundamental questions on sustainability. The reviewer explained that the limitations are more acute for some fuel pathways such as

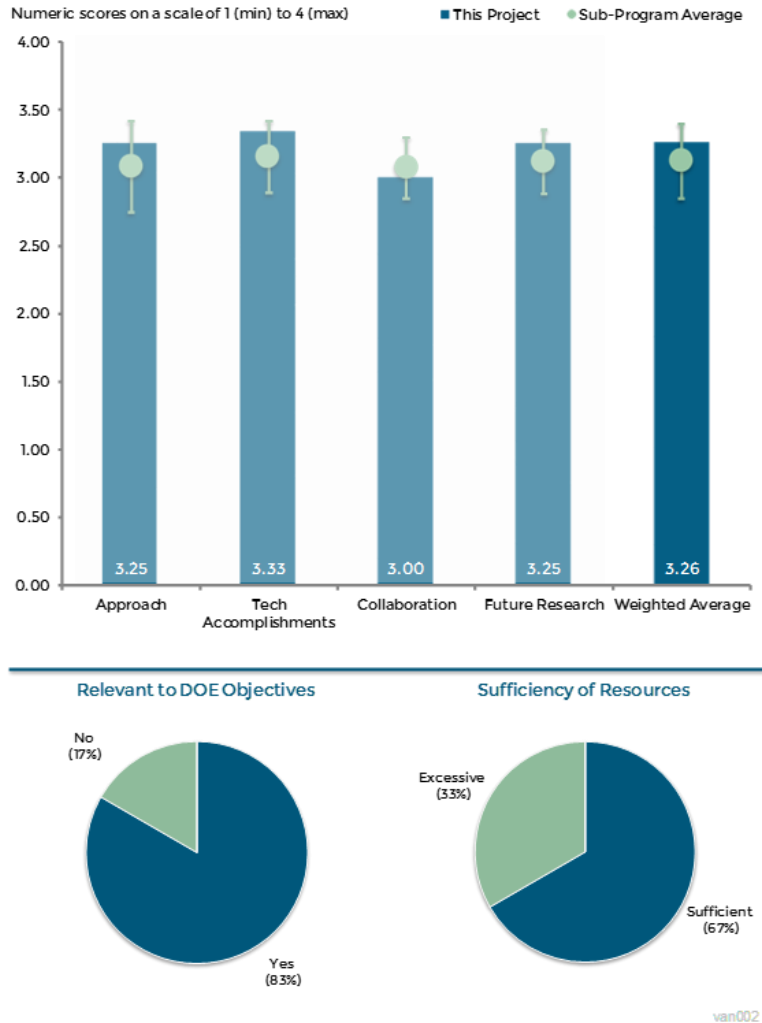


Figure 9-2 Emissions Modeling: GREET Life-Cycle Analysis: Michael Wang (Argonne National Laboratory) - Vehicle Analysis

biofuels and, more broadly, renewables, or powertrains that use renewables. System feedbacks, and dynamic changes over time are not captured.

The reviewer also stated that the emphasis on data and adding more complexity is a distraction from addressing fundamental structural issues that limit the accuracy or validity of the information generated by the model. The model uses a static measurement, even with considering variability, but does not seem to address how the assigned values change over time as with use, resources, etc. The reviewer expressed that the question of what the marginal or induced emissions are is inadequately addressed, or is poorly explained. Noting that oil sands or heavy crude is expected to increase 14%, does not explain how this is factored into the LCA overall product lifetime. The reviewer added that if the objective is to develop indicators and methods for evaluating environmental sustainability, the limitations of LCA preclude the model from being useful in the way it is presented or intended to be used to a large degree. Providing answers, independent of their accuracy, on discrete technology pathways does not answer the more holistic question because it does not answer the impacts or effects on other components or the system outside of the boundary considered in the LCA calculation.

The reviewer also said that improving data helps but only in applications or specific pathways where the model itself is appropriately robust. The reviewer explained that adding good data into a flawed or misapplied model does not necessarily give a more useful answer than bad data into the same model. If GREET were better framed or limited in its scope in how it is utilized, this ranking would go up substantially. The reviewer explained that the poor ranking reflects the potential or likelihood of GREET as currently used providing misleading information in some areas. This overwhelms the value it offers in some areas of providing valuable information. To frame in an alternative way, the research provides a bi-modal value, but this ranking reflects the greater concern or consequences where it falls short.

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

Reviewer 1:

The reviewer pointed out that the project demonstrated good progress in adding new sustainability metrics such as water consumption and detailed examination of methane leakage in the natural gas (NG) supply chain to develop indicators and methodology for evaluating environmental sustainability. The inclusion of new vehicles and fuels, and continued upgrades of the user interface and database, are very helpful to expand the usefulness of the tool. The reviewer added that the causes of the significant differences between the bottom-up and top-down analysis of NG leakage were not addressed, nor was any guidance provided on the circumstances in which one method may be more accurate or appropriate for use in an analysis.

Reviewer 2:

The reviewer reported that the additions to GREET in the last year are topical and aligned with DOE goals. Examining the methane leakage uncertainty in NG pathway GHG effects is critical to understanding how this fuel should be used. The reviewer added that inclusion of the water consumption sustainability metric is also a great addition to the tool.

Reviewer 3:

The reviewer commented that the model is addressing some very important issues, such as NG leakage percentages. One suggestion would be to not only look at the leakage percentages, but also to start quantifying the total leak volumes, ideally geographically, so that overall impact to climate change could be quantified. The reviewer remarked that in other words, a high percentage leak of a small total amount of NG is likely not nearly as harmful to climate change as a medium percentage leak of a large total amount of NG. The reviewer applauded the inclusion of water use and other sustainability metrics that are clearly growing in importance.

Reviewer 4:

The reviewer noted that the inclusion of methane leakage is a valuable improvement.

Reviewer 5:

The reviewer observed that the accomplishments included petroleum refinery GHG estimates. The reviewer said that added water consumption is a timely improvement. NG leakage is also very timely, as is light-weighting.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

The reviewer noted that the GREET team seems to have strong interactions with agencies, labs, academia, and industry. There does not seem to be much interaction with OEMs.

Reviewer 2:

The reviewer commented that there are a number of organizations that could be included as collaborators to enhance GREET's methodology and data collection. The reviewer was surprised that EDF Environmental Energy was not consulted during the development of the NG leakage studies. The project could also benefit from increased collaboration with OEMs and other industry groups with expertise in materials and fuel systems.

Reviewer 3:

The reviewer said that the project team uses a variety of tools from other labs and industry, including NREL and ORNL, Jacobs, etc.

Reviewer 4:

The reviewer expressed disappointment that there was not a connection stated to anywhere within DOT. Although DOT is primarily concerned with transportation safety, there are many other programs and divisions that research GHG, energy efficiency, and related topics. The reviewer suggested the creation and strengthening of collaboration with DOT, for it was seen to be mentioned in the future work slide. Otherwise, the team does have a comprehensive collection of collaborating or coordination with organizations.

Reviewer 5:

The reviewer stated that the collaborations of the project team help with some data, but do not provide a breadth of perspective on fundamentals. Emphasis seems to be on self-reinforcement

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 said that the direction of the research and upgrades to the platform are really excellent. Overall, this is a very high-impact and important tool for the private sector, academia, and government.

Reviewer 2:

The reviewer expressed that the future work seems reasonable with the GREET model's current status and present topics in the area of expanding the model. In particular, expanding inclusion of light-weighting materials and improving plug-in electric vehicle (PEV) technologies should be emphasized in the year to come.

Reviewer 3:

The reviewer reported that the future proposed work will include additional material and fuel options and indicators, for example, light-weighting materials, heavy crudes, and water consumption, which will help expand the usefulness of the tool for different analyses. It is also helpful that future work will engage with OEMs.

Reviewer 4:

The reviewer noted that the project team added Bakken crudes and additional refining. Refined light-weighting and electric vehicle (EV) characterization are both useful.

Reviewer 5:

The reviewer commented that the future work seems acceptable, but was not well explained on how it relates to the barriers.

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

Reviewer 1:

The reviewer remarked that this is an excellent analytical tool for evaluating energy and emission trade-offs between vehicle technology and fuel platforms.

Reviewer 2:

The reviewer said that the GREET model supports decision making when evaluating vehicle and fuel systems by providing a consistent, well-developed platform.

