9. Vehicle Analysis

The Vehicle Analysis (VAN) subprogram provides testing and analysis relevant to the 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

The U.S. Department of Energy (DOE) received feedback on the overall technical subprogram areas presented during the 2014 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 Vehicles Technologies Office (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) – van000

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

Reviewer 1:

The reviewer said that the overall strategy was covered very well, particularly with the inclusion of the pyramid to show how everything builds on top of a foundation.

Reviewer 2:

The reviewer said yes, and explained that the program area plans, executes and communicates analysis for the VTO.

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

Reviewer 1:

The reviewer pointed out a $3 million budget per year for 5 years to support data, modelling, and analysis with most of the activity being conducted at Argonne National Laboratory (ANL) and Oak Ridge National Laboratory (ORNL). The reviewer observed that this seems to have a good balance between mid- and long-range analysis support.

Reviewer 2:

The reviewer noted that there was some more emphasis on near-term research and development (R&D), for example, annual updates to models, etc. This reviewer did not mean to imply the models themselves, only research near-term timelines. Rather, according to the reviewer, the projects themselves seemed to be somewhat conservative and short-term in scope. This reviewer did not see anything in the way of a long-term vision such as combining all the models into one, or creating a common user interface for all models/analyses, or a grand plan to validate all models using a new robust validation process (all examples).

Question 3: Were important issues and challenges identified?

Reviewer 1:

The reviewer commented that an important issue is predicting the cost of transportation in 2035 and beyond. The reviewer noted that issues around fuel uncertainty, and the status of electrification technology, were identified as uncertainties that represent challenges to accurately predict trends and impact.

Reviewer 2:

The reviewer noted that important issues and challenges were identified somewhat, but this reviewer would have appreciated a summary slide on this.

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

Reviewer 1:

The reviewer said yes, provides a robust transportation analysis that speaks for itself. The reviewer also observed a strong foundation of data, relevant models and insightful analysis.

Reviewer 2:

The reviewer commented that plans were identified somewhat in the future work sections, but not in great detail at least within the presentation.

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

Reviewer 1:

The reviewer remarked that yes, all progress was compared with 2013 explicitly.

Reviewer 2:

According to the reviewer, the presentation described annual reports that discuss progress on an annual basis. Data books, market reports, and U.S. DOE levelized cost of driving (LCD) were examples of continuing work benchmarked against previous years.

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 yes, and elaborated that every project seemed to address some aspect of the broad problems and barriers of VTO.

Reviewer 2:

The reviewer said yes, and observed the projects in this technology area to be increasing public domain information and publications. The reviewer stated that the program appeared to be measuring and modelling the correct issues.

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, and suggested reading this reviewer's previous comments about bolder, longer term vision for analyses.

Reviewer 2:

The reviewer said yes. The reviewer commented that the analysis portfolio included data acquisition and analysis, modelling and simulation, emissions and environment modelling, market penetration, macro-economic accounting and integrated analysis. The reviewer perceived the program had a comprehensive action plan.

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 noted good progress in the efforts to update the Greenhouse Gas, Regulated Emissions, and Energy Use in Transportation (GREET) model to provide a user-friendly graphical user interface (GUI). The reviewer remarked that the program was working to fill in the gaps with great tools.

Reviewer 2:

This reviewer suggested deferring to individual comments on each project. For this reviewer, nothing stood out during the overview presentation.

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

Reviewer 1:

The reviewer responded yes, and commented that the operative words here were "as appropriate". The reviewer stated that the projects are not all novel or innovative as they are models that have been honed over many years. However, as far as this reviewer could tell, the models were novel and innovative when needed (e.g., positive feedback model for projecting different policy scenarios).

Reviewer 2:

The reviewer said yes, and provided cradle-to grave analysis with ANL and the fuel cell team as an example.

Question 10: Has the program area engaged appropriate partners?

Reviewer 1:

The reviewer said yes, and commented that ORNL, ANL, Sandia National Laboratories (SNL), the National Renewable Energy Laboratory (NREL), and other industry partners were involved.

Reviewer 2:

The reviewer said for the most part, although much of the work is concentrated within DOE. Speaking from experience, this reviewer remarked that there are many other agencies that could contribute/support a lot of this work, and the reviewer believed this broader collaboration would benefit all parties involved.

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

Reviewer 1:

The reviewer said yes.

Reviewer 2:

The reviewer indicated that with existing partners, the collaboration does appear effective.

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

Reviewer 1:

The reviewer was satisfied with existing tools. The reviewer noted a good portfolio, and no gaps were presented or discussed.

Reviewer 2:

The reviewer did not see any major gaps, although this reviewer would defer to individual project comments for more detail here.

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

Reviewer 1:

The reviewer would like to know if sufficient and robust cost models are available. The reviewer noted that there was not sufficient detail presented to identify any gaps in this area, but the reviewer questioned if further development in this regard might be helpful.

Reviewer 2:

The reviewer did not pick up on this in a general sense.

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

Reviewer 1:

The reviewer said probably, but the reviewer would again refer to individual feedback for each project for specifics.

Reviewer 2:

The reviewer suggested that the presentation should better articulate barriers and areas needing outside support.

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

Reviewer 1:

The reviewer said no.

Reviewer 2:

The reviewer remarked nothing that has not already been discussed somewhere in comments.

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

Reviewer 1:

The reviewer said no.

Reviewer 2:

The reviewer intimated that much of the analyses are forward looking extrapolations based on many assumptions. According to this reviewer, like the weather forecasts, all future analyses will be wrong but some will be less wrong than others. It is this reviewer's belief that the accuracy of these predictive models can be improved through a very robust model validation program. Validation does not mean one predictive model output equals another, or one model is calibrated to equal another model through tuning parameters. For this reviewer, this is a house of cards. Rather, a robust validation program would involve, for example, using what you think is a well-tuned predictive model and feeding the inputs with old data that was known at a certain point in time while seeing if the output matches what actually happened afterward. As an example, this reviewer conceived of a model that predicts vehicle miles traveled (VMT) based on a set of inputs that would then be fed all the data that was known on January 1, 2006, and then evaluated to see how well it predicts VMT through 2014. How well these predictions are made flows into a validation maturity rating for the model. The reviewer concluded that if a model gets a low rating, then it is probably valuable to understand why and to refine it.

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
Macroeconomic Accounting: VISION and NEAT	Joann Zhou (Argonne National Laboratory)	9-8	3.25	3.25	3.42	3.25	3.27
Applied Modeling and Simulation: Autonomie	Aymeric Rousseau (Argonne National Laboratory)	9-12	3.50	3.33	3.50	3.33	3.40
Transportation Energy Data Book, Market Report, and Fact of the Week	Stacy Davis (Oak Ridge National Laboratory)	9-16	3.58	3.67	3.33	3.25	3.55
Oil Security Metrics Model: OSMM	Changzheng Liu (Oak Ridge National Laboratory)	9-20	3.08	3.25	3.08	3.33	3.20
EV Sales Updates	Joann Zhou (Argonne National Laboratory)	9-24	3.25	3.17	3.50	3.33	3.25
Market Penetration Modeling: HTEB, LV Choice, and StoCo	Alicia Birky (TA Engineering, Inc.)	9-28	3.20	3.20	3.40	3.30	3.24
LAVE-Trans Model	Changzheng Liu (Oak Ridge National Laboratory)	9-32	3.58	3.42	3.33	3.42	3.45
Overall Average			**3.35**	**3.33**	**3.37**	**3.32**	**3.34**

Macroeconomic Accounting: VISION and NEAT: Joann Zhou (Argonne National Laboratory) - van006

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:

NEAT and VISION are key models for the industry, this reviewer stated. The reviewer added that long-term views are necessary, albeit usually ignored by the private sector.

Reviewer 2:

The reviewer said the approach appeared to be sound, but had questions concerning how the model was validated and hence its accuracy.
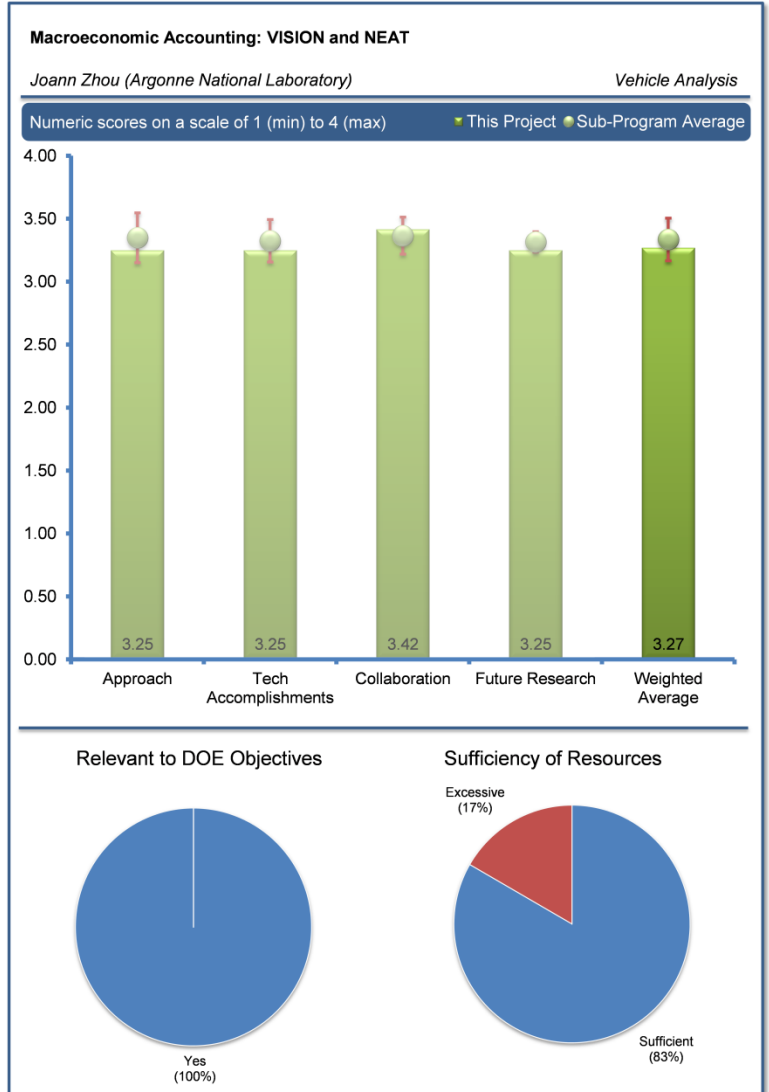
Reviewer 3:

The reviewer indicated that the approach to modeling energy and greenhouse gases (GHG) made sense, but that there was little explanation of how the underlying assumptions were developed. The reviewer regarded assumptions concerning next-generation biofuels as particularly optimistic, and saw little evidence to support this view in light of the struggling industry's current status. This reviewer also questioned the usefulness of projections out as far as 2100, noting the difficulty of projecting even as far as 2050. Suggesting that data collection also be reviewed, the reviewer noted the acknowledgement that pipeline data was old and that much of the input data and assumptions come from research groups rather than from real case studies. It is important, the reviewer added, that data be obtained from industry sources on, for example, the performance of powertrains and the variation of VMT among different vehicles and technologies.