Reviewer 3:

The reviewer stated that the availability of consistent and transparent data and methodologies to assess life-cycle petroleum use and GHG emissions is critical to inform RD3 sustainable solutions for lower-petroleum, lower-GHG technologies.

Reviewer 4:

The reviewer pointed out that LCA on energy and GHG consumption informs policy-makers on what the best options are for petroleum displacement.

Reviewer 5:

The reviewer observed that this is a robust model used to deeply understand the whole life cycle of various vehicle and fuel pairs that will help shape not only policy, but product choices at OEMs as well.

Reviewer 6:

The reviewer commented that again, this was a challenging response. GREET has the potential to support the overall objective of petroleum displacement, although the work speaks more to sustainability and GHG reductions. The reviewer added that if the objective is just petroleum displacement, then the model is not needed. If the objective is broader, then the uncertainty exists. The reviewer commented that as earlier, there is the potential for some good insights, but as the model is used, it also provides inaccurate or misleading insights which counteract and can undermine accomplishing the objectives.

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

Reviewer 1:

The reviewer stated that this is the most valuable set of research projects in the portfolio.

Reviewer 2:

The reviewer said this is a very valuable tool with a significant stakeholder and user base, and continued support is recommended.

Reviewer 3:

The reviewer reported that the budget seems to be a reasonable allocation given the current and proposed scope of work.

Reviewer 4:

The reviewer noted that the funding for this project is quite high, although the scope of the project is notably larger than other VTO Analysis projects, and that it is certainly true that significant resources are required to constantly upgrade a modeling tool of this scale, collect and verify data, and develop strong connections with non-governmental organizations (NGOs) and OEMs to review the data and methodology to ensure it is of the highest quality available. However, the reviewer expressed a concern that by concentrating so much funding on one single tool, the VTO will not be well informed of the energy implications of various vehicle and fuel options because it is relying on one single tool with a particular set of assumptions and methodological choices that cannot be fully validated. It would be more instructive to encourage development of an alternative analysis tool to help calibrate GREET's predictions, even if it is an adaptation of the GREET model based on the open-source code but with modified methodological choices.

Reviewer 5:

The reviewer stated that resources could be better spent elsewhere, and using resources to add complexity does not necessarily make the model better.

Consumer Vehicle Technology Data: Mark Singer (National Renewable Energy Laboratory) - van003

Presenter

Mark Singer, National Renewable Energy Laboratory.

Reviewer Sample Size

A total of six reviewers evaluated this project.

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

Reviewer 1:

The reviewer noted that the approach does seem robust, but had the impression that there has not been much innovation in data gathering or analysis for some time. Perhaps this is the nature of the work, but it seemed there is an opportunity here, although it was not immediately clear how these results are or will be used. The reviewer added that the data is certainly interesting, but would suggest a stronger answer to the question of so what, one that really articulates why all of this data gathering matters. This is especially important to address with respect to the other marketing surveys and OEM marketing departments that are doing much of the similar types of analyses.

Reviewer 2:

The reviewer stated that it was challenging to evaluate; the 22 questions were not provided to reviewers. The design of the study, including the questions, is fundamental. The reviewer added that the high level overview that was given suggests the structure of the survey is not well constructed, and questioned if there was any longitudinal work performed. The reviewer also said that if this has been ongoing for 10 years, the researchers should have been able to not only track trends, but also compare survey results to actual consumer behavior. The presenter seems to have inherited a disjointed or poor project; however, at that point, the work should have gone back to the beginning to do some data quality analysis before actually conducting further analysis and presenting results that were preliminary or otherwise. The reviewer said there needs to be a reconciliation of the revealed versus stated preference data. Standardizing the questions and trying to establish some type or longitudinal analysis is a good start.

Reviewer 3:

The reviewer commended the principal investigator (PI) and the project team on their work putting the structure in place to transition the project from a disparate series of studies into a single study that can be

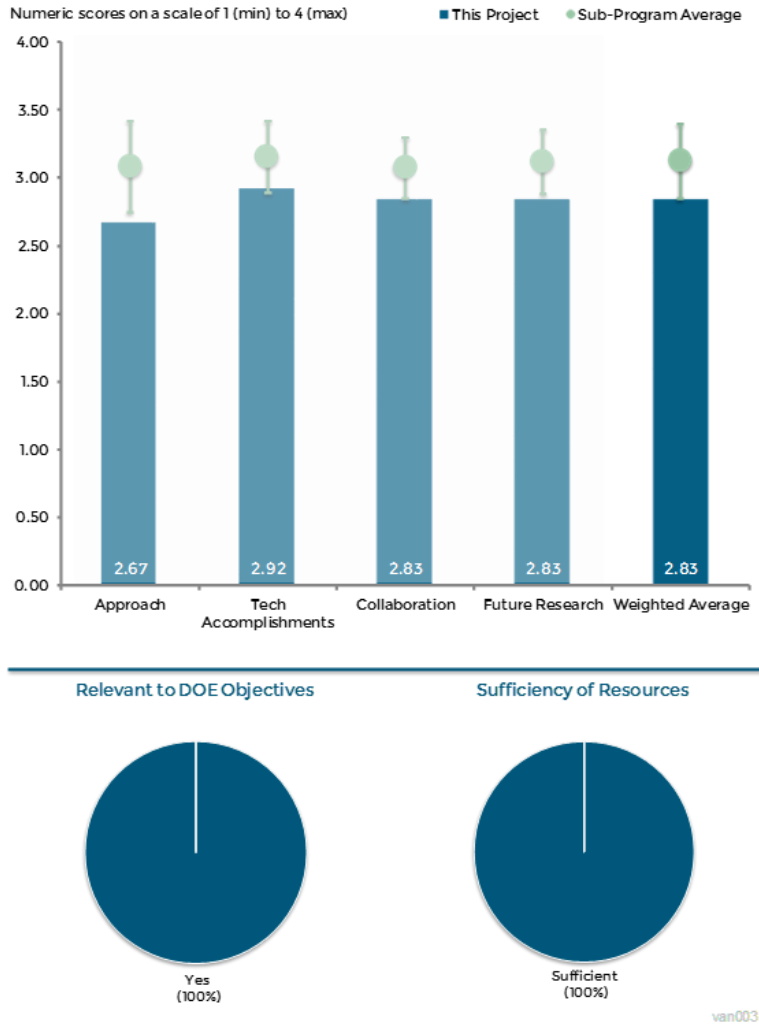


Figure 9-3 Consumer Vehicle Technology Data: Mark Singer (National Renewable Energy Laboratory) – Vehicle Analysis

tracked longitudinally. In such an early market, this is incredibly relevant work toward both barriers. Thus far, the results were a little concerning regarding whether the 1,000 adults constitute a representative sample of the U.S. market, for example, 5% compressed natural gas (CNG) vehicle drivers, and how closely the survey results translate to actual consumer behavior as stated preference versus revealed preference.

Reviewer 4:

The reviewer said that this project has a significant weakness in relying solely on stated preferences and self-reported information from surveyed individuals. Efforts to address this weakness were not described. It was not clear that the current methods can provide useful information because the stated preferences cannot be verified to be a sign of actual choice behavior. The reviewer added that future work should focus on testing the accuracy of the collected stated preference data, for example by comparing survey responses of the type and segments of vehicles owned with the actual vehicle models owned, and comparing responses on the type of vehicle the individual expects to purchase next and its most important attributes with the actual choice.

Reviewer 5:

The reviewer observed sound analysis of the older, unpublished data. No statistical uncertainty measures were reported, but should exist. The reviewer added that the question of “time from last purchase or until next purchase,” conflates a stated and revealed preference. The reviewer added that this raises the broader question of how much value we should place on stated preference when more and more alternative vehicles are entering the market.

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 reported that it is a good idea to summarize previous data, and again, the value of stated preference is declining as more vehicles enter the market. Furthermore, the reviewer said that the percentage of ownership of alternative-fuel vehicles is unusual relative to the known numbers of 5% CNG vehicles, which raises questions about the validity of the sample.

Reviewer 2:

The reviewer pointed out that collecting information on current vehicle ownership could help improve understanding of consumer behavior by identifying revealed versus stated preference responses.

Reviewer 3:

The reviewer commented that the project has made progress by standardizing the questions across years to collect longitudinal data; however, significant issues with the methods remain, particularly the fact that the analysis results rely solely on stated preference data that is not compared with any objective measures.

Reviewer 4:

The reviewer commented that the results and insights fall short of a range of other available studies, analysis, and data. For example, King Abdullah Petroleum Studies and Research Center (KAPSARC) has completed a far more detailed analysis of consumer purchasing trends and motivations. The reviewer asked whether survey results, such as cumulative payback, seem to align with consumer purchasing habits. Noting that 5% of households have a CNG vehicle, and 1% EV ownership, the reviewer rhetorically asked whether this indicates survey bias. The answer would seem to be yes. One would likely guess there was either a heavy California bias and/or fleet bias, neither of which accurately reflects broader national trends. The reviewer also asked why the data set was not compared to the national fleet mix and questioned where the statistical analysis is for the data sets. At this point, the usefulness or confidence in the analysis and output is limited and potentially misleading. The reviewer added that there is very little to show for 10 years of work. The previously noted lack of consistency in questions is just one example that limits the usefulness, for the stated versus revealed preferences is another example.

Reviewer 5:

The reviewer said that the right hand graph on Slide 9 could be reformatted to be much easier to read. For example, it is very difficult to tease out how these responses have changed from year to year. The reviewer also stated that the data is there, but drawing conclusions is challenging without very careful study. While the accomplishments are very useful and well represented, the reviewer suggested there are more impactful ways of presenting the graphs and data.

Reviewer 6:

The reviewer indicated that it was not clearly stated in the presentation how this project is related to overall DOE goals, but when asked, the PI stated that understanding the customer adoption barriers to new technologies helps the design and deployment of such technologies. The reviewer said that to this end, the results presented included consumers' preferences for battery range, incremental costs of PEVs, and some infrastructure coverage. The reviewer recommended the expansion of infrastructure awareness questions, especially as public and workplace charging is rapidly developing in certain regions.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

The reviewer remarked that several national laboratories are included as partners and a well-established polling company is being used to conduct the survey. The project would benefit from collaboration with OEMs.

Reviewer 2:

The reviewer commented that the workgroups initiated by this program demonstrate a dedication to strong collaboration between experts including ORNL, NREL, ANL, SNL, University of California-Davis, Navigant, and California Air Resources Board (CARB). It is particularly important to get these survey questions correct at the beginning for any type of long-term trends analysis of the results.

Reviewer 3:

The reviewer stated that using commercial surveying leverages collaboration with other organizations well.

Reviewer 4:

The reviewer reported the coordination does appear to be adequate, but wondered if there should be more OEM or private- sector coordination if possible. The questions of who is the ultimate customer and how this will influence petroleum displacement are important to address.

Reviewer 5:

The reviewer stated that coordination exists, but that does not speak to the quality of those coordinating organizations. While the list includes a lot of interested or vested parties, it does not reflect many of the leading institutions or organizations who conduct survey work and analysis: University of Michigan is recognized as far superior in their consumer and societal survey work to the University of California-Davis, but it is unclear what they contributed. The reviewer added that the California bias in collaborators may also help explain what appears to be some survey data bias. The information did not clearly articulate how the collaboration was conducted nor what each party was responsible for.

Question 4: Proposed future research—the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:

The reviewer observed deep-dive investigations, but would have liked to see several deep-dive investigation proposals based on the recent survey results (e.g., whether people do not understand the difference between a Prius hybrid electric vehicle (HEV) and plug-in hybrid electric vehicle (PHEV)). Regarding expanded collaboration, the reviewer was not clear about what form this collaboration would take, and said consumer

travel behavior and preferences toward vehicle technologies vary significantly by region, so it would be interesting to explore the regional differences in FY 2016.

Reviewer 2:

The reviewer said that the future work includes comparing survey results to other data such as Polk, which will help to verify the findings, but methods of comparing self-reported responses to objective measures or otherwise addressing the significant drawbacks of relying on stated preferences were not addressed in future work.

Reviewer 3:

The reviewer stated that the project seemed to lack an ambitious vision and innovation looking into the future, evidencing more of a turn-the-crank mentality.

Reviewer 4:

The reviewer was unsure if biofuels or CNG are that important, and asked if the fuel cell and hydrogen work is forward-looking.

Reviewer 5:

The reviewer said there was insufficient information provided to effectively evaluate this.

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

Reviewer 1:

The reviewer indicated that understanding consumer attitudes underlies all of the consumer preference modeling.

Reviewer 2:

The reviewer stated that identifying consumer perception barriers to PEV deployment is important to inform efforts to reduce petroleum usage.

Reviewer 3:

The reviewer stated that in theory, yes, the work meets DOE objectives, but in practice, it is inconclusive at this point.

Reviewer 4:

The reviewer said that the work possibly meets DOE objectives, but the link is a little weak. How this interacts with surveys already going on by private marketing companies and OEMs is not clear, because the latter have a much more direct relationship to future product planning for higher efficiency and/or alternative fuel vehicles.

Reviewer 5:

The reviewer commented that the presentation stated: "Provides robust assumptions for consumer choice research and supports the alignment of program budget priorities with marketplace opportunities." It was unclear why the PI would categorize the results of this work as robust yet, but the reviewer thought the project is on the right track in terms of trend analysis and collaborative input to provide input on consumer choice that is the foundation upon which the modeling efforts are built.

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 and output seem aligned.

Reviewer 2:

The reviewer stated that budget seems to be a reasonable allocation given the current and proposed scope of work.

Reviewer 3:

The reviewer said that the resources are sufficient, but the emphasis on survey data of all consumers may be misplaced.

Reviewer 4:

The reviewer said that the resources are sufficient to achieve the stated milestones, but the fact that the project relies solely on stated preferences calls into question the value of this research. The project may merit additional funds if a sound plan can be put into place to address this weakness and bring in the needed expertise to design and validate a more effective survey.

Unified Modeling, Simulation, and Market Implications: FASTSim and ADOPT: Aaron Brooker (National Renewable Energy Laboratory) - van004

Presenter

Aaron Brooker, National Renewable Energy Laboratory.

Reviewer Sample Size

A total of six reviewers evaluated this project.

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

Reviewer 1:

The reviewer commented that the approach is very comprehensive to modeling consumer behavior.

Reviewer 2:

The reviewer explained that this is a very valuable program, but there is very little on infrastructure limitations, which play a crucial role in technology adoption. The program needs to look at shifts in the fleet composition as much as technology improvements. The reviewer added that validation with percent of HEV sales, etc., is useful but is not a perfect analogue to other technologies.

Reviewer 3:

The reviewer stated that the approach to the vehicle choice model seem reasonable. Understanding economics and econometrics to incorporate various elasticities of demand for different vehicle attributes is key.

Reviewer 4:

The reviewer explained the stated approach includes all relevant VTO technologies, captures key consumer choice aspects, validates relevant dimensions, understands the results, and expands tool use. The reviewer then pointed out that stated barriers are many, and they impact DOE vehicle technology targets on DOE end goals. The reviewer’s main takeaway from the accomplishments this year was an improvement of the model in every step of the above-stated approach. The reviewer expressed a need to better understand what metric this improvement is measured against. When possible, results were validated against historical results or back-casting, but in some cases, this is not possible. The reviewer also said that a number of HEVs was used as a proxy for fuel cell electric vehicle (FCEV) offerings, for example, but it is not clear why this assumption can be made or how sensitive the results would be to such a key consumer choice aspect.