Reviewer 4:

The reviewer perceived that the pipeline gas model could be upgraded to account for the effects of gas flaring. Likewise, the model could be expanded to include off-highway, non-freight modes such as commercial rail, marine and air. Battery electric vehicle (BEV) growth in the Class 5 truck segment is also an area that could be included in the medium-duty commercial vehicle sector, the reviewer commented.

Reviewer 5:

The reviewer found the approach, including the data inputs and methods, to be sound and appropriate. The models, their general purpose, and the issues they address were clearly articulated, the reviewer said. However, the precise technical barriers that these models' findings and results help overcome could be defined in finer detail.

Macroeconomic Accounting: VISION and NEAT

Joann Zhou (Argonne National Laboratory)   *Vehicle Analysis*

Numeric scores on a scale of 1 (min) to 4 (max)   ■ This Project ● Sub-Program Average

	Approach	Tech Accomplishments	Collaboration	Future Research	Weighted Average
Score	3.25	3.25	3.42	3.25	3.27

Relevant to DOE Objectives: Yes (100%)

Sufficiency of Resources: Excessive (17%), Sufficient (83%)

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 toward DOE goals.

Reviewer 1:

The reviewer considered that this project could be the most important presented at this year's Annual Merit Review (AMR).

Reviewer 2:

In the view of this reviewer, the project's accomplishments indicate clear progress toward its goals and those of DOE. The reviewer was also impressed by the long-term modeling results, and by the broad use of the model within DOE offices and in other major government estimates and analyses of energy use. The reviewer deemed the achievement of similar outcomes for the NEAT model to be a clear goal going forward.

Reviewer 3:

The reviewer said that accomplishments are solid. However, it is unclear how well the model had been validated. The reviewer was not convinced that all factors are considered in the model such as rebound effect (VMT up when fuel cost down due to lower demand). Noting that the model is essentially one of the transportation systems, the reviewer found it unclear how well actual, known transportation networks have been integrated into the model and suspected this factor may have been overly generalized.

Reviewer 4:

The VISION model has been used by national and state policy makers, the reviewer noted, and is definitely helping those groups to advance DOE goals. This reviewer found the NEAT model output interesting and welcomed its inclusion of upstream energy use. The reviewer asked if this model has been compared to others that attempt to predict future transportation splits.

Reviewer 5:

Technical progress appears to be on schedule, in the opinion of this reviewer.

Reviewer 6:

The reviewer urged that the model's performance relative to Annual Energy Outlook (AEO) projections and calibrations be examined to ensure that calibration methods are not distorting model projections beyond the last AEO projection year. The reviewer advised that the method used for extended projections (beyond 2040) should be evaluated against other long-term models to ensure consistency.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

The reviewer noted the identification of considerable, strong coordination that ensured strong input from diverse, expert sources, validation of the modeling assumptions, and its use by other leading research groups and government agencies.

Reviewer 2:

The reviewer deemed the project accomplishments excellent, noting the over 400 users who comprise a diverse user base representing DOE, the U.S. Department of Transportation (DOT) and other agencies.

Reviewer 3:

The reviewer termed the project collaborators appropriate, citing the Energy Information Administration (EIA), ORNL, TA Engineering, and NREL, specifically.

Reviewer 4:

This reviewer also noted the VISION model's use by other DOE groups but noted that no mention had been made of its verification by private industry or transport sector groups.

Reviewer 5:

The magnitude of the project, in the opinion of this reviewer, makes collaboration absolutely necessary. The reviewer would welcome greater collaboration with the private sector to ensure the effort was not wholly an academic exercise, but was unsure such collaboration was happening.

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:

Making the tools widely available on their separate website was an idea the reviewer strongly approved. The reviewer also suggested employing more resources for data collection.

Reviewer 2:

Proposed future work seemed logical to this reviewer, if modest. In view of the project's scope and funding level, however, the reviewer deemed this appropriate. The reviewer suggested the addition of a feedback loop to account for the rebound effect.

Reviewer 3:

The reviewer reported that proposed future research would include commercial marine and other passenger modes in marine and rail. The reviewer suggested that impacts on the defense sector (e.g., tactical and combat vehicles) be considered for inclusion in future work.

Reviewer 4:

Noting that proposed future work includes annual updates of current data, as well as new and enhanced features and website development, the reviewer expressed the view that the critically important need identified by the presenter (and other session attendees) is for research concerning medium- and heavy-duty (HD) vehicle characteristics, uses, activities and survival. Further, the reviewer stated that while the project team appears to be proposing further tweaking of the model, there seems to be broad agreement that a serious impediment to rigorous, reliable modeling of medium- and heavy-duty trucks is a deficiency of real, current data, especially since the discontinuation of the Vehicle Inventory and Use Survey (VIUS).

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

Reviewer 1:

The reviewer said the project directly relates to petroleum displacement, assuming the model is accurate.

Reviewer 2:

The reviewer stated that the project supports development of appropriate tools for energy and GHG analysis.

Reviewer 3:

The reviewer affirmed that the VISION model offers important and relevant contributions to the energy research and policy community, and expressed the hope that the NEAT model would, also, when complete.

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 level of funding for this work seems correct.

Reviewer 2:

The reviewer said no resource barriers had been identified that require additional or different resources.

Reviewer 3:

The reviewer commented that while the research offers strong contributions, its use of medium- and HD vehicle data known to be imperfect makes it an example of DOE's excessive focus on modeling and insufficient focus on the fundamental, real-world data needed to ensure the model's rigor.

Applied Modeling and Simulation: Autonomie: Aymeric Rousseau (Argonne National Laboratory) - van008

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 termed the approach as very sound and efficient. Additionally, this person described use of an existing model as the core of the project as an excellent way to leverage resources.
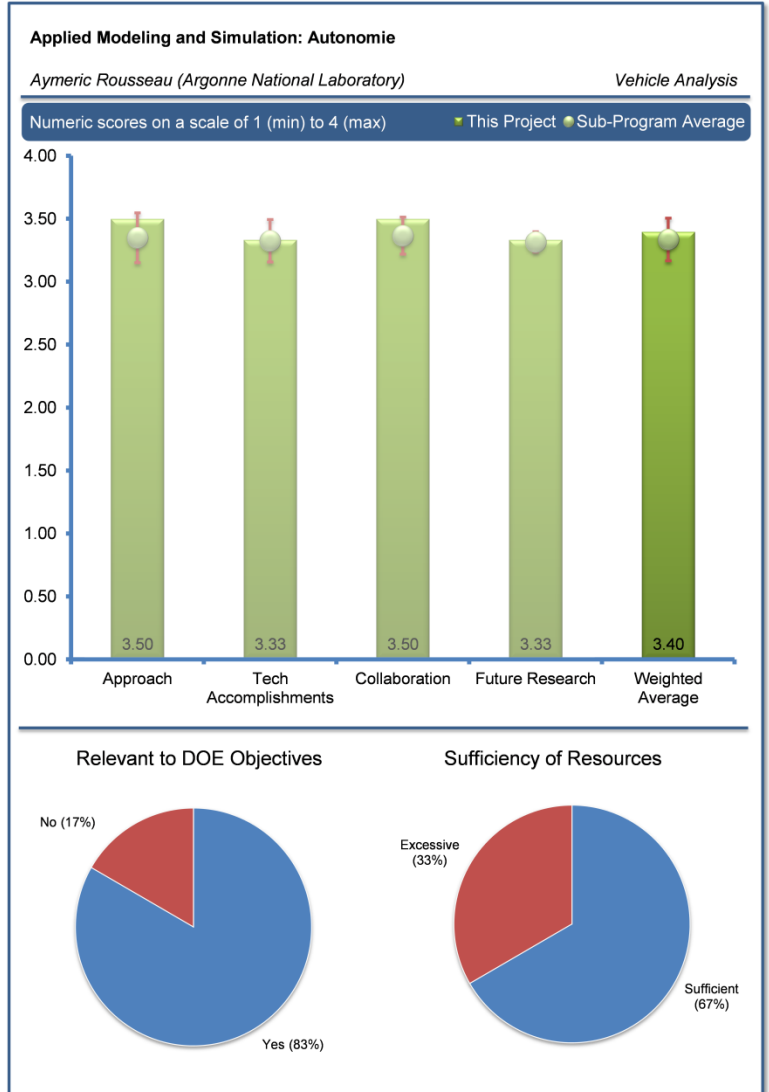
Reviewer 2:

The reviewer approved the idea of developing a process enabling numerous variables to be handled efficiently, particularly if it can be integrated with the Autonomie model. To this reviewer, the project appeared to be on track, the model to be well structured, and the project to be founded on a clear conception of the ultimate product of two years' work. While also deeming the project to be integrated with other efforts (because its results will support other DOE work), this reviewer expressed concern that it will be hard to keep track of all the assumptions with so many data points. The reviewer cautioned that if another research group takes the output of the model and uses it in their own models without fully understanding the assumptions and variables used in this model, there will be poor quality results.

Applied Modeling and Simulation: Autonomie

Aymeric Rousseau (Argonne National Laboratory) — *Vehicle Analysis*

Numeric scores on a scale of 1 (min) to 4 (max) — This Project — Sub-Program Average

	Approach	Tech Accomplishments	Collaboration	Future Research	Weighted Average
This Project	3.50	3.33	3.50	3.33	3.40

Relevant to DOE Objectives: No (17%), Yes (83%)

Sufficiency of Resources: Excessive (33%), Sufficient (67%)

Reviewer 3:

The reviewer termed the approach appropriate. Noting that the question had arisen of whether actual vehicle configurations were modeled and the answer that representative vehicles and technologies were modeled, the reviewer speculated that it may be worthwhile to assess whether actual configurations are included in the combinations of technologies and vehicle types and to include those combinations if they are not covered.