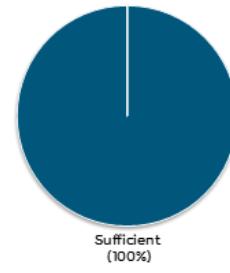
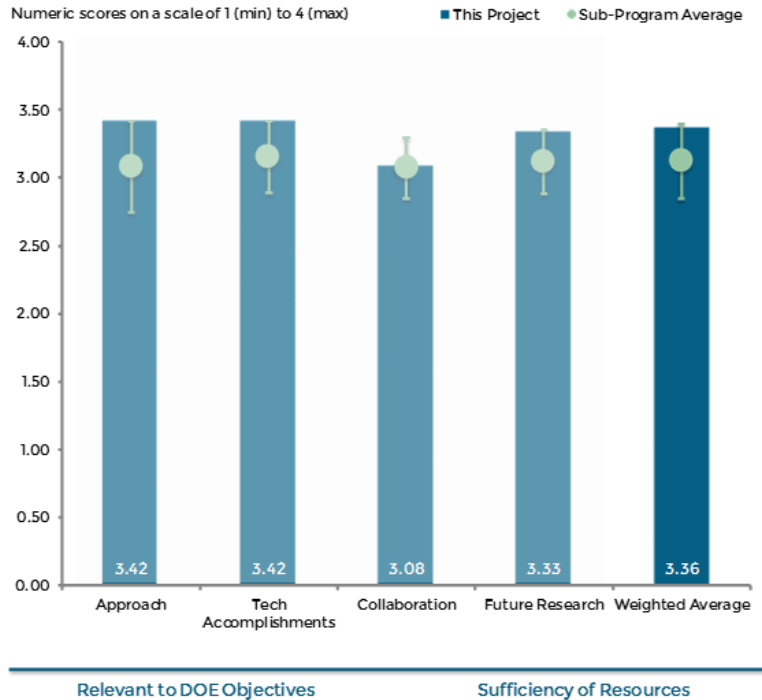


Figure 9-4 Unified Modeling, Simulation, and Market Implications: FASTSim and ADOPT: Aaron Brooker (National Renewable Energy Laboratory) - Vehicle Analysis

Reviewer 5:

The reviewer commented that the model is generally well designed with many important consumer choice aspects, for example, heterogeneity of preferences across consumer population and nonlinearity of preferences. Validation of the consumer choice model and the complete connected model is taken seriously. The reviewer added that the work to create an intuitive and easy-to-use interface that helps users visualize the results is also an important aspect of this project. Even with these accomplishments, additional improvements could be made, particularly regarding validation and comparison of the model with alternative approaches. The reviewer also said that the PI should consider how key insights predicted by the model, for example, that PHEVs sold well because of faster acceleration and low-cost electricity source. This could be validated or at least reinforced by consumer surveys or other evidence to build confidence in the model.

Reviewer 6:

The reviewer asked why U.S. Environmental Protection Agency (EPA) GHG vehicle regulations, which are aligned with but credited differently than CAFE, are not included. The reviewer asked where other regulations, such as Zero Emission Vehicle (ZEV), Renewable Fuel Standard (RFS), Low Carbon Fuel Standard (LCFS), etc., are in the model. The effect that these parallel and overlapping regulations have is significant in terms of technologies contributing to compliance. The reviewer said that the presentation notes CAFE and GHG, but predominantly talks about CAFE, and seems to treat them as the same, but they are not. For example, diesel helps more with CAFE than GHG.

The reviewer also said a clearer explanation of the type of the logistic regression (LOGIT) model used would greatly benefit the review process and general understanding of the approach, strengths, weaknesses, and limitations of the model. In addition, the reviewer asked if attribute bundles and clusters are considered. Literature suggests or has demonstrated the importance of this type of analysis. The reviewer added that the PI answered a question on this, but acknowledged a gap. A lot of emphasis has been on trying to make the model precise or improve its apparent predictive power, but there was not much discussion on important sensitivities or relationships. For example, the reviewer said, the fact that the PHEV sold well seems to give some insight within a narrow type of vehicle within a given nest, but the reviewer expressed a desire to know how these attributes affect platform switching and consumer preference. In addition, the reviewer stated that, as with all models like this, empirical calibration is good, but caution is always warranted since if the behavior changes, it may not predict the future well. Overprescribing to achieve a better fit to historical data may work against the predictive power of the model moving forward.

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

Reviewer 1:

The reviewer stated that there was an excellent representation of consumer diversification and product choices in the market. Diagnostic capabilities provide interesting insights on model results.

Reviewer 2:

The reviewer noted that there was technically excellent new progress. Better output display, validation, and the improved interface are always steps forward. The reviewer asserted the importance of the added CAFE and GHG accounting, and fuel cell vehicles refueling. Regionality and mid-level blend fuel prices, etc., are also useful improvements.

Reviewer 3:

The reviewer stated that there was an emphasis on addressing consumer heterogeneity to improve substitution patterns, which is valuable. Discussion on understanding the results is solid. The reviewer added that the scenario comparison is useful to understand trends or primary drivers and key sensitivities to changes, but presented work falls short in discussing how to use the output.

Reviewer 4:

The reviewer applauded the addition of all the new options which greatly enhance this tool. Also, the reviewer said that the validation of results by looking at past data is great and not done enough on other models.

Reviewer 5:

The reviewer reported that the project has made good progress, especially considering the relatively low amount of funds compared to other VTO Analysis projects of similar scale. Several additional capabilities have been added into the simulations, including consumer preference heterogeneity and compliance with CAFE standards.

Reviewer 6:

The reviewer said that because the barriers and goals were not clearly expressed, it is hard to provide a lot of specific feedback on this question. The model does include all VTO R&D technologies, and the insight chart provides an interesting look into the relative penalties of each offering. The reviewer added that it is hard to say how well one can directly link R&D to vehicle technology in fleets, and therefore, GHG emissions and petroleum reductions, given the long timeline and the other parallel activities on the industry side. This model is also missing impacts of the ZEV mandate proposed for FY 2016.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

The reviewer said that the collaboration with industry and government partners led to improvement in the model as well as understanding and confidence in the results.

Reviewer 2:

The reviewer commented that the project has several collaborators representing OEMs, national laboratories, consulting companies and one university partner.

Reviewer 3:

The reviewer commented that the slide on collaboration was in the deck but not covered during the presentation. Consequently, it is hard to evaluate fully or properly. The reviewer added that limiting the collaboration to what some call the domestic manufacturers, such as Ford, GM, and Fiat Chrysler, limits the perspective substantially. European and Asian manufacturers should be part of the collaborative effort as different market shares for platforms and technology approaches do exist, and it is also unclear what each collaborator provides.

Reviewer 4:

The reviewer commented that there are other vehicle choice models, including NHTSA and the Volpe Model that is used for CAFE modeling and rulemaking and other choice models developed by universities such as Massachusetts Institute of Technology. It seemed the collaboration is more up front and/or results benchmarking with the various other choice models is important, but currently missing. For example, the reviewer asked if the results are the same, and why they are different. In addition, the reviewer asked how the models are built differently, and if these differences are deliberate or accidental.

Reviewer 5:

The reviewer indicated that there was not a lot of collaboration, but there was good cooperation with other laboratories for benchmarking. The reviewer added that as suggested elsewhere, collaboration or benchmarking with the EPA or NHTSA models would be instructive.

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 pointed out that adding heavy-duty vehicles is a major expansion at this level of completion of the project. The other items are quite enough, but more on infrastructure challenges would be useful.

Reviewer 2:

The reviewer stated that there are modest but important improvements on the horizon for FY 2016. Data visualization innovation seems to have a gap so that customers can really pull out a much richer set of conclusions from the data.

Reviewer 3:

The reviewer reported that the proposed future work is well aligned with the reviewer's suggestions for the project (i.e., incorporating the ZEV mandate and understanding consumer choice aspects related to EV charging infrastructure impacts). Nonlinear preferences with regard to vehicle range could also be improved by better characterizing the number of vehicles in a household, for example, 100-mile range might be okay for daily commuters who have access to a back-up internal combustion engine (ICE) vehicles or HEVs.

Reviewer 4:

The reviewer commented that adding capability to evaluate tax incentives and infrastructure impacts will provide greater insights.

Reviewer 5:

The reviewer indicated that the future proposed research is planned to add several important features to the simulations, including start-stop, CNG vehicles, connected and autonomous vehicles, policy incentives and mandates in different regions, learning curves, and neighbor effects. In addition to these features, the PI should consider including additional methods of improving the efficiency of spark ignition (SI) engine vehicles, for example, gasoline direct injection (GDI), cylinder deactivation, dual clutches, and continuously variable transmissions, especially considering the importance of SI efficiency to the estimated adoption of advanced powertrains as predicted by other VTO Analysis projects. The reviewer added that the proposed future work could also include a plan for communicating key insights from the simulations to decision makers other than DOE.

Reviewer 6:

The reviewer said that the topics seem reasonable, but details are inadequate to permit full evaluation.

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

Reviewer 1:

The reviewer reported that vehicle technology and choice are important in understanding the penetration of efficient vehicles and the subsequent reduction in petroleum consumption.

Reviewer 2:

The reviewer observed that understanding how DOE targets influence actual petroleum and GHG reduction goals is critical to informing the choice of targets so they are most effective. This model is also providing a very useful capability to understand how the interaction between DOE targets and other policies, for example, CAFE and ZEV, affects end goals.

Reviewer 3:

The reviewer noted that if the model is used properly, or results are used properly, they can provide guidance into strategic direction and investment or contribute to understanding them.

Reviewer 4:

The reviewer commented that the model includes all VTO R&D targets and can be used to assess overall contribution to petroleum reduction.

Reviewer 5:

The reviewer suggested that the project team should understand consumer choices and the interaction with CAFE that can inform energy and transportation policy decisions that would ultimately displace petroleum.

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 project is progressing very well with the current level of funding, even though it is relatively low compared to other VTO Analysis projects of similar scope. Additional funds may be warranted to increase the scope of future research to include additional capabilities and improve validation of the simulations.

Reviewer 2:

The reviewer stated that this model provides an interesting and unique approach to modeling consumer behavior, one that many stakeholders could use and employ. Given that, continued funding and support of the planned updates and development activities is recommended.

Reviewer 3:

The reviewer commented that the budget seems to be a reasonable allocation given the current and proposed scope of work.

Consumer-Segmented Vehicle Choice Modeling: the MA3T Model: Zhenhong Lin (Oak Ridge National Laboratory) - van005

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 remarked that the project incorporates many factors that are important to understanding barriers to PEV adoption, including recharging infrastructure, state incentives, travel patterns, energy prices, and household vehicle usage behavior. Systematic calibration and validation is also included in past and future work plans. The reviewer added that the effort seems well integrated with other VTO Analysis projects. The approach would benefit from a comparison of the model with other analysis methods and results.

Reviewer 2:

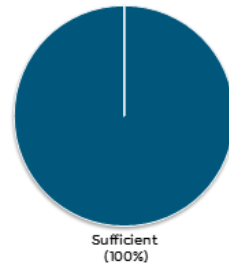
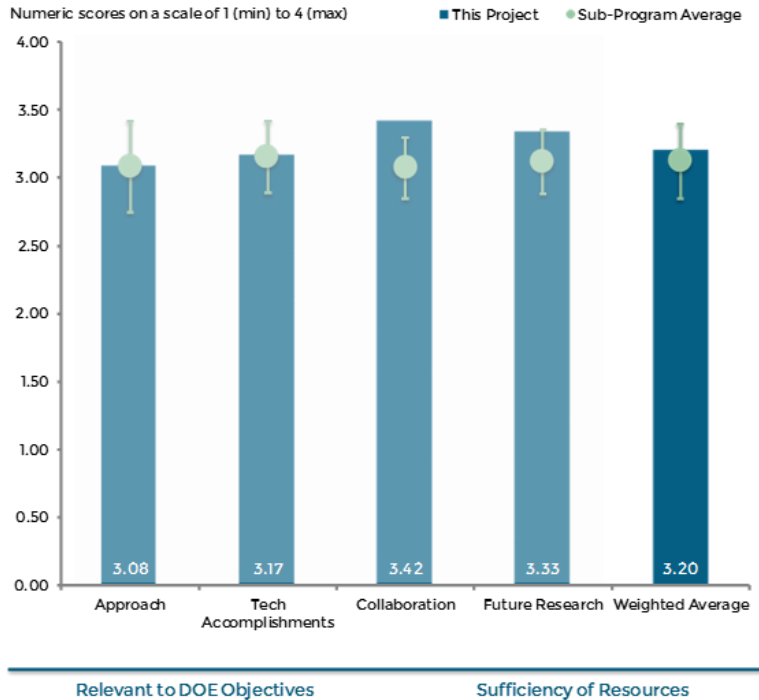
The reviewer indicated that investigating vehicle choice using LOGIT is a valuable approach, and validation is useful, but now that there are multiple SI vehicles, validation could be more comprehensive.

Reviewer 3:

The reviewer commented that the project team had a very comprehensive approach to addressing consumer choice.

Reviewer 4:

The reviewer said that the model estimates market acceptance and sales as a function of technology, infrastructure, consumer behavior, and policy factors. The barriers addressed are cost of advanced powertrains and behavior of manufacturers and consumers. The reviewer added that a large emphasis in FY 2015 has been on improvements to and validation of model in several ways. As identified by the PI, understanding supply-side and consumer behavior could be improved, and furthermore, the model could examine the impact of infrastructure on consumer’s decision to buy an alternative fuel vehicle (AFV).



van005

Figure 9-5 Consumer-Segmented Vehicle Choice Modeling: the MA3T Model: Zhenhong Lin (Oak Ridge National Laboratory) - Vehicle Analysis

Reviewer 5:

The reviewer noted that at first glance, it seems there is overlap in the inputs and outputs of this model and others within VTO. Certainly this conclusion could be incorrect, but would suggest highlighting how all the various models are different and the same. The reviewer added that the project would bolster confidence that there is an overall cohesive modeling strategy. At a minimum, for all of these models, it might be helpful to have a Simulink-like box showing the inputs and outputs at the beginning.

Reviewer 6:

The reviewer reported that the dynamic diagram is unclear and fails to capture many of the system relationships and feedbacks. This limits confidence in the output. The reviewer also said conclusions about the Osborne effect are not warranted. This requires actual testing, although other causes such as general market saturation could be at play. The reviewer stated that it is unwarranted to make the conjecture at this time. Work to date did not show sensitivity analysis or discuss; the listed future work demonstrates why this is important. The reviewer noted that the researcher does not seem familiar with much of the market/technology diffusion modeling or theory. There was a lack of transparency in the model as presented or included in the slide deck. Given that structure leads to behavior, this needs to be resolved or addressed. The reviewer also said that for the model to be useful, the structure needs to capture the relevant interactions and the underlying consumer choice models, other inputs, and underlying mathematical mechanics need to be robust. More value would be derived from exploring the why, rather than what happened.

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

Reviewer 1:

The reviewer stated that the project has made good progress, including the incorporation of state-level analysis, battery electric vehicle (BEV) range uncertainty and utilization, and increased transparency of all modeling inputs. Systematic validation tests will be an important future contribution.

Reviewer 2:

The reviewer stated that the work captures key elements and dynamics associated with consumer choice and behavior.

Reviewer 3:

The reviewer noted that the project seems on track to meet project goals. Validation on multiple levels increases confidence in tool's utility. The reviewer stated that the main concern with validation sounds like the so-called Osborne Effect, where sales are flat-lining when a new model is announced. This effect is probably especially pronounced with respect to PEVs because a new model often corresponds to a significant performance improvement. The reviewer added that another effect that has been very noticeable in 2015 is dealerships offering deeply discounted BEV leases to ensure that the manufacturer meets its ZEV credit goals. Fiat is an example.

Reviewer 4:

The reviewer pointed out that the project team should have done validation a while ago, but wondered why the project team cannot capture extended range electric vehicle (EREV)-40. Either the PI misheard or this probably should be added. State policies seem hard to capture with so few vehicles. Multiple SI vehicles were also finally added. SI vehicles.

Reviewer 5:

The reviewer commented that it seems there is confusion between verification and validation. Verification is often referred to as did you build it right, whereas validation is did you build the right thing. The reviewer had the sense that validation was being used to say that the model calculates properly and does not have any major errors, etc., which is verification, not validation. Validation is more about the perceived accuracy of the results compared to what it is really desired to measure. For example, if there is a 5% market share for EVs in 2020

based on a number of inputs, then one would expect that in 2020 the team for this model will check how well they predicted this at that time. At the same time, these predictions have certainly been made for years, yet a slide on how accurately the model created in 2010 predicted the 2015 market share could not be seen. Validation can also be used against other models that attempt to produce the same output. The reviewer added that although this is not as robust as the first method, it is still a form of testing whether the right thing was built. A third method is to poll consumers of the model as to its usefulness and accuracy. The reviewer also said that this is another way of validating the right thing was built. On a final thought, validation is often not recommended to be completed by the model builder, which is why Underwriters Laboratories (UL) and so many third party agencies, certify safety-related models and equipment.

Reviewer 6:

The reviewer reported that the results shown were limited, and it would be beneficial to see some scenarios and how the researcher analyzes or draws conclusions from them.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

The reviewer remarked that the project has an excellent set of collaborators, including an OEM, several universities, and national laboratories.

Reviewer 2:

The reviewer observed strong collaboration with many different stakeholders and agencies.

Reviewer 3:

The reviewer noted that because other researchers such as International Institute for Applied Systems Analysis (IIASA) are trying to adapt the model, is a vote of confidence in the modeling and approach. Peer-reviewed papers are well cited.