Reviewer 4:

The reviewer expressed the belief that the modeling effort does indeed assist in addressing barriers represented by computational modeling methods and complex benefits analysis, as claimed in the presentation, but was more skeptical of its value in addressing risk aversion, technology advances, and cost. The reviewer said those latter factors are better addressed by consumer behavior research, vehicle simulation and validation, and vehicle teardown research, all of which feed into this project. That aside, the reviewer said, the approach described and the input data used appeared to be state-of-the-art.

Reviewer 5:

The reviewer expressed the view that knowing some 89,000 simulations support the results of Autonomie is of considerable value to any serious transport analyst. Because reviewers have not seen the tool itself, this expert stated it is difficult to assess how technical barriers have been dealt with; however, the 80,000 simulations engender confidence that most technical limitations have been addressed.

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 toward DOE goals.

Reviewer 1:

The reviewer deemed technical accomplishments to have been as planned and noted no apparent gaps.

Reviewer 2:

Terming the overall project as excellent and the database analysis tool clearly very powerful, this reviewer was less clear on the user-friendliness of the graphical user interface.

Reviewer 3:

The reviewer speculated that if the aim of this model is to show how predicted research and development (R&D) improvements will affect the transport industry, then it definitely helps towards DOE goals as it will show other research groups from which areas of R&D that they could get the best results. The reviewer was left with the impression that the model, and the results from the model, will be for internal use only. This reviewer opined that this perhaps dilutes some of its benefits as this way only internal DOE research groups will be able to view the results and be able to assess which R&D programs are worth investing in.

Reviewer 4:

The reviewer believed the analysis could benefit from alternative baseline assumptions from other federal agencies that consider estimates of conventional internal combustion engine technology performance and cost.

Reviewer 5:

The reviewer considered it too early in the project fully to evaluate the accomplishments (including a database analysis tool) because the modeling effort has not been completed and final results have not been presented.

Reviewer 6:

The reviewer termed the technical accomplishments and progress to not be outstanding, because final results will not be available until the project's next phase.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

The reviewer noted strong collaboration with partners Argonne National Laboratory (ANL), ONRL, NREL, and U.S. Driving Research and Innovation for Vehicle Efficiency and Energy (U.S. DRIVE).

Reviewer 2:

This reviewer stated that operating a model of the magnitude typified by Autonomie requires a high degree of collaboration, which the presentation showed to be the case. The reviewer emphasized the importance of involving the private transport sector in the project.

Reviewer 3:

Acknowledging strong collaboration within DOE, one reviewer suggested the possibility of further collaborative opportunities outside the Department with, for example, EPA, DOT, original equipment manufacturers (OEMs), etc. Such collaboration could be customized or incorporated into the analysis requirements of these agencies. Wider collaboration was mentioned toward the end of the presentation, the reviewer noted, but no details were provided.

Reviewer 4:

The reviewer noted the project's coordination and collaboration with U.S. DRIVE, ANL, NREL and ORNL and urged that ways be found to ensure the work is exposed beyond the national laboratories and U.S. DRIVE to greater leverage the investment, and thus to broaden its impact. Universities, DOT, and EPA are key practitioners that are largely unaware of many of these DOE modeling activities and would gain from better understanding the research as it is being conducted, and later as it is completed. Such partnerships, in this reviewer's view, would ensure that everyone's research is state-of-the-art and applied to the most pressing and timely research questions.

Reviewer 5:

The reviewer saw this project as aggregating, digesting and disseminating information, and believed this demands collaboration with other institutions. Its reliance on external expertise to set some of its assumptions was viewed as a good use of resources, provided such outside collaborators are unbiased and representative of a range of sectors and areas. The reviewer directed attention to Slide 15, which showed most model inputs come from research groups. If data were also derived from real life, the reviewer speculated, the model's accuracy might be improved. The reviewer cited U.S.DRIVE as a good source of data from OEMs and suggested further that household surveys and other forms of real-life data could enhance modeling of how technical improvements perform on the road. The importance of such sources could increase in coming years when a higher proportion of the on-road fleet consists of electric vehicles (EVs), fuel cell vehicles (FCVs), natural gas vehicles (NGVs), etc. This reviewer also suggested collaboration with the EV sales project, which is attempting to obtain real automobile usage data.

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 presenter had identified a clear path through 2014-15 to complete the work, improve the analysis, and distribute the product to the national laboratories.

Reviewer 2:

The reviewer felt the proposed future research was limited to evolutionary changes and suggested that soliciting customer feedback on the tool or the data might develop some revolutionary future research that could be of particular benefit to non-DOE users of the model.

Reviewer 3:

This reviewer was left with the impression that the only fuels under consideration are gasoline, diesel fuel and ethanol, and wondered about the inclusion of advanced biofuels, mentioning renewable diesel fuel (in commercial use nationally) and renewable gasoline. The reviewer noted that there are several biofuel technologies that, if production can be successfully scaled up to hit Renewable Fuel Standard 2 (RFS) targets, could substantially change model outputs. The reviewer also inquired if it was planned to examine earlier simulations to assess their accuracy, based on technology improvements that have been achieved. The model could be used retrospectively to examine changes in the automation space to determine if such step changes could have been predicted using the model, the reviewer suggested.

Reviewer 4:

Noting that future work includes distribution of database analysis tools to other national laboratories, the reviewer asked about the possibility of its being made available to other organizations, observing that reports were available via the website, but that analytical tools were said not to be available.

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

Reviewer 1:

The reviewer labeled the project as highly relevant, and noted that it was mandated statutorily.

Reviewer 2:

Noting that the model will be employed to analyze the usefulness of DOE's investment, the reviewer predicted its major use would lie in aggregating R&D data from a wide range of sources. The reviewer urged care that all assumptions underlying provided data and employed by model users be understood and made explicit. The reviewer also wondered if, once a critical number of assumptions were incorporated, results would begin to lose significance.

Reviewer 3:

The project, the reviewer indicated, provides an effective modeling tool to assess the impacts of technologies.

Reviewer 4:

While terming this project somewhat relevant to several internal DOE activities, the reviewer was unclear as to the degree of relevance, and was unsatisfied with the specificity of the response to a request for examples of the value of the work in improved decision making. According to the presenter, the reviewer said, the work had originally helped justify the Government Performance and Results Act (GPRA), but had since expanded to other uses, such as informing market penetration and connecting real-world data to DOE forecasting. In response to a question concerning the project's linkage to the 2017-25 Corporate Average Fuel Economy (CAFE) and carbon dioxide emission standards, which the reviewer considered the most important and pressing vehicle technology issue facing the United States, the reviewer noted that the presenter was unable to forge a connection with the work, its objectives, results, or its baseline vehicle characteristics. The reviewer said this showed the work was not aimed at being externally relevant other than to DOE's national laboratories. The reviewer expressed the hope that by the end of the project, a stronger answer will be available to the question of how exactly this work is a relevant contribution to the research world.

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

Reviewer 1:

The reviewer found it difficult to judge, discerning little transparency as to how the funding had been spent. Because the project is only two years old, the reviewer observed that heavy early funding may be justified. The reviewer speculated that beyond that period this project's funding will be folded into that for the Autonomie project, which would be bolstered in recognition of the additional modeling work.

Reviewer 2:

According to the reviewer, the presentation summary showed that the number of technologies has increased significantly and the number of combinations modeled should be evaluated. Further, the reviewer explained it was unclear whether project resources should be adjusted.

Reviewer 3:

Although calling this great work, the reviewer said it seemed less ambitious than would be suggested by its $500,000 annual budget (co-funded by Vehicle Systems and Analysis). The reviewer could not exclude the possibility of having missed important details (e.g., software costs, etc.) that could easily justify that yearly sum.

Reviewer 4:

The reviewer said the project could be significantly relevant, given its scale and again expressed the hope that a better case could be made for the work by the time of the 2015 AMR.

Transportation Energy Data Book, Market Report, and Fact of the Week: Stacy Davis (Oak Ridge National Laboratory) - van009

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 called the process excellent and said it was apparent it had been finely honed over many years. Noting that the presenter had said the process includes a continuous improvement perspective to ensure the product and process always evolve, the reviewer said that seeing examples of this, or at least mention of it in the presentation, may further strengthen this already excellent process.

Reviewer 2:
The reviewer rated the approach excellent and explained the reason it had not been rated outstanding was that the group working on the two publications and the fact of the week seems to rely on other government agencies, but only one private-sector source/partner – Infobank. DOE has access to the most comprehensive data sources, the reviewer acknowledged, but said it is important to ensure that privately collected data is taken into account.

Transportation Energy Data Book, Market Report, and Fact of the Week

Stacy Davis (Oak Ridge National Laboratory) — Vehicle Analysis

Numeric scores on a scale of 1 (min) to 4 (max). This Project, Sub-Program Average

Approach	Tech Accomplishments	Collaboration	Future Research	Weighted Average
3.58	3.67	3.33	3.25	3.55

Relevant to DOE Objectives: Yes (100%)

Sufficiency of Resources: Sufficient (100%)

Reviewer 3:
The reviewer called the approach sound, the methodology and results proven and asked if there is an opportunity to print fewer copies of the Data Book and to assess if a portion of the user group would prefer to rely on the website for access, thus saving printing costs and materials. The reviewer also said it would be interesting to evaluate whether the on-line questions were coming from subscribers of the data books or from those who primarily use the website for information access.

Reviewer 4:
The reviewer said the project is less about overcoming technical barriers than about overcoming very significant practical, institutional, public understanding and outreach barriers in its unique and comprehensive syntheses of information. The project is excellent in addressing these barriers, the reviewer said, and is well-designed and clearly well linked to many actions by DOE and other government agencies. The approach – discovery, numerous due-diligence steps, outreach – is strong, the reviewer said.

Reviewer 5:
The reviewer wondered whether, if basic analysis and calculations were consuming a lot of hours, time could be saved by working with other groups doing the same work, or if the aim of the Data Book is to be independent from other data book producers and working groups. Even if these data books are the best available, those who have provided the data (national laboratories, auto manufacturers, etc.) will have analyzed the data they provide and done unit conversions. Could those working on this project request data in certain formats or standard units, the reviewer asked. The reviewer also acknowledged that some people prefer the hardcopy format of the Data
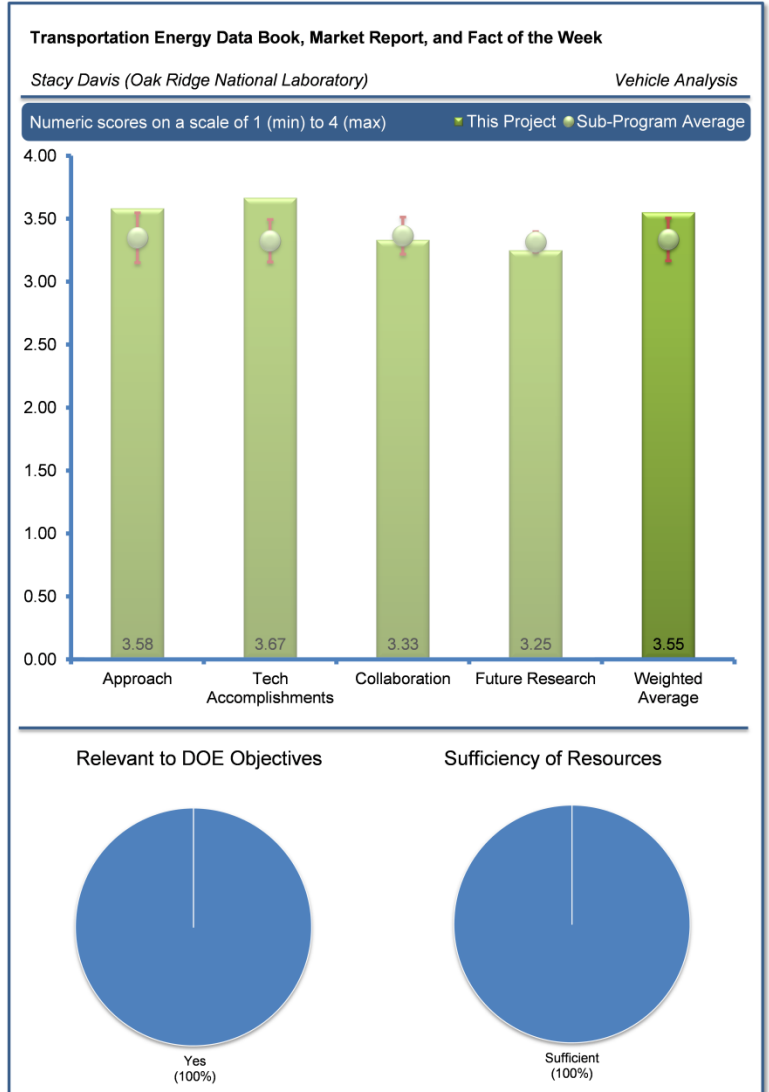
Book, but noted that if the numbers of those continue to decline, it might be advisable just to publish an interactive PDF of the book. Users could print this out, if desired, or use it online, clicking on icons or tables and graphs to take them to the underlying data sets. Finally, the reviewer asked if a search engine function could be added to the fact of the week so that users could see all facts relating to, for example, FCVs or HD vehicles.

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 toward DOE goals.

Reviewer 1:

Rating the technical accomplishments as excellent overall, the reviewer suggested the team consider a formal feedback mechanism for Data Book customers. The reviewer was sure excellent feedback was currently available from some customers, but felt tracking an overall feedback score as well as gathering formal feedback in words would likely improve this further.

Reviewer 2:

The reviewer said progress and indicators of the project's accomplishments are very clear and impressive. Steadily increasing citations in government reports, universities, and popular media are clear testament to the importance of the Transportation Energy Data Book (TEDB), and its 1,300-copy distribution and 6,000 to 9,000 visits to the website per month show high popularity and usefulness, the reviewer continued. The progress of the newer Vehicle Technologies Market Report (VTMR) also impressed the reviewer, who noted web traffic having increased to 5,000 visits per month in March 2014. The reviewer said the fact that 61% of visitors and 53% of new visitors to the VTO site come from the Fact of the Week shows great progress for VTO's outreach efforts and the general public's understanding of many of DOE's broader energy work.

Reviewer 3:

The reviewer indicated that the book, web page, and Fact of the Week all inform the public about main transportation trends and issues. The reviewer said it is good for the industry to have in DOE an unbiased data aggregator. The reviewer considered the most important technical achievement is to have tracked and maintained transport data for over 30 years.

Reviewer 4:

The reviewer noted the project is ongoing and has projected improvements, so it was difficult to answer this question. If the data from the Data Books is being used in DOE models, the reviewer said, this is a good use of it and shows it is working toward DOE goals. However, no specific examples were provided of how the book is used by DOE models or analysts, which made it quite hard to judge this aspect of the project.

Reviewer 5:

Noting there had been a brief period when the website was down for maintenance and could not be updated, the reviewer asked if maintenance could be done in off hours to minimize downtime.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

The reviewer noted previously that gathering feedback from a representative sample of users after the product is published would be best, and reiterated this comment. The reviewer also said it was clear there was strong collaboration on the input side of the product/data book.

Reviewer 2:

The reviewer said there appeared to be good collaboration with other institutions including EIA, DOT, ANL, Wards, EPA, the Census Bureau, NREL, and others.

Reviewer 3:

The reviewer commented that good management of all collaborations with EIA, EPA, DOT, Census Bureau, ANL, NREL, and Wards is important to allow all the restricted-use and hard-to-find data to be publicly used, re-used, and updated. Outreach of the TEDB,

VRTM, and Fact of the Week to a wider audience (e.g., through the web, with Excel data available, via the publications and response to inquiries) ensures that DOE is well connected and is critically valuable writ large.

Reviewer 4:

The reviewer acknowledged the importance of collaboration with industry that provides data, but said the question is how the project team is collaborating with users of the data. This reviewer queried how accessible the team is to users with questions or suggestions. It seems there is a well-defined process for producing the reports and Fact of the Week, but it is unclear to this reviewer how flexible these processes are or how likely they are to change based on market needs.

Reviewer 5:

Noting that the data is used by and probably taken from other institutions, the reviewer said it appeared all analysis, data aggregation and calculations are done fresh for each book. The reviewer said this process could probably be accelerated and improved by working with other departments who also might perform the calculations. Referring to a comment that the definitions of certain vehicle classes change over the years, making it hard for the project team to redefine things or compare to previous years' classifications, the reviewer suggested a discussion with national laboratories and OEMs about how they do such reclassifications could result in a standard being developed that would help clarify.

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 deemed efforts to continue to add and vet good data as excellent.

Reviewer 2:

The reviewer stated the plan is sufficient.

Reviewer 3:

The reviewer believed the proposed future research was somewhat unimaginative because it consists mostly of updating the book with the latest figures. If this is truly the mission, acknowledging the long, steady tradition of the Data Book, then perhaps this question is not as applicable. With more comprehensive feedback, on the other hand, the reviewer believed it possible that customers themselves might have some important suggestions for future research.

Reviewer 4:

This reviewer noted that future work involves doing the same thing as in previous years, and thus found it hard to judge this question. The reviewer assumed that informal feedback was used to improve the book for next year. Because much work goes into compiling these books, the reviewer intimated that it seems it would be difficult to make significant developments or improvements with the resources provided.

Reviewer 5:

The reviewer said it seemed the project team aims to continue doing what it has been doing to date. This seemed reaction-based to the reviewer, who expressed the opinion that change would come only when absolutely necessary and would therefore come too late. Holistic overviews of this type tend to lose relevancy very quickly, the reviewer said, so perhaps splitting the Data Book or the web-based report into sections that are updated periodically would have greater value to users.

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

Reviewer 1:

The reviewer stated that knowing the data first is extremely important to subsequently implementing policies and/or researching methods to displace petroleum, and commented that the Data Book clearly fills that need.

Reviewer 2:

This project is highly relevant in aiding and amplifying all the U.S. government's efforts (by EPA, DOE, DOT, etc.) to increase awareness and availability of data on all things related to energy and transportation, the reviewer said.

Reviewer 3:

The reviewer observed that the TEDB is reaching 1,300 individuals deeply involved in the industry, calling this a very strong readership. The reviewer added VTMR appears to be gaining momentum, and thanks to the Fact of the Week, a lot of information in it is being made available to the general public. The reviewer said that 60% of visitors and 53% of new visitors arriving at the VTO's website are attributable to the Fact of the Week.

Reviewer 4:

This project, by providing detailed data on U.S. transport, definitely helps inform other private and public transport groups, in the opinion of this reviewer.

Reviewer 5:

The reviewer said that this project provides a useful data resource for the government and the public.

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

Reviewer 1:

The reviewer expressed that with such a history of flat funding for a steady product, the resources appear to be well honed.

Reviewer 2:

The reviewer stated that no barriers were identified that required additional resources.

Reviewer 3:

The reviewer said the TEDB and VTMR appear to have sufficient DOE funding and do an excellent job researching and troubleshooting issues that arise from compiling some 300 sources of information, and summarizing and presenting these to users. From the question-and-answer period, however, the reviewer got the impression that some insufficiencies exist in fundamental data collection areas, namely in collecting medium- and HD vehicle sales, use, activity and market characteristics data. Since the defunding of VIUS, the reviewer indicated there has been only limited rigorous data on which researchers and government agencies can base sound, well-grounded conclusions concerning what is going on in this important and growing U.S. transportation energy use sector. This essentially forces TEDB to repackage and publish relatively old data for HD vehicles, the reviewer concluded.

Reviewer 4:

The reviewer indicated there was not much input on this.