Reviewer 4:

The reviewer stated that there was a fairly broad collaboration and coordination, but suggested at least bringing in DOT.

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 reported that the future work does seem comprehensive, with some useful features on the way, such as incentives modeling, but the PI could consider expanding beyond just charging EVs and possibly refueling in general, for example, hydrogen (H₂) refueling time versus range as compared to EVs.

Reviewer 2:

The reviewer stated that the proposed future work seems reasonable, but would recommend that if the PI plans to investigate more regional analysis of consumer preference for BEV size (for example, LEAF versus Tesla in Michigan) the model be expanded to include climate as well as an estimate of PHEV and BEV battery range as a function of outdoor temperature.

Reviewer 3:

The reviewer commented that the future work plans cover many important areas of development for the model, including systematic validation, additional supply-side behavior, and sensitivity analyses. The incorporation of conventional vehicles that are competing with PEVs, particularly high-efficiency vehicles, will be an important contribution. The reviewer also noted that the model would benefit from the addition of advanced SI vehicle technologies (e.g., HEVs, exhaust gas recirculation (EGR), dual clutches, and continuously variable

transmissions (CVTs)). There are several possible explanations for flat sales of the Volt other than the Osborne effect, such as decreases in gasoline prices. The reviewer added that it would be helpful to perform further validation tests and systematically examine the model to verify the Osborne effect before incorporating it into the model.

Reviewer 4:

The reviewer indicated that the increase in NG technologies should be timely and systematic validation should be useful. The reviewer added that the multi-vehicle households are emphasized, primarily for BEV and PHEV markets, which is also timely.

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

Reviewer 1:

The reviewer remarked that the project is an excellent tool for evaluating potential market penetration of advanced technologies.

Reviewer 2:

The reviewer stated that knowing consumer acceptance of various charging scenarios is important in shaping future product plans and predicting acceptance of EVs in the future.

Reviewer 3:

The reviewer reported that the vehicle choice is critical in understanding penetration of AFVs, which reduce petroleum consumption.

Reviewer 4:

The reviewer noted that this model can be used to identify potential technology, infrastructure, consumer marketing and outreach, and policy methods that may be more successful in promoting AFV sales.

Reviewer 5:

The reviewer commented that examining the influence of refueling and recharging infrastructure, regulations, and incentives on the penetration of PEVs is important to inform VTO decisions of what targets to set and where to concentrate their efforts to most effectively achieve reductions in petroleum use and GHG emissions.

Reviewer 6:

The reviewer said that yes, the work supports DOE objectives, but a significant opportunity for improvement exists.

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

Reviewer 1:

The reviewer said that the amount of resources seems about the right level given the model.

Reviewer 2:

The reviewer reported that the budget seems to be a reasonable allocation given the current and proposed scope of work.

Reviewer 3:

The reviewer stated that the project funds are higher than several other VTO Analysis projects, but the project's past and future work plan includes a substantial level of depth in calibration, validation, and state-specific analysis, which justifies the higher funding level.

Parametric Vehicle Choice Modeling: ParaChoice: Dawn Manley (Sandia National Laboratories) - van014

Presenter

Dawn Manley, 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 reviewer commented that the approach is good, and it is just going to take time and continued iteration to overcome more barriers. The reviewer was unsure whether there were any deficiencies in the approach, though at this stage, the complexity and breadth provide some limits to the ability to overcome all of the VTO program barriers. The reviewer added that the project team had a logical approach to the study and model.

Reviewer 2:

The reviewer observed that the first very positive aspect of the approach was soliciting feedback from Toyota and Ford as well as convening a workshop in advance. This type of activity should be at the heart of the beginning of every model endeavor to understand the customer. The reviewer added that the second very positive aspect is how clearly articulated the approach was of using the outputs of all the other various models from the VTO portfolio, then processing and aggregating the results, where the potential here is very powerful.

Reviewer 3:

The reviewer reported that the project team had an interesting approach to defining and quantifying potential market share trade-offs between critical model parameters including vehicle attributes, tax incentives, etc.

Reviewer 4:

The reviewer stated that the project approach was to hold stakeholder engagement workshops and conduct parametric analysis to address uncertainty associated with vehicle adoption and identify sensitivities and tipping points. Barriers addressed include the availability of alternative fuel, charging infrastructure, and vehicles, the uncertainty in vehicle choice models and projections, identifying leverage points for reducing petroleum consumption, and GHG emissions. The reviewer added that the approach is well suited to address

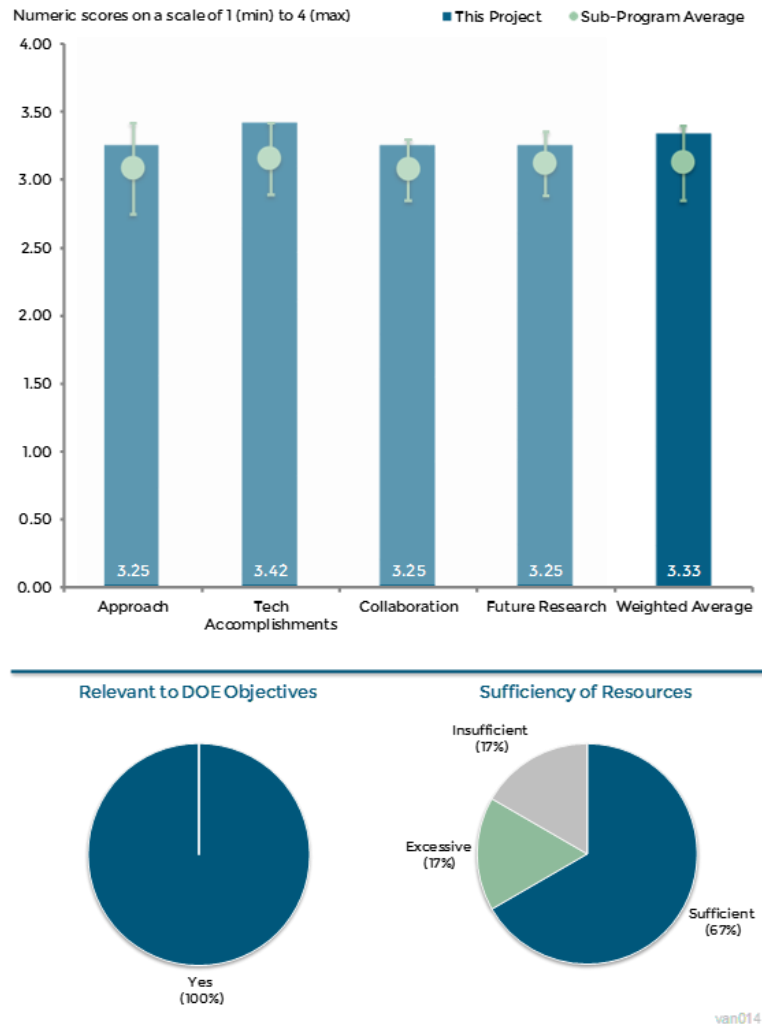


Figure 9-6 Parametric Vehicle Choice Modeling: ParaChoice: Dawn Manley (Sandia National Laboratories) – Vehicle Analysis

modeling uncertainties and identifying scenarios that might be more successful in promoting AFVs and reducing petroleum use and GHG emissions. The reviewer commented that it was unclear how the workshop that was held on NG and H₂ translated into the ParaChoice model development, and asked if this was an input to the model. Perhaps this was discussed in the parallel H₂-focused presentation, but it was unclear from this presentation.

Reviewer 5:

The reviewer said that the parametric analysis provides useful insights that can guide VTO decisions and those of other stakeholders, but validation of the various parts of the model and input assumptions could be improved. For example, the assumptions of vehicle miles traveled (VMT) and vehicle growth rate per capita do not follow historic trends. The reviewer added that many more validation tests could also be performed for the logit model, including matching predicted sales of SI and compression ignition (CI) vehicles with historical data.

Reviewer 6:

The reviewer indicated that there was a very broad focus that included models, energy supply, vehicles, powertrains, VMT, and demographics. The reviewer added that this seems to be a great deal for one model.

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

Reviewer 1:

The reviewer stated that the project has made good progress since it was started last year. Several parametric analyses were conducted and multiple validation tests were performed with the results.

Reviewer 2:

The reviewer reported that interesting insights were provided on a variety of factors effecting market share trade-offs between variation in gas-SI and plug-in vehicle performance, infrastructure development, and cost.