Oil Security Metrics Model: OSMM: Changzheng Liu (Oak Ridge National Laboratory) - van010

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 said this work is definitely needed and is a great way to demonstrate why alternative energy development is so important for U.S. energy security and to show the hidden cost of reliance on fossil fuels. If the only aim is to show the cost of importing oil and how price shocks might affect those costs, the model is sufficient, the reviewer said. However, if the model does not take into account the types and qualities of imported oil, it cannot model how much oil will be displaced by EVs or biofuels. For example, if all imported oil is light crude with a large gasoline fraction, increasing the penetration of renewable diesel fuel or increasing the use of liquefied natural gas (LNG) in HD engines might not reduce importation of oil, the reviewer said. If light crude is imported but used mainly as chemical feedstock rather than for gasoline production, increasing penetration of EVs might not reduce the importation of this type of crude. The reviewer said the reason oil data used in this project takes the form it does is because it comes from AEO and is not characterized by type, so perhaps the next step in the project should be to seek more detailed data elsewhere than just AEO.
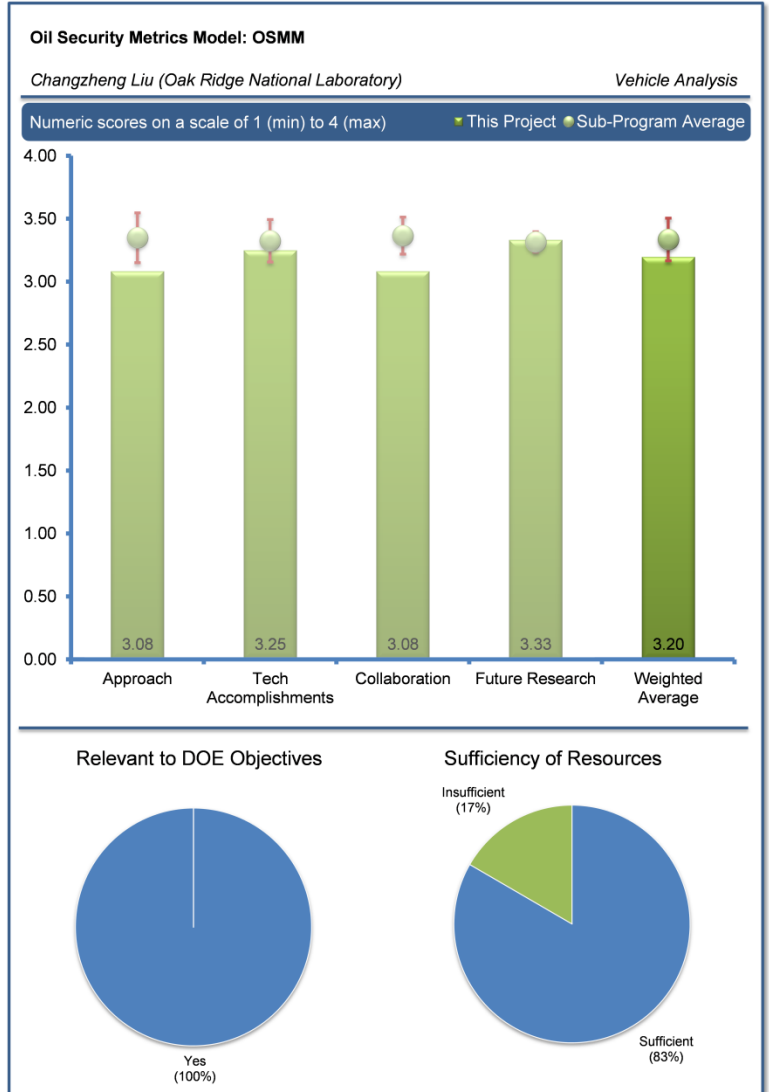

Reviewer 2:

The reviewer indicated that the approach does a good job addressing the target questions of quantifying the value of reducing petroleum use and measuring the costs of petroleum dependence and of utilizing the best available methods and updated data to study these questions.

Reviewer 3:

The reviewer said that there is an opportunity to improve the project with recognition of the effect domestic natural gas production will have on oil consumption and foreign oil dependence.

Reviewer 4:

The assumption that oil prices will continue to rise despite more shale oil discoveries, flat VMT, falling demand and displacement by alternatives may not be valid, in the view of this expert. The reviewer continued that Slide 4 of the presentation presents this assumption as a given and it may creep into the overall modeling approach in unintended ways. There is a school of thought, the reviewer added, that holds a dramatic global oversupply of oil will develop and prices could collapse. It was not clear to this reviewer what affect this would have on this project.

Reviewer 5:

This type of analysis is not new, having been carried out by many private and public companies for a long time, this reviewer noted. Furthermore, its approach seemed quite general to the reviewer in its assumption that all crude oils are the same and therefore fungible. The reviewer pointed out that supply shocks in countries with specific crude categories have proved that the fungibility of crude oils is high, but not absolute.

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 toward DOE goals.

Reviewer 1:

The reviewer indicated the supply shock simulator is definitely a solid accomplishment, as are others such as the uncertainty analysis of oil dependence as a percent of gross domestic product (GDP), but added that it was not clear how much rebound effect is factored into the analysis.

Reviewer 2:

The reviewer reiterated that the accomplishment is good if the aim is to show how much money the United States is spending on oil, and how future oil shocks could affect the United States. However, this reviewer expressed uncertainty of the use of this data (apart from for publicity's sake) if further modelling is not done with regards to looking at how alternative energy penetration in the advanced transport market would affect oil use in the United States. The reviewer continued that perhaps this model could use some of the outputs from other DOE models that look at advanced transport penetration and compare it to the types of fossil fuels it displaces. The reviewer said that this information could then be used to discern which type of oil imports from whole countries, would be displaced and how this would affect other related markets like chemicals and power. The reviewer asked what would be the knock on effects, for instance.

Reviewer 3:

The reviewer commented that the work appears to be on schedule. This reviewer recounted that the project is 90% complete on milestones set for June 30 and asked if these would be 100% complete by June 30. The reviewer referenced price elasticities and competitive oil prices, oil supply shock algorithm, and preliminary results on U.S. oil dependence cost estimation.

Reviewer 4:

Observing that the work is not yet complete, the reviewer said the results presented for the 90% completed task on wealth transfer and potential GDP loss show the project's progress in achieving its goals has been good and it appears to be headed toward delivering useful, novel results.

Reviewer 5:

The reviewer indicated it was not clear how this contributes to DOE's goals. The reviewer further stated that U.S. energy independence seems to be an issue well debated and quantified. Implementation of policy to ensure it is achieved appears to be more important than spending resources in quantifying the size of the energy gap.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

Collaboration is adequate, in the view of this commenter, but not excellent. The reviewer said this is an important model that seemingly should be either incorporated into more agencies' planning or at least more agencies should be stakeholders.

Reviewer 2:

The reviewer said the collaboration partners were appropriate, including ORNL, the University of Tennessee and ANL. The reviewer wondered if it might be relevant to consider the effect of natural gas production and consumption and how they will affect U.S. oil dependence, and suggested consideration be given to collaborating with natural gas consumption models.

Reviewer 3:

The reviewer stated project coordination among the University of Tennessee, ANL and ORNL appeared to be good, but that there appeared to be relatively limited collaboration beyond that immediate group of researchers. The reviewer wondered if there might be interest in connecting the research outside that group.

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:

Calling the proposed future work valid and valuable, although not revolutionary in scope, the reviewer said making the model more user-friendly and improving the shock simulator (for example) are important pieces of work.

Reviewer 2:

The reviewer said all the proposed work sounds valuable and suggested further work could be focused on getting better oil import data and in modeling the effect of key programs such as zero-emission vehicles and RFS2 might have on oil dependence.

Reviewer 3:

The efforts discussed – to finalize the model, include an Organization of the Petroleum Exporting Countries supply shock simulator in 2014 and an analysis of the transition to an e-drive fleet in 2015 – seemed to the reviewer to be good areas for future work.

Reviewer 4:

Noting that the project has identified the potential impacts of EVs and alternative fuels, the reviewer asked for clearer articulation of how to include alternative energy sources, natural gas, EVs, hydrogen, biofuels, and renewable fuels in the model.

Reviewer 5:

The reviewer was unsure how much more research on this topic is required. The main question seemed to have been answered and future work to be just a matter of updating.

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

Reviewer 1:

The rigorous efforts of the researchers to reassess the importance of and outlook for oil security into the future is highly relevant, in the opinion of this reviewer, considering current geopolitics and major changes in the world oil market. The reviewer also acknowledged the researchers' goal of increasing public understanding and expressed the hope that the project team would ensure some effort was devoted to press releases, the TEDB, dissemination of their results at conferences, etc. to bring these results to a wider audience.

Reviewer 2:

The reviewer said the model is very important for reducing petroleum use. Although it needs some refinement in its assumptions and tolerance for variations in inputs, the reviewer stated that it serves a role for policy makers to make better decisions on future energy policy.

Reviewer 3:

The reviewer agreed that the project is showing the government and general public the cost to the country of importing oil. However, if the model is not disseminated outside DOE, the reviewer said, it is less clear how it is advancing DOE goals.

Reviewer 4:

The reviewer expressed that model focuses primarily on oil projections, not on alternative fuel impacts. Scenario analyses would be useful, given the wide variability of predicted effects.

Reviewer 5:

The reviewer acknowledged that the model quantifies the size of the displacement required; but once quantified, the reviewer was unclear about how the project is necessary.

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 the $100,000 funding level makes the project a decent bargain and suggested consideration be given to increasing funding to permit the scope to be expanded to include better validation and overall model improvements.

Reviewer 2:

No resource barriers were identified that require additional or different resources, in the view of this reviewer.

EV Sales Updates: Joann Zhou (Argonne National Laboratory) - van011

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 indicated that the project is a great example of how national laboratories can use data produced by private organizations to build their long-term forecasts. The reviewer added that it is important for the advanced transport industry to have the thought leaders in the national laboratories using all available data in the market.

Reviewer 2:
The reviewer said the approach is sound and the project appears to be doing a good job of addressing the lack of available data on electric drive vehicle sales, use and costs and the uncertainty of projections. The reviewer said that improving the various DOE forecasting models' uncertainty is a very good objective, although it was not quite clear how the project will reduce the uncertainty and variability of DOE models' EV projections. The reviewer looked forward to seeing the results of later project stages.
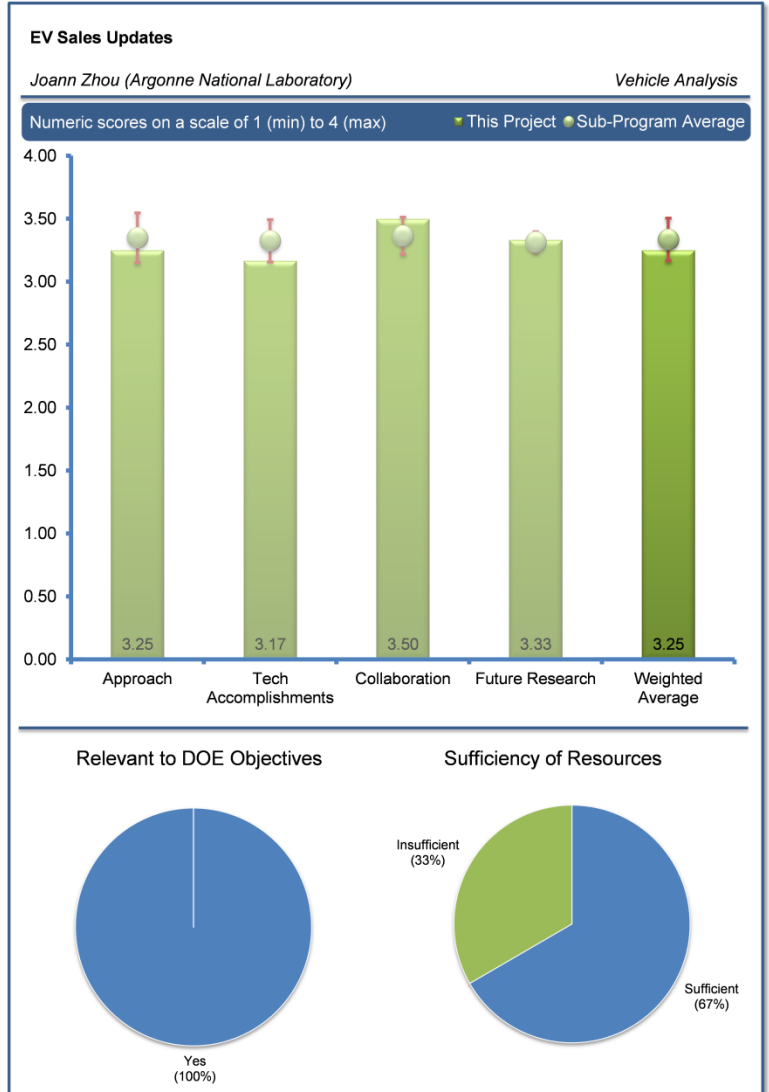
Reviewer 3:
The reviewer stated the approach appears sound and effective in producing the intended product.