Reviewer 3:

The reviewer pointed out that the results emphasize learning and insights, versus absolute answers. The results and analysis are clearly presented; this should be continued moving forward. The reviewer added that one area not covered for PHEVs and charge sustaining is the effect of high-occupancy vehicle (HOV) lane sticker access. One area that could improve the value is to conduct (or show) more sensitivity and uncertainty analysis on what the research identifies as the most influential factors or relationships. The reviewer commented that this was covered in Q&A, but not shown in the results for this extends beyond the PHEV-10 versus PHEV-40 shown as backup.

Reviewer 4:

The reviewer commented that back casting has resulted in a close match between model outputs and historical data for hybrid sales. The reviewer recommended digging deeper into the relationship between infrastructure and BEV and PHEV attractiveness, but was unclear whether the model includes different electric vehicle supply equipment (EVSE) power levels. The addition of direct-current (DC) fast charging, as well as Level-2 public charging, could make a significant difference among the non-single-family market. The reviewer added that finding that the access to one hour of public charging increases PHEV attractiveness is interesting, but also surprising. The reviewer also recommended doing a deep dive into this result, especially with regard to the cost of public charging. PHEVs on the road today do not typically charge at public stations unless it is free.

Reviewer 5:

The reviewer commented that confusion over verification versus validation persists here, similar to the Market Acceptance of Advanced Automotive Technologies (MA3T) model. Verification is expressed as whether one built it right, and validation is expressed as whether one built the right thing. The reviewer added that in this presentation, both were actually demonstrated. One validation method used was comparison to other models,

whereas validation can also be employed through surveys of customers and users to ensure the results are useful and beneficial to them. The reviewer said that a third method is to see if prior models successfully predicted what has happened today. Also, while the point that this model is not for predicting the future is understood, it is a little disingenuous. The reviewer said clearly that these models are for predicting different future scenarios based on a set of inputs at a minimum, and it should predict the future, plus or minus some uncertainty, if the inputs known at the time are correct. The observed very interesting results and a useful model.

Reviewer 6:

The reviewer noted that the validation was based on a very short time period with few vehicles sold. CNG seemed to be over-emphasized. The reviewer added that assumptions on S-curve for technology are hard to calibrate, as are the infrastructure build-out assumptions.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

The reviewer said the project team has excellent peer reviews and wide collaborations.

Reviewer 2:

The reviewer commented that as part of the project, the PI convened a workshop to engage a variety of stakeholders and receive input on the simulation methodology. Multiple OEMs and national laboratories are included as partners. The reviewer added that it would be helpful to add university partners that have experience with choice model validation as well as with comparable models of the fueling infrastructure.

Reviewer 3:

The reviewer stated that there was collaboration with an OEM – Ford– as well as model input, review, and critiques from agencies and other stakeholders.

Reviewer 4:

The reviewer reported that the PI uses modeling information from various sources, but does not have much collaboration with other organizations.

Question 4: Proposed future research—the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:

The reviewer stated that the future work was well defined and addresses appropriate issues.

Reviewer 2:

The reviewer said that the researcher clearly understands the limitations and weaknesses of the model and has articulated clear actionable items to address with appropriate expectations on what the improvements will provide, where the challenges in executing the improvements are understood. The reviewer could offer no real substantive critique or suggestion for improvement.

Reviewer 3:

The reviewer stated that one piece missing from future work is improvement to data visualization. While the graphic produced for this product did outperform other project, which is great, the reviewer believed even these could become more compelling with, for example, animated graphs (that pivot, rotate, or change in time), or the many other emerging methods. The reviewer added that a second area would be a tornado chart quantifying the relative sensitivities of the outputs to the inputs, as this could be at least as valuable as the graphs already produced. Otherwise, the future plans look solid.

Reviewer 4:

The reviewer recommended inclusion of the ZEV mandate as an additional policy input to the model. Overall, the proposed future research is thoughtfully planned out. The reviewer added that it does seem that including heavy-duty vehicles would require major updates to the model which could exceed available resources. The reviewer looked forward to seeing comparative results between ParaChoice and other VTO Analysis models in the future.

Reviewer 5:

The reviewer commented that the proposed future research addresses uncertainty in vehicle choice models, comparison of results and approach with similar models, and the inclusion of heavy-duty vehicles, which are welcome additions. Further validation by comparing results to historical data of the various pieces of the model should also be included, for example, the vehicle choice model and the influence of infrastructure availability and fuel demands.

Reviewer 6:

The reviewer reported that adding heavy-duty vehicles seemed to extend the scope significantly on an already-expansive model. Issues related to infrastructure are important and timely. The reviewer also said that comparison to other models is definitely valuable.

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

Reviewer 1:

The reviewer commented that this project goes beyond typical sensitivity analysis of vehicle choice models. When completed, the model should provide robust indicators regarding different technologies and policies that are tipping points when it comes to AFV adoption.

Reviewer 2:

The reviewer commented that understanding and aggregating the output of the other models that also work to displace petroleum, would also displace petroleum.

Reviewer 3:

The reviewer reported that understanding how various parameters, such as battery costs and SI efficiency, influence the transition to alternative vehicles, will help DOE target the mechanisms that are most effective to reduce petroleum use.

Reviewer 4:

The reviewer indicated that the project directly addresses petroleum consumption through evaluation of technology programs.

Reviewer 5:

The reviewer stated that results may not have been what some wanted or expected, but they are insightful and can help inform technology deployment and development.

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

Reviewer 1:

The reviewer said that for \$100,000, this project was a bargain, but that DOE may want to consider increased funding in the future.

Reviewer 2:

The reviewer stated that the budget seems to be a reasonable allocation given the current and proposed scope of work.

Reviewer 3:

The reviewer indicated that the funding level is comparable to other VTO Analysis projects of similar scope.

Reviewer 4:

The reviewer thought this project is premature. As the consumer gets more alternative vehicles this model can be empirically calibrated. The reviewer added that, as it stands, exhaustively enumerating possibilities does not seem to help a policy-maker when there is so much uncertainty.

PEV Consumer Behavior in Practice (PCBIP): Mike Nicholas (University of California, Davis) - van015

Presenter

Mike Nicholas, University of California, Davis.

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 there was an excellent approach to better understanding the utilization of battery powered vehicles in single- and multi-vehicle households.

Reviewer 2:

The reviewer noted that there was an excellent use of collaboration and that there were relatively large samples.

Reviewer 3:

The reviewer stated that electric vehicle miles traveled (eVMT) is an important metric to explore. The project could just focus on this issue, the reviewer said, but added that the presenter did not effectively cover existing literature, for example, Zoepf and more, that explored consumer charging behavior. Combining the OEM and survey data sets is good. The reviewer questioned the significance of the data given the sample size and breadth of metrics. The presenter articulated some interesting questions, but they need to be clearly articulated in the presentation as part of what is motivating the research. The reviewer asked how the project team drove the research. This was not an easy project to evaluate, the reviewer found, as the presenter was disorganized and was unable to fully or properly present the material.

Reviewer 4:

The reviewer stated that the project seeks to address the barriers of infrastructure and constant advances in technology through a 37,000- person survey as well as vehicle data collection in 144 households over the course of one year. The travel data is examined at the household level and covers households with most major PEV categories. The reviewer added that shorter time frames may miss long, infrequent trips that are the primary contributor to annual VMT. The project seems well-designed and the resulting dataset will be incredibly valuable. The reviewer also said the project could be improved by the inclusion of some non-PEV households for comparison.