EV Sales Updates

Joann Zhou (Argonne National Laboratory) — Vehicle Analysis

Numeric scores on a scale of 1 (min) to 4 (max). This Project / Sub-Program Average

	Approach	Tech Accomplishments	Collaboration	Future Research	Weighted Average
This Project	3.25	3.17	3.50	3.33	3.25

Relevant to DOE Objectives: Yes (100%)

Sufficiency of Resources: Insufficient (33%), Sufficient (67%)

Reviewer 4:
Noting that the e-drive vehicle policy matrix includes fiscal subsidies to consumers, the reviewer suggested that social incentives, such as access to high-occupancy vehicle (HOV) lanes, reserved parking, etc., for EVs also be included.

Reviewer 5:
The reviewer noted that virtually all data used in this project is from third parties – primarily Navigant – and asked if its accuracy has been evaluated, as some of it (e.g., the National Household survey) appears to be very old and thus probably more misleading than helpful with regard to EV usage. Other parts of the work involve some aggregation and analysis, such as compiling EV sales data and the policy matrix, which is probably done by other government and non-government groups. Thus, the reviewer found it difficult to determine if the data aggregation and compilation done under this project is unique. Certainly a lot of private companies already do this, observed the reviewer. Because others do such work, the reviewer opined that it would make more sense simply to pay Navigant, or some other group, more so they could compile the data and produce the charts for DOE/VTO. This reviewer explained that the issue with this is that VTO might not trust the outcome of the data, but already relies so heavily on Navigant data. The reviewer found the presentation slide concerning Japan and the factors that could affect EV sales to be interesting, and further suggested that doing this analysis to predict EV sales could be a helpful exercise.

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 toward DOE goals.

Reviewer 1:

The reviewer deemed all the accomplishments to be significant, but said it was unclear how important this project actually is to other models or projects. It could be very important, the reviewer acknowledged, but that did not come across in the presentation. The reviewer also noted that evaluating depreciation is tricky due to OEM incentives and other factors (e.g., Tesla's guaranteeing a re-sale value after some period of time). The reviewer found it unclear how well the project is covering these types of market distortions. Identifying the differences in model outputs, is very important, but the reviewer was left unsatisfied that this was well-understood. Nor was the reviewer sure that this is an accomplishment, unless the reference was purely to identifying model outputs' differing sensitivities and outputs.

Reviewer 2:

This reviewer found the accomplishments shown (e.g., China, Japan, the EU, Navigant forecast, policy matrix, etc.) very interesting and looked forward to seeing all these results.

Reviewer 3:

The reviewer said it appeared that most of the project data collection and processing had been done and that the analysis was now underway. The reviewer anticipated that the analysis should prove interesting and useful, but that it and a portion of the data need to be made available to the public, as it would be a shame if this effort failed to make it beyond the DOE's firewall.

Reviewer 4:

Noting that progress appeared to be on schedule, the reviewer called attention to the barriers section where lack of available historical data on sales, advanced vehicle usage and cost components was mentioned. The reviewer believed this might benefit from additional input regarding component cost, which could also contribute to ongoing work related to total-cost-of-ownership data for plug-in electric vehicles and comparable conventional vehicles.

Reviewer 5:

The reviewer believed the analysis could benefit from better understanding of the technology labels from various data sources, offering as an example the question of whether all hybrid vehicle sales data include vehicles of similar design and capability.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

The reviewer said there appears to be good collaboration with national laboratories, TA Engineering, Navigant and other entities in Asia and the United Kingdom.

Reviewer 2:

The reviewer noted that the project team had worked with four or five national laboratories to achieve accomplishment four (i.e., comparing various different models), but that few other collaborations were mentioned. Perhaps, the reviewer speculated, working with other groups would be a good way to get more up-to-date information on EV usage. The reviewer also noted there was no mention of whether these models were going to be aligned, or whether or how the output of this work will be used. The reviewer wondered if it would make sense for all makers of these models to discuss whether these differences matter.

Reviewer 3:

The reviewer stated coordination with Hybridcars.com, European Automotive Industry Newsletter, Kelley Blue Book, National Automobile Dealers Association, Navigant Research, Tsinghua University, ORNL, NREL, Sandia National Laboratories and TA Engineering, Inc. is clearly an important part of making this project work. The reviewer suggested that the project researchers, including Tsinghua University and Navigant, work together toward an arrangement that would allow all partners to share their data more completely. The project team should be willing to do so, the reviewer said, in view of the increased exposure the project team is getting through DOE, as The Polk Co. and Ward's Auto do via their contributions to the TEDB.

Reviewer 4:

The reviewer said some very similar studies had been seen at Transportation Research Board that had come to different conclusions, for example, on how hybrid vehicles are used by their drivers. The reviewer believed this should be addressed in some way, at least by creating some cross-collaboration with various DOT entities, and that more collaboration in general would bolster the project.

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

Reviewer 1:

Completing the rest of the planned 2014 research seemed straightforward and highly valuable to this reviewer.

Reviewer 2:

The reviewer looked forward to the upcoming reports on usage trends, levelized cost of energy, and model comparison.

Reviewer 3:

The future work plan appeared satisfactory, in this reviewer's opinion.

Reviewer 4:

The reviewer believed further work on EV sales by battery type and capacity, using other data sources to improve understanding of EV purchase decisions, and work on total cost of ownership (TCO), are all excellent ideas for future work. In the reviewer's opinion, if TCO work is done, collaboration with other public and private groups already doing such work would save considerable time. The reviewer also mentioned examination of how EV choices are affected by the availability of charging infrastructure and power at charging points, as well as how electricity price affects EV purchase decisions (i.e., how regional variations in TCO affect EV sales), as possible areas of future work. The reviewer offered the opinion that collaboration with EV manufacturers would be very useful, as manufacturers will have surveyed their customers regarding their satisfaction with and use of the vehicles, and will have opinions on how to influence customers to purchase EVs. The reviewer believed that this information could be of interest.

Reviewer 5:

The reviewer found the proposed future research interesting but perceived that it did not connect to the bigger picture. The reviewer did not see how the proposed work would help or who was asking for it.

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

Reviewer 1:

The reviewer considered tracking EV penetration data and modeling future usage to be extremely important for the industry and that this project is an effort that needs to continue. It should, in the opinion of this reviewer, be one of the main objectives of VTO to ensure the results of this analysis are known to industry players.

Reviewer 2:

This research is clearly related to petroleum displacement, in the opinion of the reviewer, as it directly tracks this variable through purchase of fuel-efficient vehicles.

Reviewer 3:

The reviewer stated that a better understanding of the EV market can only help DOE better support this growing market.

Reviewer 4:

The reviewer said the project is relevant to EV sales analysis.

Reviewer 5:

The reviewer said the project is highly relevant, as many researchers and policy makers are drawing conclusions and making decisions with limited data on what drives EV sales, activity, etc. The reviewer noted references to the fact that some of the data and results are available (or not) to the VTO analysis team in their full form and gave the examples of Navigant and the Chinese data. The reviewer opined that research resulting from such significant DOE funding and resources should be made fully available if the aim is to make it fully relevant. Making all the research publicly available in full, not just partially and not behind technical journal paywalls, should be a DOE goal for all the work it supports.

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

Reviewer 1:

The reviewer, noting that some two-thirds of the project budget went to pay for data from Navigant, perceived the project perhaps needs more resources to enable it to do some of its own survey work and source its data from other areas and groups. Collecting data with other organizations on consumer use of EVs and household transport use in general, the reviewer said, would be a good use of additional funds, because relying on a 2009 household survey probably does not yield very good results.

Reviewer 2:

While no specific requests were made for additional resources, the reviewer stated there was some indication that additional input data on cost and vehicle usage patterns would be desirable.

Reviewer 3:

Ideally, the reviewer said that far greater effort and resources would be put into understanding the emerging electric-drive vehicle market. DOE, the reviewer continued, could use projects like this, as well as collaborations in the wider research community to better understand what policy and underlying factors are driving differential EV sales and use around the United States and internationally. In view of the long-term implications for energy, climate, and U.S. leadership in the automotive industry, DOE could take an even more active interest than it does in helping the world understand the leading policies that will spur the EV market, the reviewer concluded.

Reviewer 4:

The reviewer believed the small budget for this task to be sufficient and would not suggest it be increased without answers to the broader question of what the impact would be.

Market Penetration Modeling: HTEB, LV Choice, and StoCo: Alicia Birky (TA Engineering, Inc.) - van012

Reviewer Sample Size

A total of five reviewers evaluated this project.