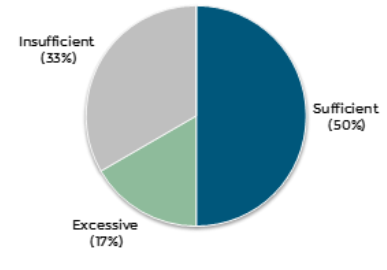
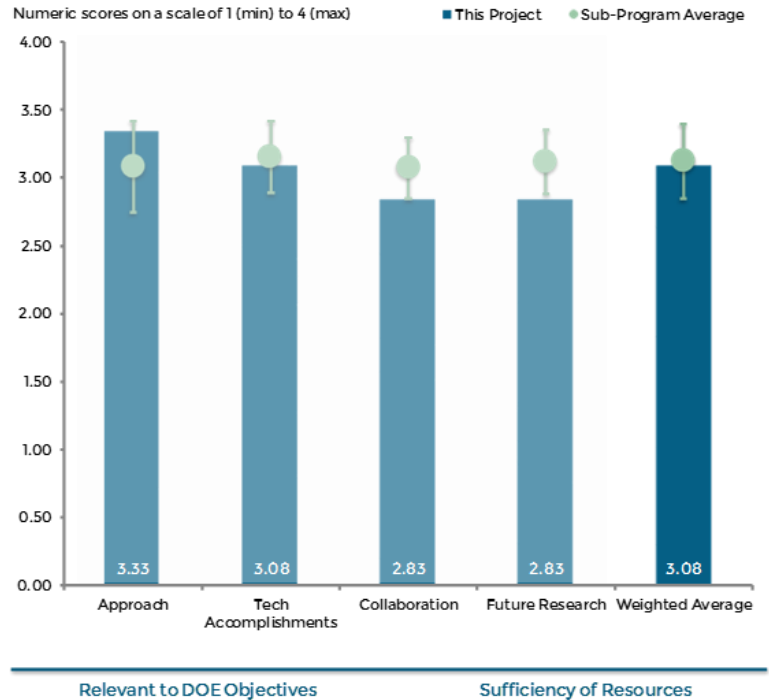


Figure 9-7 PEV Consumer Behavior in Practice (PCBIP): Mike Nicholas (University of California, Davis) – Vehicle Analysis

Reviewer 5:

The reviewer reported that this project makes a very good contribution to understanding BEV adoption and usage by collecting detailed data at the household level. The household sample was carefully selected to approximate a representative set. The reviewer added that the possibility of monitoring or inferring who in the household is driving the vehicles would be an important addition, which should be considered carefully when collecting future data.

Reviewer 6:

The reviewer noted that the shift between PHEVs, BEVs and ICEs does seem very relevant to explore, and eVMT is an important metric to explore. This reviewer further commented that the presenter was thrown a bit by having a different presentation than anticipated, which may or may not have been the presenter's fault.

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

Reviewer 1:

The reviewer stated that the analysis is sound and demonstrated progress is strong even though a complete year of household data is not yet available, and noted that collecting household-level data of this scale takes considerable time and effort.

Reviewer 2:

The reviewer noted that a lot of analysis is left on the table. A good first start would be comparing the shifting between the LEAF and the PHEVs. The reviewer added that work is not at a sufficient stage of completeness to permit adequate evaluation.

Reviewer 3:

The reviewer explained that work has a narrow focus and is well developed. The household as unit of data and data collection by vehicle seems very timely, but the project team will not be able to compare households with two ICEs, which is something of a disadvantage.

Reviewer 4:

The reviewer said that this project is at a little too early stage for accomplishments but preparatory analysis was presented using an existing one-week dataset from Caltrans with just LEAF households. Although all vehicle use in a household is tracked, it is not a planned capture that members of the household are driving each vehicle, for this could be a useful metric to understand differences in weekday and weekend travel behavior within a household.

Reviewer 5:

The reviewer commented that the project is in the data collection phase, but the presentation did not reflect that.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

The reviewer commented that the dataset will be available to NREL, ORNL, and ANL, and some related coordination has been initiated. Given the size of the eventual dataset, the reviewer recommended early collaboration on formatting of the final delivered dataset to eliminate wasted time and parallel work. The reviewer said thus far, besides CARB, there does not seem to be a lot of collaboration with other institutions.

Reviewer 2:

The reviewer pointed out that the project team leverages other data and programs.

Reviewer 3:

The reviewer stated that the collaboration and coordination did seem adequate, though a little bit more detail as to how the collaboration is happening, would have been helpful.

Reviewer 4:

The reviewer said that the data is obviously coming from a collaborator, but the collaborations that could help in the analysis appear to be non-existent. For example, Don McKenzie, from the University of Washington, has a far more proven capability and experience in developing the mathematical analysis and models to describe the behavior.

Reviewer 5:

The reviewer indicated that this project has no OEM partners nor university partners. Increasing this collaboration would be beneficial to cross-validate results with OEM insights and academic research.

Question 4: Proposed future research—the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:

The reviewer indicated that the important future challenges to the work are identified and sensible approaches, including automatic data cleaning, are proposed that will be a good contribution to further the work. The reviewer would have liked to see a more detailed explanation of how the team will collect information on driver identification and how selection bias can be dealt with so that the analysis can provide useful interpretations of miles shifted between ICE vehicles and the LEAF.

Reviewer 2:

The reviewer noted that the goals to complete the project and log data for all households are logical next steps.

Reviewer 3:

The reviewer reported that the future research seemed fairly straightforward and adequate, but nothing more ambitious.

Reviewer 4:

The reviewer stated that not a lot of detailed information was given on future work in the presentation, and gathered that the future work is to execute the survey as planned with timeline provided, and to analyze the results.

Reviewer 5:

The reviewer said that almost no information on planned future work was given by the PI.

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

Reviewer 1:

The reviewer stated that quantifying and predicting eVMT is an important gap to fill and will certainly inform future choices that maximize the likelihood of displacing petroleum.

Reviewer 2:

The reviewer commented that in theory, yes, the work supports DOE objectives especially with regard to how eVMT could enhance petroleum reduction overall. As this project is expected to wrap up in FY 2016, the reviewer expressed hope it can address the shortcoming to date. If not, the reviewer said that fudging should not be continued, especially beyond FY 2016 and alternative entities to execute the research should be sought.

Reviewer 3:

The reviewer observed that this project will provide a dataset to characterize eVMT in a diverse range of households. This will help inform many other modeling efforts in the VTO.

Reviewer 4:

The reviewer indicated that understanding household level behavior of BEV adoption and use is important to inform BEV targets and infrastructure decisions.

Reviewer 5:

The reviewer noted that how people use BEV will inform all later modeling on consumer choice.

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 financial resources are sufficient. There is uncertainty or a lack of confidence that the technical resources are sufficient for reasons noted in the collaboration with others.

Reviewer 2:

The reviewer noted that while the FY 2015 funds are relatively high compared to other VTO Analysis projects, the household-level data that this project provides is difficult to obtain and warrants the current level of support.

Reviewer 3:

The reviewer pointed out that more emphasis should be on this project and its type, and less on the generic consumer survey.

Reviewer 4:

The reviewer reported that in a way, this project was tough to assess because the presentation was not correct and this threw the presentation off a bit. However, as valuable as this work is, the resources do seem like a lot for what has been delivered.

Reviewer 5:

The reviewer's concern was that the data cleaning activity, already identified as a risk, will exceed the resources available.

Acronyms and Abbreviations

AFV	Alternative fuel vehicle
ANL	Argonne National Laboratory
BEV	Battery electric vehicle
CAFE	Corporate Average Fuel Economy
CI	Compression ignition
CNG	Compressed natural gas
CVT	Continuously variable transmissions
DC	Direct current
DOE	Department of Energy
DOT	Department of Transportation
EERE	Office of Energy Efficiency and Renewable Energy
EGR	Exhaust gas recirculation
EPA	Environmental Protection Agency
EREV	Extended range electric vehicle
EV	Electric vehicle
eVMT	Electric vehicle miles traveled
EVSE	Electric vehicle supply equipment
FCEV	Fuel cell electric vehicle
FY	Fiscal year
GDI	Gasoline direct injection
GHG	Greenhouse Gas
REET	Greenhouse Gas, Regulated Emissions, and Energy Use in Transportation
H ₂	Hydrogen
HEV	Hybrid electric vehicle
HOV	High-occupancy vehicle
ICE	Internal combustion engine
ISO	International Organization for Standardization

LCA	Life cycle assessment
LCFS	Low-carbon fuel standard
LOGIT	Logistic regression
MA3T	Market Acceptance of Advanced Automotive Technologies
MY	Model year
NG	Natural gas
NHTSA	National Highway Traffic Safety Administration
NREL	National Renewable Energy Laboratory
OE	Department of Energy Office of Electricity Delivery and Energy Reliability
OEM	Original Equipment Manufacturer
ORNL	Oak Ridge National Laboratory
PHEV	Plug-in hybrid electric vehicle
PI	Principal investigator
Q&A	Questions and answers
R&D	Research and development
RFS	Renewable Fuel Standard
SI	Spark ignition
SNL	Sandia National Laboratories
VAN	Vehicle Analysis
VMT	Vehicle miles traveled
VTO	Vehicle Technologies Office
ZEV	Zero emission vehicle