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

Reviewer 1:

The reviewer describes the Heavy-Truck Energy Balance/dynamic (HTEBdyn) project as improving the model by accepting criticism and feedback, specifically from the trucking industry, which is a great way to compare the model to real-life data. If the purpose of the HTEBdyn project is to model the energy use of heavy trucks as accurately as possible, it appears to be doing this well, the reviewer said, and to be trying actively to improve the model and to overcome existing barriers. The TRUCK model, the reviewer said, is being developed to fill the gap in knowledge about alternative energy penetration in the HD truck sector and thus is definitely overcoming barriers.
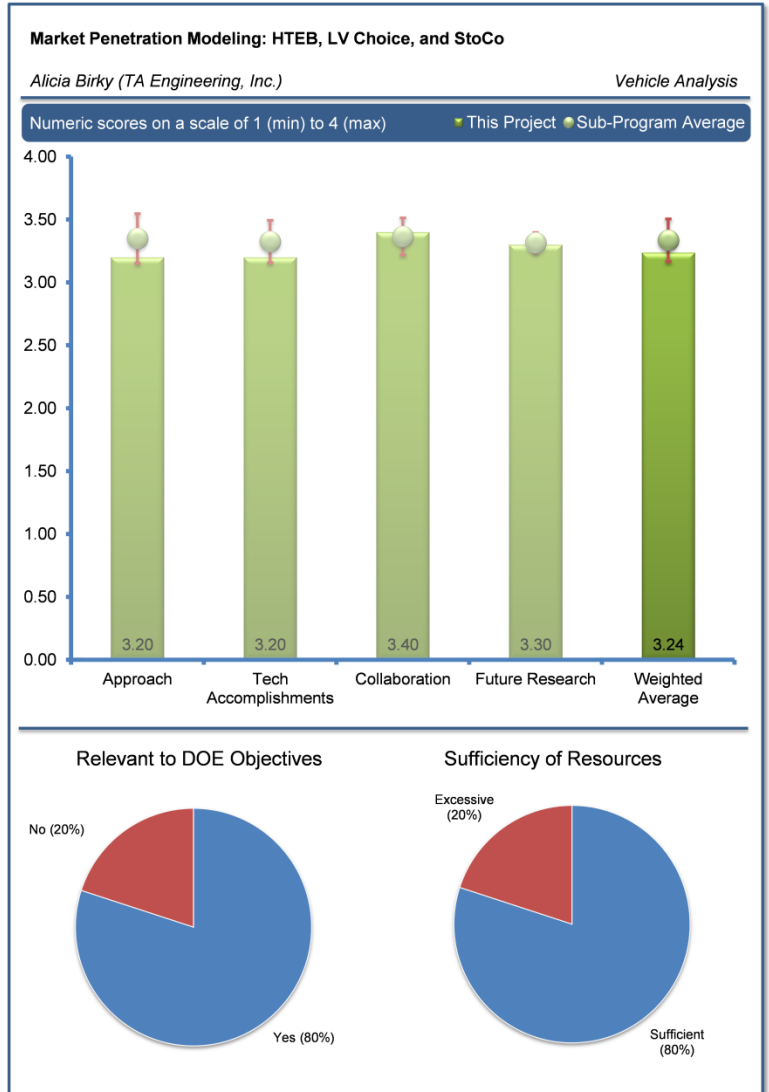
Reviewer 2:

The HTEB model could benefit from a more complete inclusion of maintenance expenses in the total-cost-of-operation evaluation, in the opinion of this reviewer. The TRUCK and LV Choice models might also benefit from more detailed total-cost-of-operation factors, including maintenance cost (scheduled and unscheduled), as an effective way of differentiating technologies and identifying both the benefits and risks associated with introducing new technologies.

Reviewer 3:

The reviewer noted that a legacy model was used on a time-step basis, but was unsure if the approach to regenerative braking is robust. Regenerative braking, the reviewer said, has a huge impact on vehicle efficiency, and the recoverable kinetic energy depends, at a minimum, on battery chemistry and temperature, ambient temperature, driving history, control strategy, state of charge, real-time maximum charging rate, etc. The assumption that any available braking energy is used seemed over-simplified to this reviewer, who suggested applying a regenerative efficiency curve as a function of initial braking speed, braking rate (which the reviewer said appears to be capped at 0.3 g currently), and perhaps one or two other parameters. Acknowledging that this recommendation might give the impression the reviewer was swinging the pendulum back the other way in view of the fact that the project approach was described at last year's AMR was too complicated, the reviewer nonetheless said personal experience indicated that is necessary to make this a reasonably accurate model.

Reviewer 4:

Noting that the presenter had discussed approaches to several work streams, the reviewer commented that the approach to the HTEB energy balance modeling might not be using state-of-the-art assumptions. The reviewer observed that the presenter could not readily

Market Penetration Modeling: HTEB, LV Choice, and StoCo

Alicia Birky (TA Engineering, Inc.) — Vehicle Analysis

discuss the baseline vehicle on which the energy balance analyses were based. While there was discussion of advanced technologies, e.g., hybridization, waste heat recovery, the reviewer said there was limited discussion of the incorporation of incremental powertrain technologies – accessory improvement, engine downspeeding with dual-clutch transmissions, etc. – that are much more likely to be widely deployed in the real world as a result of the EPA/NHTSA Phase 1 and 2 HD standards. The reviewer offered as an example whether the project's HD vehicle model be validated against a base engine, a 2014-2018-compliant engine, and incremental engine efficiency.

Summarizing, the reviewer expressed the hope that the project will be able, going forward, to demonstrate in its final reporting that it is indeed a sound approach. The reviewer deemed the TRUCK HD vehicle modeling approach as sound, although it appeared to be an oversight that Class 2b and 3 trucks, which make up a very significant portion of the medium-duty and HD fleet, are not included. As for the LVChoice model, the reviewer considered it too early in the project to say whether that light-duty vehicle market assessment tool represents a rigorous approach that is well-designed, feasible and integrated with other efforts compared to the very substantial and numerous modeling efforts at national laboratories, universities and other government agencies.

Reviewer 5:
Citing a lack of experience in the HD truck sector, the reviewer declined to comment on this project.

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

Reviewer 1:
The reviewer said the outputs of the project are very useful and powerful if the model and underlying assumptions are assumed to be correct.

Reviewer 2:
This reviewer said the project did a good job laying out the accomplishments to date and satisfactory completion of milestones, also to date.

Reviewer 3:
The reviewer felt the HTEB and TRUCK model projects fill gaps in DOE's knowledge of heavy trucks and their outputs will feed into other DOE models and GPRA. The reviewer regarded as less clear the purpose of the LVChoice model, because it seemed to model the same thing as the AEO, albeit without CAFE inputs and the full National Energy Modeling System suite, and therefore delivers different results. Those outputs, the reviewer noted, change significantly with changes in assumptions, indicating the model is very sensitive, so that using the results of just one of its simulations could give a distorted view of the future.

Reviewer 4:
The reviewer noted that some of the project milestones appear to be behind schedule, particularly those for April and May, such as the user guide and documentation for HTEBdyn. For LVChoice, the reviewer added, the May 30 update to AEO 2014 is 0% complete, as is the final analysis of common inputs with sensitivity, targeted for completion on June 13, 2014.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The project gets data from AEO and works with a number of national laboratories, the reviewer remarked. The comparison of outputs from AEO and LVChoice models show that thought is being given to examining the work of other research groups.

Reviewer 2:
The reviewer said there appears to be good collaboration with ANL, NREL, ORNL, EIA, VTO and with SuperTruck partners Daimler (Daimler Trucks North America), Cummins, Navistar and Volvo.

Reviewer 3:

The reviewer said the project's collaborations and partner seem very good and named ANL, NREL, ORNL EIA and industry partners of SuperTruck.

Reviewer 4:

The reviewer thought the subject had been covered very quickly, but said the collaboration with OEMs and other DOE laboratories seemed adequate.

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

Reviewer 1:

The reviewer noted many excellent ideas for future research.

Reviewer 2:

The reviewer said the proposed future work seems relevant and appropriate.

Reviewer 3:

The project, in the opinion of this reviewer, showed clearly delineated future project steps to complete the work ahead successfully.

Reviewer 4:

The reviewer said that Slide 28 described that adoption rates for the TRUCK model are taken from a late 1990's survey, the results of which are possibly out of date. Even if they are not, the reviewer asserted the importance of having this double-checked. The reviewer recommended that future work include updating adoption rate numbers and attempting to find a truck population survey newer than from 2002, and speculated that the project team's relationship with industry players and association could assist in this effort. A survey could be put together by this group and sent to key players, the reviewer offered.

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

Reviewer 1:

The project is very relevant, in the view of this reviewer, because this particular type of data is required to be known for petroleum displacement, especially in this case for medium- and heavy-duty trucks.

Reviewer 2:

The reviewer asserted that gaining a better understanding of how HD trucks work and how alternative energy can be used in this sector definitely helps DOE. The reviewer believed it was less clear how the LVChoice model fits in with other DOE models.

Reviewer 3:

The work provided a modeling toolset for planning and evaluating technical targets for fuel consumption and GHG benefits, in the opinion of this reviewer.

Reviewer 4:

The reviewer said the presentation discussion of how the project was validated against the Autonomie simulation model (after the work was substantially completed) begged the question of why DOE does not use the extensively vetted, peer-reviewed Autonomie model to analyze HD vehicle technology improvement and DOE's technology goals rather than this very simple HTEB model. In response to the question of whether previous efforts related to this project were made available, the reviewer said the presenter indicated the project team could see if the DOE sponsor was inclined to share any of the memos, reports, and models related to those efforts. The reviewer expressed the belief that to ensure project relevance, all such DOE-funded reports, models, and data should be made widely available and to the fullest extent possible. Further, the reviewer hoped that all of this project's associated work streams, past and future, will be posted.

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

Reviewer 1:

This reviewer said that the project seems to be funded at the proper level.

Reviewer 2:

The reviewer recommended that once the models themselves have had sufficient work done on them, resources should be reallocated within the project to exploring how to gain access to more up-to-date data on truck population and adoption numbers.

Reviewer 3:

Resources appeared to be sufficient, the reviewer said, and no barriers were identified requiring additional or different resources.

Reviewer 4:

The reviewer reiterated the view that the HTEB work does not appear to employ state-of-the-art approaches compared to HD vehicle simulation work by others at national energy laboratories (i.e., Autonomie) or at other agencies such as EPA and DOT. In addition, the reviewer said fleet modeling with TRUCK and LVChoice appear to overlap significantly with the many fleet models done by or for DOE (e.g., VISION), and therefore seem to be creating duplicative work.

Reviewer 5:

In general, the reviewer believed the approach and method seemed sound. However, it was unclear to this reviewer if the results are of use or interest to involved parties, nor was it clear how redundant this model is to those developed by ANL.

LAVE-Trans Model: Changzheng Liu (Oak Ridge National Laboratory) - van013

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 observed an excellent approach, overall. The use of feedback loops is a particularly strong feature and one not often seen in other models. The reviewer discerned a possible issue regarding model validation; however, it would be very valuable to find any similar product or technology from history from which this model accurately predicts the known outcome.

Reviewer 2:

Understanding the interplay among technologies, consumer markets, policies and infrastructure is, in the opinion of this reviewer, a great project idea, and focusing on the market barriers and feedback loops seems like the best approach. Likewise, including consumer behavior is essential, but the reviewer questioned how such data was sourced, how up-to-date data are, and whether they are linked to the work of Ms. Joann Zhou of ANL (i.e., van006 and van010). The reviewer said there are a few models within VTO's work that require good consumer behavior data, that should work together to source it.

LAVE-Trans Model

Changzheng Liu (Oak Ridge National Laboratory) — Vehicle Analysis

Numeric scores on a scale of 1 (min) to 4 (max). ■ This Project ● Sub-Program Average

	Approach	Tech Accomplishments	Collaboration	Future Research	Weighted Average
Score	3.58	3.42	3.33	3.42	3.45

Relevant to DOE Objectives: Yes (100%)

Sufficiency of Resources: Insufficient (17%), Sufficient (83%)
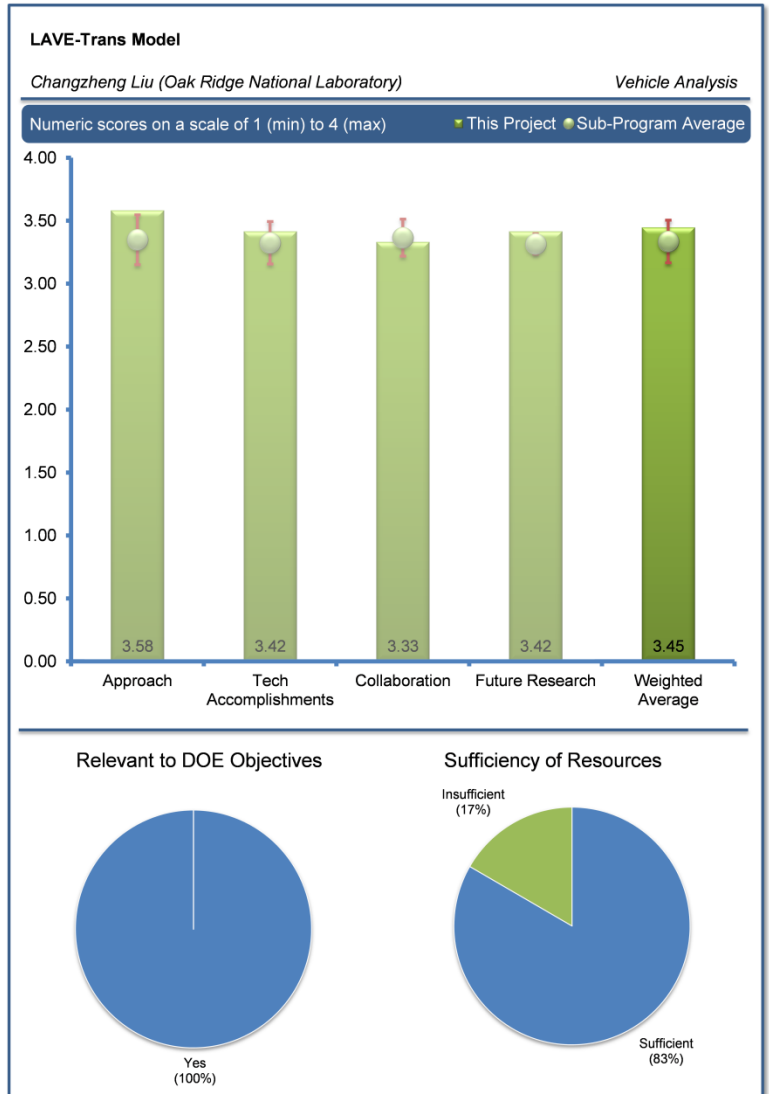
Reviewer 3:

Petroleum and carbon dioxide reduction goals consider the full effect of well-to-wheels impact on GHGs, the reviewer said. Vehicle technologies also consider the use of renewable and alternative fuels to be one of the relevant technology areas in this model. The reviewer believed the Monte Carlo simulation approach is valid and relevant for this type of analysis.

Reviewer 4:

The reviewer credited the presenter with having discussed a clear, strong and rigorous approach to modeling the future vehicle fleet. The approach, the reviewer went on, is well-suited to the targeted barriers of better understanding alternative fuel vehicle/energy transitions, powertrain costs, manufacturer and consumer behavior and the role of policy.

Reviewer 5:

This project appeared to the reviewer to be redundant to VISION, NEAT and Autonomie. Nor was it clear to the reviewer why the project is necessary when, in the reviewer's opinion, the same question is being answered in more detail by other projects presented in this session.

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 toward DOE goals.

Reviewer 1:

The accomplishments of the project were seen by this reviewer to be very valuable, including the net present value (NPV) over time of subsidies, for example. A piece of the presentation that was not entirely clear to the reviewer was whether this was more about the model technology or the scenarios run through the model. For example, the reviewer asked, is this projecting that fuel cell vehicles will overtake the vehicle market by 2050, or merely an example of what would happen if incentives were provided for FCVs. The reviewer found that Slide 12 was very powerful and accurate, and recommended it be shown to Congress.

Reviewer 2:

The reviewer was impressed by the work to date presented in the slides on LAVE-Trans, saying it appeared the model has broken new ground in its level of rigor in accounting for best-available knowledge of consumer behavior, technology, and its associated cost evolution and regulations, with very meaningful results.

Reviewer 3:

The reviewer found the results of the comparison of policy and non-policy on Slide 7 interesting and recommended their dissemination to policy makers. Likewise, the reviewer described the comparison of subsidy NPV to the benefits due to transition is also really interesting.

Reviewer 4:

The reviewer found technical accomplishments to be generally on track with targets, but cited the exceptions of those slated for June 30 were only 90% complete regarding representation of hydrogen infrastructure and preliminary results on the costs and benefits of the transition electric drive. The reviewer expressed concern that these goals might not be met on schedule.

Reviewer 5:

If this is an adapted version of a model built by International Council on Clean Transportation (ICCT), then the reviewer would like to know why ICCT is not working on it.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

The reviewer found that collaboration with partners seemed appropriate, citing work with National Research Council (NRC), ICCT, ANL, and outside experts such as David Greene of the University of Tennessee.

Reviewer 2:

The reviewer believed the project team is clearly collaborating with other institutions, as the project only models external assumptions (e.g., CAFE and other policy scenarios).

Reviewer 3:

The reviewer believed collaboration was excellent overall but noted there is always room to improve, suggesting DOT and EPA would be very interested in being involved.

Reviewer 4:

Noting that current collaboration is entirely with other research groups, the reviewer said other good partners would be industry groups, which would help in getting the best input data as well as feedback.

Reviewer 5:

Coordination with the various groups (i.e., NRC, ICCT, University of Tennessee, and ANL) seemed to this reviewer to be well-coordinated to ensure the work would be well-positioned to impact relevant research groups. The reviewer recommended the project team also consider connecting with analysts at EPA, the California Air Resources Board, Plug-in Electric Vehicle Collaborative,

Northeast States for Coordinated Air Use Management, and infrastructure providers to increase the link between their work and relevant decision-making about vehicle technology, costs, infrastructure and policy and their timing.

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 expressed the belief that the proposed future work is all spot-on, commenting only that comparison and cross-validation with other consumer choice models should probably be expanded to the DOT CAFE consumer choice model, and perhaps backward validated with some other technology to see how valid it would be historically.

Reviewer 2:
All the 2014-15 work proposed is good and sensible, in the opinion of this reviewer, who noted in particular that researchers' proposed efforts to provide insights on the conditions that underlie potential tipping points would offer an excellent and novel addition to the broader dialogue among researchers and decision makers in this space.

Reviewer 3:
The reviewer indicated that the plan is appropriate, particularly collaboration with other DOE consumer choice models. It is unclear, the reviewer went on, how the multiple models available can best be coordinated or interpreted to provide meaningful results without appearing to be contradictory. The reviewer urged that care be taken to avoid too many models that detract from the clarity of reporting the results of combined modeling efforts.

Reviewer 4:
The reviewer said great idea to compare with those of other consumer choice models, and to analyze the tipping points.

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

Reviewer 1:
This project appeared to this reviewer to be one of the better and more important models in the effort to displace petroleum. Having mathematical backup for the opportunity afforded by offering incentives is very powerful, the reviewer said.

Reviewer 2:
This reviewer stated that the model serves to add clarity to the prediction of the light alternative-energy vehicle impact and to the transition process.

Reviewer 3:
The reviewer called this work highly relevant to major decisions that automakers, policy makers and infrastructure providers are attempting to make.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?
The reviewer said the amount spent on this project is a bargain and suggested simultaneously increasing both the budget and the scope in pursuit of the premier model in this area.

Reviewer 1:
The reviewer stated that this work is well-warranted and quite high-value for the level of funding it is currently receiving. If the researchers further develop their methods to connect to local and state policy-making discussions of the role of state and local HOV lane access, public fast-charging infrastructure, etc., the reviewer continued, the work might warrant greater funding.

Reviewer 2:

Any additional funding, in the opinion of this reviewer, should be shared with other researcher groups that want to further investigate consumer adoption, or to collect real data on transport use.

Reviewer 3:

No barriers were identified by this reviewer that required additional or different resources.

Acronyms and Abbreviations

Acronym	Definition
AEO	Annual Energy Outlook
AMR	Annual Merit Review
ANL	Argonne National Laboratory
BEV	Battery electric vehicle
CAFE	Corporate Average Fuel Economy
DOE	Department of Energy
DOT	Department of Transportation
EERE	Energy Efficiency and Renewable Energy
EIA	Energy Information Administration
EPA	Environmental Protection Agency
EV	Electric vehicle
FCV	Fuel cell vehicle
GDP	Gross domestic product
GHG	Greenhouse Gas
GPRA	Government Performance and Results Act
GREET	Greenhouse Gas, Regulated Emissions, and Energy Use in Transportation
GUI	Graphical user interface
HD	Heavy-duty
HOV	High-occupancy vehicle
LCD	Levelized cost of driving
LNG	Liquefied natural gas
NEAT	
NGV	Natural gas vehicles
NPV	Net present value
NREL	National Renewable Energy Laboratory
OEM	Original Equipment Manufacturer
ORNL	Oak Ridge National Laboratory
R&D	Research and development
RFS	Renewable Fuel Standard
SNL	Sandia National Laboratories
TCO	Total cost of ownership
TEDB	Transportation Energy Data Book
US DRIVE	U.S. Driving Research and Innovation for Vehicle Efficiency and Energy sustainability
VAN	Vehicle Analysis subprogram
VISION	
VIUS	Vehicle Inventory and Use Survey
VMT	Vehicle miles traveled
VTMR	Vehicle Technologies Market Report
VTO	Vehicle Technologies Office